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STRUCTURAL, CIVIL

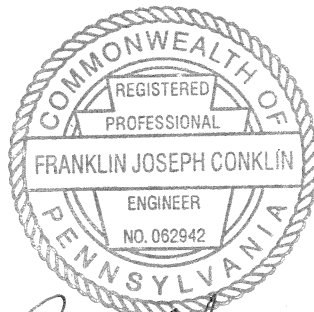
1180 WELSH RD. SUITE 190 NORTH WALES, PA 19446

**PROJECT: DESIGN AQUATIC CLIMBING WALL**

**CLIENT: PYRAMIDE USA INC.**

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11/30/09

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**Scope of Work:**

AquaClimb climbing walls are to be installed permanently or semi permanently in various places throughout the country. In these locations the assembly may be subjected to a maximum of 100 mph wind load or a 250 lb climber located at the face of the wall. The purpose of this report is to analyze the AquaClimb assembly for these loads and design its components according to the AISC “Manual of Steel Construction”. Proper installation of the climbing wall assembly is the responsibility of others. Gary K. Munkelt & Associates shall take no responsibility of improper installation or use of this assembly. Design of existing pools or pool curbing to which this system may be connected is by others. Others are to ensure the material to which the AquaClimb assembly is anchored is constructed of competent material and provides enough ballast to resist maximum anchor loads.

**References:**

American Institute of Steel Construction inc. (2006). *Manual of Steel Construction 13th Edition*. AISC.

American Society of Civil Engineers. (2002). *Specification for the Design of Cold-Formed Stainless Steel Members ASCE 8-02*. Reston, Va: American Society of Civil Engineers.

ASTM. (2009). *F 2461 – 09 Standard Practice for Manufacture, Construction, Operation, and Maintenance of Aquatic Play Equipment*.

International Code Council. (2006). *International Building Code*. ICC.

Pyramide USA Inc. *Aquatic Climbing Wall Specification*. Fredrick, MD: Pyramide.

Pyramide USA Inc. *Installation Guide AC09 Series Revision B*. Fredrick, MD: AquaClimb.

**Material Specifications:**

AquaClimb will be constructed of A304 stainless steel with yield strength of no less than 38 ksi & according to the AquaClimb aquatic climbing wall specification by Pyramide.

**Conclusions:**

When installed according to manufacturer’s instructions the assembly can withstand 100 mph wind loads or a 250 lb climber. As such it will also be in compliance with structural requirements of ASTM F2461-09.

Checked by:

**Analysis & Design Method:**

Geometry of the system has been optimized by the manufacturer based on the use of the wall. The component materials of assembly have been provided by the manufacturer and are set forth in the Aquatic Climbing Wall Specifications. Two loads cases for the design of the AquaClimb assembly will be considered. The first will be a maximum 250 lb climber located at the face of the wall. The second will be the pressure placed on an upright assembly from a 100 mph wind load as determined from the American Society of Civil Engineer publication ASCE-05 “Minimum design Loads for Buildings and Other Structures”.

A model of the assembly will be built & analysis will then be performed using the structural design software MultiFrame 11.03 by Daystar Software, Inc. Kansa City, MO. This software has an integral design check module that will assess each section of the assembly for compliance with the American Institute of Steel Construction “Manual of Steel Construction” ASD method. The output for each of the members will constitute the bulk of this report. For ease of understanding the output sketched of the frame joint & member numbers have been included.

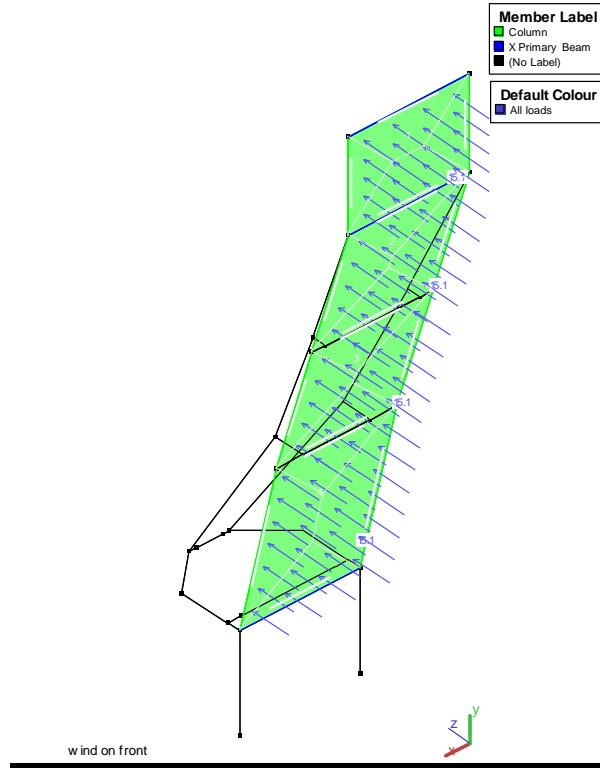
**Wind Loads:**

Per ASCE 7 with low hazard to human life in the event of failure

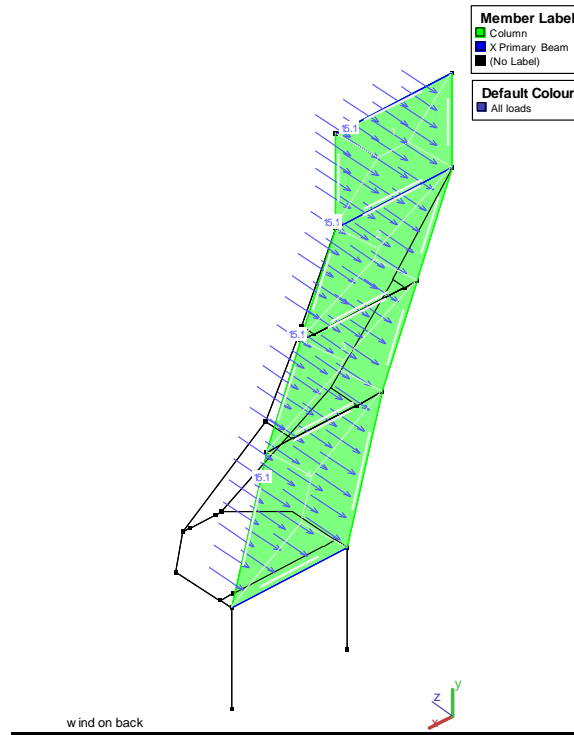
$$Q_z = 0.00256 K_z K_{zt} K_d V^2 I$$

<b><u>V. Wind Loads - Other Structures:</u></b>							
	Importance Factor =	0.87					
	Gust Effect Factor (G) =	0.85	Wind Speed	100 mph			
	K <sub>zt</sub> =	1.00	Exposure	B			
<b><u>A. Solid Freestanding Walls &amp; Solid Signs (&amp; open signs with less than 30% open)</u></b>							
			s/h =	1.00		<b><u>Case A &amp; B</u></b>	
	Dist to sign top (h)	12.7 ft	B/s =	0.24		C <sub>f</sub> =	1.64
	Height (s)	12.7 ft	Lr/s =	0.00		F = q <sub>z</sub> G C <sub>f</sub> A <sub>s</sub> =	<b>15.1 As</b>
	Width (B)	3.0 ft	K <sub>z</sub> =	0.575		A <sub>s</sub> =	10.0 sf
	Wall Return (Lr)	0.0 ft	q <sub>z</sub> =	10.9 psf		F =	151 lbs
	Directionality (K <sub>d</sub> )	0.85					

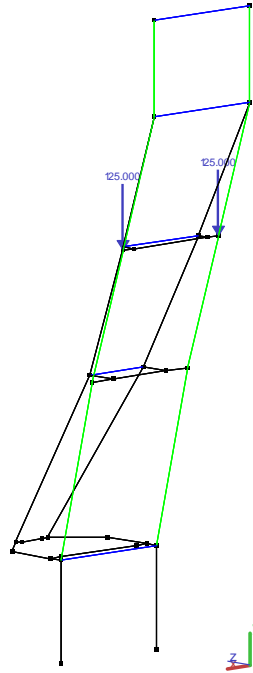
ASCE W+D load combination governs design



Loads – Wind on Front



Loads – Wind on Back



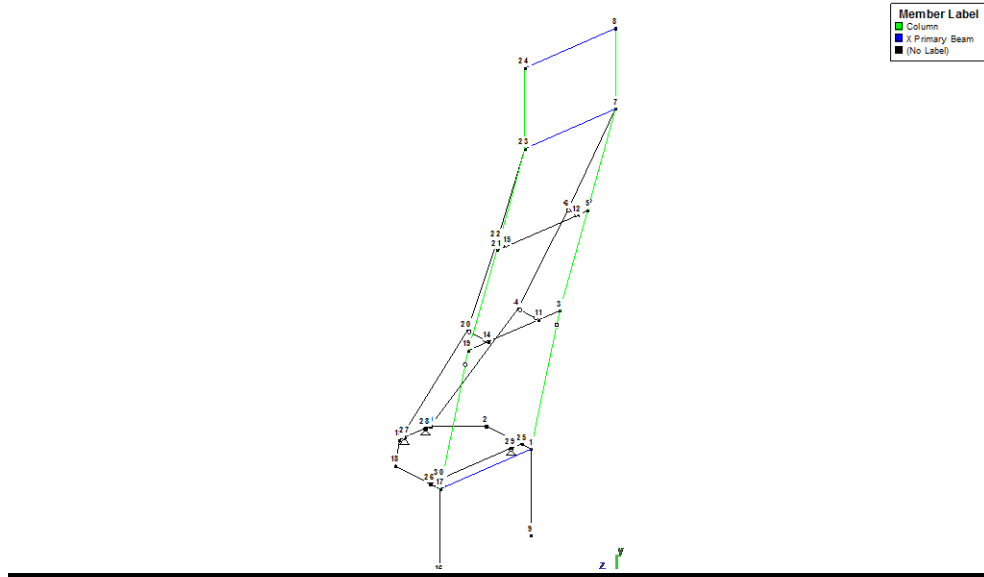
Member Label	
■	Column
■	X Primary Beam
■	(No Label)

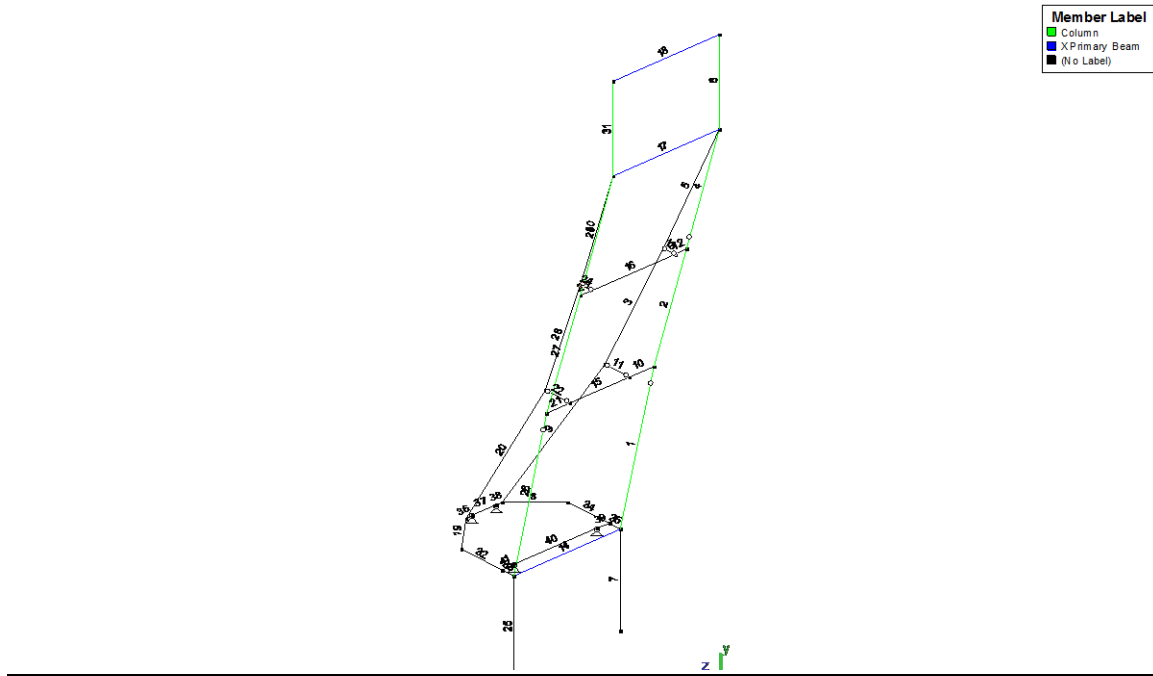
Default Colour	
■	All loads

climber

Loads – Climber



Joint Numbers



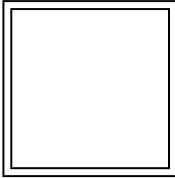
Member Numbers

# Steel Design Report

Checking C:\Users\Frank Conklin\Desktop\aquac\11-30\aquac\climb.mfd to ASD code  
Monday, November 30, 2009 7:30 PM

## Checking design member 1 (Column)

Members: 1  
Group: Custom1  
Section: RT1.5 x 1.5 x 0.064



### Load Case: wind on front

$F_y = 40.0$  ksi  
On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0$  ksi  
On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0$  ksi  
 $F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0$  ksi  
 $Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 51.42 / 0.586, 1.0 * 51.42 / 0.586) = 87.747$   
 $F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 87.747^2 / (2 * 119.63^2)) * 40.0 / 1.892 = 15.451$  ksi  
*Major Axis:*  
 $F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4$  ksi  
*Minor Axis:*  
 $F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4$  ksi

### Design Member 1, wind on front, Major Bending

Tensile Bending Stress:  
 $f_b \leq F_b, 10.751 \leq 26.4$  OK 59% under  
Compressive Bending Stress:  
 $f_b \leq F_b, 10.751 \leq 26.4$  OK 59% under

### Design Member 1, wind on front, Major Shear

$f_v \leq F_v, 0.342 \leq 16.0$  OK 98% under

### Design Member 1, wind on front, Minor Bending

Tensile Bending Stress:  
 $f_b \leq F_b, 4.108 \leq 26.4$  OK 84% under  
Compressive Bending Stress:  
 $f_b \leq F_b, 4.108 \leq 26.4$  OK 84% under

### Design Member 1, wind on front, Minor Shear

$f_v \leq F_v, 0.093 \leq 16.0$  OK 99% under

### Design Member 1, wind on front, Tension

On gross area  $f_t \leq F_t, 2.344 \leq 24.0$  OK 90% under  
On net area  $f_t \leq F_t, 2.344 \leq 44.0$  OK 95% under

### Design Member 1, wind on front, Compression

$f_a \leq F_a, 0.0 \leq 15.451$  OK 100% under

### Design Member 1, wind on front, Bending + Tension

$f_a / F_t + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.344 / 24.0 + 10.751 / 26.4 + 4.108 / 26.4 = 0.66 \leq 1$  OK 34% under

### Design Member 1, wind on front, Bending + Compression

$f_a / F_a = 0.0 / 15.451 = 0.0 \leq 0.15 \therefore \phi_0$   
 $\phi_\alpha / \Phi_\alpha + \phi_{\beta_x} / \Phi_{\beta_x} + \phi_{\beta_y} / \Phi_{\beta_y} = 0.0 / 15.451 + 10.751 / 26.4 + 4.108 / 26.4 = 0.563 \leq 1$  OK 44% under

### Load Case: climber

$F_y = 40.0$  ksi  
On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0$  ksi

Checked by:

On net area  $F_t=0.5*F_u=0.5*88.0=44.0$  ksi $F_v=0.4*F_y=0.4*40.0=16.0$  ksi $Kl/r=\max(K_x/r_x, K_y/r_y)=\max(1.0*51.42/0.586, 1.0*51.42/0.586)=87.747$  $F_a=(1-(Kl/r)^2/(2*Cc^2))*F_y/FS=(1-87.747^2/(2*119.63^2))*40.0/1.892=15.451$  ksi*Major Axis:* $F_b=0.66*F_y=0.66*40.0=26.4$  ksi*Minor Axis:* $F_b=0.66*F_y=0.66*40.0=26.4$  ksi**Design Member 1, climber, Major Bending**

Tensile Bending Stress:

 $f_b \leq F_b, 2.451 \leq 26.4$  OK 91% under

Compressive Bending Stress:

 $f_b \leq F_b, 2.451 \leq 26.4$  OK 91% under**Design Member 1, climber, Major Shear** $f_v \leq F_v, 0.042 \leq 16.0$  OK 100% under**Design Member 1, climber, Minor Bending**

Tensile Bending Stress:

 $f_b \leq F_b, 1.256 \leq 26.4$  OK 95% under

Compressive Bending Stress:

 $f_b \leq F_b, 1.256 \leq 26.4$  OK 95% under**Design Member 1, climber, Minor Shear** $f_v \leq F_v, 0.03 \leq 16.0$  OK 100% under**Design Member 1, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0$  OK 100% underOn net area  $f_t \leq F_t, 0.0 \leq 44.0$  OK 100% under**Design Member 1, climber, Compression** $f_a \leq F_a, 0.671 \leq 15.451$  OK 96% under**Design Member 1, climber, Bending + Tension** $f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 2.451/26.4 + 1.256/26.4 = 0.14 \leq 1$  OK 86% under**Design Member 1, climber, Bending + Compression** $f_a/F_a = 0.671/15.451 = 0.043 \leq 0.15$  ∴  $\phi_0$  $\phi_\alpha/\Phi_\alpha + \phi_{\beta_x}/\Phi_{\beta_x} + \phi_{\beta_y}/\Phi_{\beta_y} = 0.671/15.451 + 2.451/26.4 + 1.256/26.4 = 0.184 \leq 1$  OK 82% under**Load Case: wind on back** $F_y=40.0$  ksiOn gross area  $F_t=0.6*F_y=0.6*40.0=24.0$  ksiOn net area  $F_t=0.5*F_u=0.5*88.0=44.0$  ksi $F_v=0.4*F_y=0.4*40.0=16.0$  ksi $Kl/r=\max(K_x/r_x, K_y/r_y)=\max(1.0*51.42/0.586, 1.0*51.42/0.586)=87.747$  $F_a=(1-(Kl/r)^2/(2*Cc^2))*F_y/FS=(1-87.747^2/(2*119.63^2))*40.0/1.892=15.451$  ksi*Major Axis:* $F_b=0.66*F_y=0.66*40.0=26.4$  ksi*Minor Axis:* $F_b=0.66*F_y=0.66*40.0=26.4$  ksi**Design Member 1, wind on back, Major Bending**

Tensile Bending Stress:

 $f_b \leq F_b, 10.751 \leq 26.4$  OK 59% under

Compressive Bending Stress:

 $f_b \leq F_b, 10.751 \leq 26.4$  OK 59% under**Design Member 1, wind on back, Major Shear** $f_v \leq F_v, 0.342 \leq 16.0$  OK 98% under**Design Member 1, wind on back, Minor Bending**

Tensile Bending Stress:

 $f_b \leq F_b, 4.108 \leq 26.4$  OK 84% under

Compressive Bending Stress:

 $f_b \leq F_b, 4.108 \leq 26.4$  OK 84% under

Checked by:

**Design Member 1, wind on back, Minor Shear**

$$f_v \leq F_v, 0.093 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 1, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 1, wind on back, Compression**

$$f_a \leq F_a, 2.344 \leq 15.451 \text{ OK } 85\% \text{ under}$$

**Design Member 1, wind on back, Bending + Tension**

$$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 10.751/26.4 + 4.108/26.4 = 0.563 \leq 1 \text{ OK } 44\% \text{ under}$$

**Design Member 1, wind on back, Bending + Compression**

$$\text{Axial Ratio} = f_a/F_a = 2.344/15.451 = 0.152$$

$$\text{Major Ratio} = C_m x f_{bx} / ((1 - f_a/F_{ex}) * F_{bx}) = 1.0 * 10.751 / ((1 - 2.344/19.395) * 26.4) = 0.463$$

$$\text{Minor Ratio} = C_m y f_{by} / ((1 - f_a/F_{ey}) * F_{by}) = 1.0 * 4.108 / ((1 - 2.344/19.395) * 26.4) = 0.177$$

$$\text{Axial Ratio} + \text{Major Ratio} + \text{Minor Ratio} = 0.152 + 0.463 + 0.177 = 0.792 \leq 1 \text{ OK } 21\% \text{ under}$$

$$f_a / (0.6 * F_y) + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.344 / (0.6 * 40.0) + 10.751 / 26.4 + 4.108 / 26.4 = 0.66 \geq 1 \text{ OK } 34\% \text{ under}$$

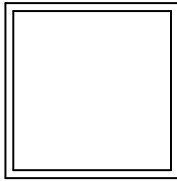
Checked by:

**Checking design member 2 (Column)**

Members: 2

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.373 / 0.586, 1.0 * 39.373 / 0.586) = 67.19$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 67.19^2 / (2 * 119.63^2)) * 40.0 / 1.855 = 18.161 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 2, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 2, wind on front, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 2, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 2, wind on front, Minor Shear**

$$f_v \leq F_v, 0.043 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 2, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 2.365 \leq 24.0 \text{ OK } 90\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.365 \leq 44.0 \text{ OK } 95\% \text{ under}$$

**Design Member 2, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 18.161 \text{ OK } 100\% \text{ under}$$

**Design Member 2, wind on front, Bending + Tension**

$$f_a / F_t + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.365 / 24.0 + 1.399 / 26.4 + 1.406 / 26.4 = 0.205 \leq 1 \text{ OK } 80\% \text{ under}$$

**Design Member 2, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 18.161 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.161 + 1.399 / 26.4 + 1.406 / 26.4 = 0.106 \leq 1 \text{ OK } 89\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.373 / 0.586, 1.0 * 39.373 / 0.586) = 67.19$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 67.19^2 / (2 * 119.63^2)) * 40.0 / 1.855 = 18.161 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 2, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 2, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 2, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.338 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.338 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 2, climber, Minor Shear**

$$f_v \leq F_v, 0.011 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 2, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 2, climber, Compression**

$$f_a \leq F_a, 0.68 \leq 18.161 \text{ OK } 96\% \text{ under}$$

**Design Member 2, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 0.338 / 26.4 = 0.013 \leq 1 \text{ OK } 99\% \text{ under}$$

**Design Member 2, climber, Bending + Compression**

$$f_a / F_a = 0.68 / 18.161 = 0.037 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.68 / 18.161 + 0.0 / 26.4 + 0.338 / 26.4 = 0.05 \leq 1 \text{ OK } 95\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 39.373 / 0.586, 1.0 * 39.373 / 0.586) = 67.19$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 67.19^2 / (2 * 119.63^2)) * 40.0 / 1.855 = 18.161 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 2, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 2, wind on back, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 2, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 2, wind on back, Minor Shear**

$$f_v \leq F_v, 0.043 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 2, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 2, wind on back, Compression**

$f_a \leq F_a$ ,  $2.365 \leq 18.161$  OK 87% under

**Design Member 2, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 1.399/26.4 + 1.406/26.4 = 0.106 \leq 1$  OK 89% under

**Design Member 2, wind on back, Bending + Compression**

$f_a/F_a = 2.365/18.161 = 0.13 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 2.365/18.161 + 1.399/26.4 + 1.406/26.4 = 0.237 \leq 1$  OK 76% under

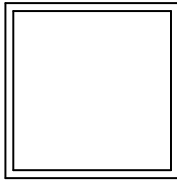
Checked by:

**Checking design member 3**

Members: 3

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.367 / 0.586, 1.0 * 41.367 / 0.586) = 70.593$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.593^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.74 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 3, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

**Design Member 3, wind on front, Major Shear**

$$f_v \leq F_v, 0.215 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 3, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 3, wind on front, Minor Shear**

$$f_v \leq F_v, 0.087 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 3, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 3, wind on front, Compression**

$$f_a \leq F_a, 2.52 \leq 17.74 \text{ OK } 86\% \text{ under}$$

**Design Member 3, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 13.653 / 26.4 + 4.055 / 26.4 = 0.671 \leq 1 \text{ OK } 33\% \text{ under}$$

**Design Member 3, wind on front, Bending + Compression**

$$f_a / F_a = 2.52 / 17.74 = 0.142 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 2.52 / 17.74 + 13.653 / 26.4 + 4.055 / 26.4 = 0.813 \leq 1 \text{ OK } 19\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.367 / 0.586, 1.0 * 41.367 / 0.586) = 70.593$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.593^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.74 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 3, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.728 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.728 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 3, climber, Major Shear**

$$f_v \leq F_v, 0.115 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 3, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.598 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.598 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 3, climber, Minor Shear**

$$f_v \leq F_v, 0.02 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 3, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.372 \leq 24.0 \text{ OK } 98\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.372 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 3, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 17.74 \text{ OK } 100\% \text{ under}$$

**Design Member 3, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.372 / 24.0 + 2.728 / 26.4 + 0.598 / 26.4 = 0.141 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 3, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 17.74 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 17.74 + 2.728 / 26.4 + 0.598 / 26.4 = 0.126 \leq 1 \text{ OK } 87\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 41.367 / 0.586, 1.0 * 41.367 / 0.586) = 70.593$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.593^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.74 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 3, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

**Design Member 3, wind on back, Major Shear**

$$f_v \leq F_v, 0.215 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 3, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 3, wind on back, Minor Shear**

$$f_v \leq F_v, 0.087 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 3, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 2.52 \leq 24.0 \text{ OK } 89\% \text{ under}$$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $2.52 \leq 44.0$  OK 94% under

**Design Member 3, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 17.74$  OK 100% under

**Design Member 3, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.52/24.0 + 13.653/26.4 + 4.055/26.4 = 0.776 \leq 1$  OK 22% under

**Design Member 3, wind on back, Bending + Compression**

$f_a/F_a = 0.0/17.74 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/17.74 + 13.653/26.4 + 4.055/26.4 = 0.671 \leq 1$  OK 33% under

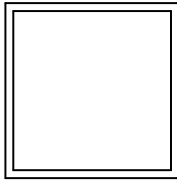
Checked by:

**Checking design member 4 (Column)**

Members: 4

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.85 / 0.586, 1.0 * 39.85 / 0.586) = 68.003$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 68.003^2 / (2 * 119.63^2)) * 40.0 / 1.857 = 18.061 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 4, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 4, wind on front, Major Shear**

$$f_v \leq F_v, 0.176 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 4, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 4, wind on front, Minor Shear**

$$f_v \leq F_v, 0.021 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 4, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 2.375 \leq 24.0 \text{ OK } 90\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.375 \leq 44.0 \text{ OK } 95\% \text{ under}$$

**Design Member 4, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 18.061 \text{ OK } 100\% \text{ under}$$

**Design Member 4, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.375 / 24.0 + 3.509 / 26.4 + 0.47 / 26.4 = 0.25 \leq 1 \text{ OK } 75\% \text{ under}$$

**Design Member 4, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 18.061 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.061 + 3.509 / 26.4 + 0.47 / 26.4 = 0.151 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.85 / 0.586, 1.0 * 39.85 / 0.586) = 68.003$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 68.003^2 / (2 * 119.63^2)) * 40.0 / 1.857 = 18.061 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 4, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.525 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.525 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 4, climber, Major Shear**

$$f_v \leq F_v, 0.012 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 4, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.131 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.131 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 4, climber, Minor Shear**

$$f_v \leq F_v, 0.004 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 4, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 4, climber, Compression**

$$f_a \leq F_a, 0.325 \leq 18.061 \text{ OK } 98\% \text{ under}$$

**Design Member 4, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.525 / 26.4 + 0.131 / 26.4 = 0.025 \leq 1 \text{ OK } 98\% \text{ under}$$

**Design Member 4, climber, Bending + Compression**

$$f_a / F_a = 0.325 / 18.061 = 0.018 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.325 / 18.061 + 0.525 / 26.4 + 0.131 / 26.4 = 0.043 \leq 1 \text{ OK } 96\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 39.85 / 0.586, 1.0 * 39.85 / 0.586) = 68.003$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 68.003^2 / (2 * 119.63^2)) * 40.0 / 1.857 = 18.061 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 4, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 4, wind on back, Major Shear**

$$f_v \leq F_v, 0.176 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 4, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 4, wind on back, Minor Shear**

$$f_v \leq F_v, 0.021 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 4, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 4, wind on back, Compression**

$f_a \leq F_a$ ,  $2.375 \leq 18.061$  OK 87% under

**Design Member 4, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 3.509/26.4 + 0.47/26.4 = 0.151 \leq 1$  OK 85% under

**Design Member 4, wind on back, Bending + Compression**

$f_a/F_a = 2.375/18.061 = 0.132 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 2.375/18.061 + 3.509/26.4 + 0.47/26.4 = 0.282 \leq 1$  OK 72% under

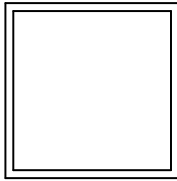
Checked by:

**Checking design member 5**

Members: 5

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.425 / 0.586, 1.0 * 41.425 / 0.586) = 70.69$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.69^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.727 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 5, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

**Design Member 5, wind on front, Major Shear**

$$f_v \leq F_v, 0.072 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 5, wind on front, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, wind on front, Compression**

$$f_a \leq F_a, 2.456 \leq 17.727 \text{ OK } 86\% \text{ under}$$

**Design Member 5, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.645 / 26.4 + 0.159 / 26.4 = 0.144 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 5, wind on front, Bending + Compression**

$$f_a / F_a = 2.456 / 17.727 = 0.139 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 2.456 / 17.727 + 3.645 / 26.4 + 0.159 / 26.4 = 0.283 \leq 1 \text{ OK } 72\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.425 / 0.586, 1.0 * 41.425 / 0.586) = 70.69$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.69^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.727 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 5, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.725 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.725 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 5, climber, Major Shear**

$$f_v \leq F_v, 0.07 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.399 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.399 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 5, climber, Minor Shear**

$$f_v \leq F_v, 0.007 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.325 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.325 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 5, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 17.727 \text{ OK } 100\% \text{ under}$$

**Design Member 5, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.325 / 24.0 + 2.725 / 26.4 + 0.399 / 26.4 = 0.132 \leq 1 \text{ OK } 87\% \text{ under}$$

**Design Member 5, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 17.727 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 17.727 + 2.725 / 26.4 + 0.399 / 26.4 = 0.118 \leq 1 \text{ OK } 88\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 41.425 / 0.586, 1.0 * 41.425 / 0.586) = 70.69$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.69^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.727 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 5, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

**Design Member 5, wind on back, Major Shear**

$$f_v \leq F_v, 0.072 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 5, wind on back, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 5, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 2.456 \leq 24.0 \text{ OK } 90\% \text{ under}$$

Checked by:

On net area  $f_t \leq F_t$ ,  $2.456 \leq 44.0$  OK 94% under**Design Member 5, wind on back, Compression** $f_a \leq F_a$ ,  $0.0 \leq 17.727$  OK 100% under**Design Member 5, wind on back, Bending + Tension** $f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.456/24.0 + 3.645/26.4 + 0.159/26.4 = 0.246 \leq 1$  OK 75% under**Design Member 5, wind on back, Bending + Compression** $f_a/F_a = 0.0/17.727 = 0.0 \leq 0.15 \therefore \phi_0$  $\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/17.727 + 3.645/26.4 + 0.159/26.4 = 0.144 \leq 1$  OK 86% under

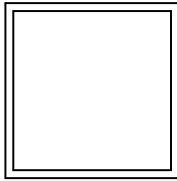
Checked by:

**Checking design member 6 (Column)**

Members: 6

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 26.5 / 0.586, 1.0 * 26.5 / 0.586) = 45.222$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 45.222^2 / (2 * 119.63^2)) * 40.0 / 1.802 = 20.615 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 6, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 6, wind on front, Major Shear**

$$f_v \leq F_v, 0.004 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 6, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 6, wind on front, Minor Shear**

$$f_v \leq F_v, 0.178 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 6, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 6, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 20.615 \text{ OK } 100\% \text{ under}$$

**Design Member 6, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 20.615 + 0.111 / 26.4 + 3.875 / 26.4 = 0.151 \leq 1 \text{ OK } 85\% \text{ under}$$

**Design Member 6, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 20.615 = 0.0 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.615 + 0.111 / 26.4 + 3.875 / 26.4 = 0.151 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 26.5 / 0.586, 1.0 * 26.5 / 0.586) = 45.222$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 45.222^2 / (2 * 119.63^2)) * 40.0 / 1.802 = 20.615 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 6, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.027 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.027 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Major Shear**

$$f_v \leq F_v, 0.001 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 20.615 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 24.0 + 0.027 / 26.4 + 0.0 / 26.4 = 0.001 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 6, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 20.615 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.615 + 0.027 / 26.4 + 0.0 / 26.4 = 0.001 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 26.5 / 0.586, 1.0 * 26.5 / 0.586) = 45.222$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 45.222^2 / (2 * 119.63^2)) * 40.0 / 1.802 = 20.615 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 6, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 6, wind on back, Major Shear**

$$f_v \leq F_v, 0.004 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 6, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 6, wind on back, Minor Shear**

$$f_v \leq F_v, 0.178 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 6, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 6, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 20.615$  OK 100% under

**Design Member 6, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/24.0 + 0.111/26.4 + 3.875/26.4 = 0.151 \leq 1$  OK 85% under

**Design Member 6, wind on back, Bending + Compression**

$f_a/F_a = 0.0/20.615 = 0.0 \leq 0.15 \therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/20.615 + 0.111/26.4 + 3.875/26.4 = 0.151 \leq 1$  OK 85% under

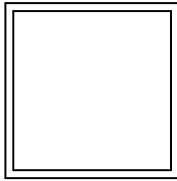
Checked by:

**Checking design member 7**

Members: 7

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.5 / 0.586, 1.0 * 28.5 / 0.586) = 48.635$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 48.635^2 / (2 * 119.63^2)) * 40.0 / 1.811 = 20.265 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 7, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 20.265 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 0.0 / 26.4 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 20.265 = 0.0 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.265 + 0.0 / 26.4 + 0.0 / 26.4 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.5 / 0.586, 1.0 * 28.5 / 0.586) = 48.635$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 48.635^2 / (2 * 119.63^2)) * 40.0 / 1.811 = 20.265 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 7, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 7, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 7, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 7, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 20.265 \text{ OK } 100\% \text{ under}$$

**Design Member 7, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 0.0 / 26.4 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 7, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 20.265 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.265 + 0.0 / 26.4 + 0.0 / 26.4 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 28.5 / 0.586, 1.0 * 28.5 / 0.586) = 48.635$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 48.635^2 / (2 * 119.63^2)) * 40.0 / 1.811 = 20.265 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 7, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on back, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 7, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 7, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 20.265$  OK 100% under

**Design Member 7, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.0/26.4 + 0.0/26.4 = 0.0 \leq 1$  OK 100% under

**Design Member 7, wind on back, Bending + Compression**

$f_a/F_a = 0.0/20.265 = 0.0 \leq 0.15$   $\therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/20.265 + 0.0/26.4 + 0.0/26.4 = 0.0 \leq 1$  OK 100% under

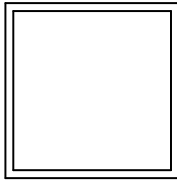
Checked by:

**Checking design member 8**

Members: 8

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 16.279 / 0.586, 1.0 * 16.279 / 0.586) = 27.78$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 27.78^2 / (2 * 119.63^2)) * 40.0 / 1.752 = 22.213 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 8, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

**Design Member 8, wind on front, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 8, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

**Design Member 8, wind on front, Minor Shear**

$$f_v \leq F_v, 0.162 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 8, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.177 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.177 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 8, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 22.213 \text{ OK } 100\% \text{ under}$$

**Design Member 8, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.177 / 24.0 + 7.927 / 26.4 + 1.798 / 26.4 = 0.376 \leq 1 \text{ OK } 62\% \text{ under}$$

**Design Member 8, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 22.213 = 0.0 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 22.213 + 7.927 / 26.4 + 1.798 / 26.4 = 0.368 \leq 1 \text{ OK } 63\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 16.279 / 0.586, 1.0 * 16.279 / 0.586) = 27.78$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 27.78^2 / (2 * 119.63^2)) * 40.0 / 1.752 = 22.213 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 8, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.0 \leq 26.4 \text{ OK } 92\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.0 \leq 26.4 \text{ OK } 92\% \text{ under}$$

**Design Member 8, climber, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 8, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.325 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.325 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 8, climber, Minor Shear**

$$f_v \leq F_v, 0.035 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 8, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 8, climber, Compression**

$$f_a \leq F_a, 0.047 \leq 22.213 \text{ OK } 100\% \text{ under}$$

**Design Member 8, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 2.0 / 26.4 + 0.325 / 26.4 = 0.088 \leq 1 \text{ OK } 91\% \text{ under}$$

**Design Member 8, climber, Bending + Compression**

$$f_a / F_a = 0.047 / 22.213 = 0.002 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.047 / 22.213 + 2.0 / 26.4 + 0.325 / 26.4 = 0.09 \leq 1 \text{ OK } 91\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 16.279 / 0.586, 1.0 * 16.279 / 0.586) = 27.78$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 27.78^2 / (2 * 119.63^2)) * 40.0 / 1.752 = 22.213 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 8, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

**Design Member 8, wind on back, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 8, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

**Design Member 8, wind on back, Minor Shear**

$$f_v \leq F_v, 0.162 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 8, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

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Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 8, wind on back, Compression**

$f_a \leq F_a$ ,  $0.177 \leq 22.213$  OK 99% under

**Design Member 8, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 7.927/26.4 + 1.798/26.4 = 0.368 \leq 1$  OK 63% under

**Design Member 8, wind on back, Bending + Compression**

$f_a/F_a = 0.177/22.213 = 0.008 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.177/22.213 + 7.927/26.4 + 1.798/26.4 = 0.376 \leq 1$  OK 62% under

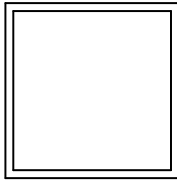
Checked by:

**Checking design member 9**

Members: 9

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 60.042 / 0.586, 1.0 * 60.042 / 0.586) = 102.46$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 102.46^2 / (2 * 119.63^2)) * 40.0 / 1.909 = 13.266 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 9, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

**Design Member 9, wind on front, Major Shear**

$$f_v \leq F_v, 0.299 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 9, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

**Design Member 9, wind on front, Minor Shear**

$$f_v \leq F_v, 0.083 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 9, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 9, wind on front, Compression**

$$f_a \leq F_a, 2.585 \leq 13.266 \text{ OK } 81\% \text{ under}$$

**Design Member 9, wind on front, Bending + Tension**

$$f_a / F_t + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 13.996 / 26.4 + 2.844 / 26.4 = 0.638 \leq 1 \text{ OK } 36\% \text{ under}$$

**Design Member 9, wind on front, Bending + Compression**

$$\text{Axial Ratio} = f_a / F_a = 2.585 / 13.266 = 0.195$$

$$\text{Major Ratio} = C_m * f_{bx} / ((1 - f_a / F'_{ex}) * F_{bx}) = 1.0 * 13.996 / ((1 - 2.585 / 14.225) * 26.4) = 0.648$$

$$\text{Minor Ratio} = C_m * f_{by} / ((1 - f_a / F'_{ey}) * F_{by}) = 1.0 * 2.844 / ((1 - 2.585 / 14.225) * 26.4) = 0.132$$

$$\text{Axial Ratio} + \text{Major Ratio} + \text{Minor Ratio} = 0.195 + 0.648 + 0.132 = 0.974 \leq 1 \text{ OK } 3\% \text{ under}$$

$$f_a / (0.6 * F_y) + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.585 / (0.6 * 40.0) + 13.996 / 26.4 + 2.844 / 26.4 = 0.746 \geq 1 \text{ OK } 25\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

Checked by:

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * I/r_x, K_y * I/r_y) = \max(1.0 * 60.042 / 0.586, 1.0 * 60.042 / 0.586) = 102.46$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 102.46^2 / (2 * 119.63^2)) * 40.0 / 1.909 = 13.266 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 9, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.63 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.63 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 9, climber, Major Shear**

$$f_v \leq F_v, 0.045 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 9, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.406 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.406 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 9, climber, Minor Shear**

$$f_v \leq F_v, 0.012 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 9, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.36 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.36 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 9, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 13.266 \text{ OK } 100\% \text{ under}$$

**Design Member 9, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.36 / 24.0 + 2.63 / 26.4 + 0.406 / 26.4 = 0.13 \leq 1 \text{ OK } 87\% \text{ under}$$

**Design Member 9, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 13.266 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 13.266 + 2.63 / 26.4 + 0.406 / 26.4 = 0.115 \leq 1 \text{ OK } 89\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * I/r_x, K_y * I/r_y) = \max(1.0 * 60.042 / 0.586, 1.0 * 60.042 / 0.586) = 102.46$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 102.46^2 / (2 * 119.63^2)) * 40.0 / 1.909 = 13.266 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 9, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

**Design Member 9, wind on back, Major Shear**

$$f_v \leq F_v, 0.299 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 9, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

**Design Member 9, wind on back, Minor Shear**

Checked by:

$$f_v \leq F_v, 0.083 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 9, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 2.585 \leq 24.0 \text{ OK } 89\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.585 \leq 44.0 \text{ OK } 94\% \text{ under}$$

**Design Member 9, wind on back, Compression**

$$f_a \leq F_a, 0.0 \leq 13.266 \text{ OK } 100\% \text{ under}$$

**Design Member 9, wind on back, Bending + Tension**

$$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.585/24.0 + 13.996/26.4 + 2.844/26.4 = 0.746 \leq 1 \text{ OK } 25\% \text{ under}$$

**Design Member 9, wind on back, Bending + Compression**

$$f_a/F_a = 0.0/13.266 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/13.266 + 13.996/26.4 + 2.844/26.4 = 0.638 \leq 1 \text{ OK } 36\% \text{ under}$$

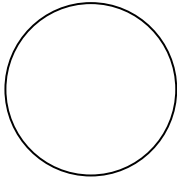
Checked by:

**Checking design member 10**

Members: 10

Group: Custom1

Section: 1/2" diameter bar

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 8.0 / 0.125, 1.0 * 8.0 / 0.125) = 64.0$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 64.0^2 / (2 * 119.63^2)) * 40.0 / 1.848 = 18.546 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 10, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 10, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 10, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

**Design Member 10, wind on front, Minor Shear**

$$f_v \leq F_v, 0.136 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 10, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 10, wind on front, Compression**

$$f_a \leq F_a, 0.133 \leq 18.546 \text{ OK } 99\% \text{ under}$$

**Design Member 10, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.218 / 26.4 + 7.243 / 30.0 = 0.25 \leq 1 \text{ OK } 75\% \text{ under}$$

**Design Member 10, wind on front, Bending + Compression**

$$f_a / F_a = 0.133 / 18.546 = 0.007 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.133 / 18.546 + 0.218 / 26.4 + 7.243 / 30.0 = 0.257 \leq 1 \text{ OK } 74\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 8.0 / 0.125, 1.0 * 8.0 / 0.125) = 64.0$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 64.0^2 / (2 * 119.63^2)) * 40.0 / 1.848 = 18.546 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 10, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.202 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.202 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 10, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 10, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.391 \leq 30.0 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.391 \leq 30.0 \text{ OK } 85\% \text{ under}$$

**Design Member 10, climber, Minor Shear**

$$f_v \leq F_v, 0.056 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 10, climber, Tension**On gross area  $f_t \leq F_t, 0.04 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.04 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 10, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 18.546 \text{ OK } 100\% \text{ under}$$

**Design Member 10, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.04 / 24.0 + 0.202 / 26.4 + 4.391 / 30.0 = 0.156 \leq 1 \text{ OK } 84\% \text{ under}$$

**Design Member 10, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 18.546 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.546 + 0.202 / 26.4 + 4.391 / 30.0 = 0.154 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 8.0 / 0.125, 1.0 * 8.0 / 0.125) = 64.0$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 64.0^2 / (2 * 119.63^2)) * 40.0 / 1.848 = 18.546 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 10, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 10, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 10, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

**Design Member 10, wind on back, Minor Shear**

$$f_v \leq F_v, 0.136 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 10, wind on back, Tension**On gross area  $f_t \leq F_t, 0.133 \leq 24.0 \text{ OK } 99\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.133 \leq 44.0$  OK 100% under

**Design Member 10, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 18.546$  OK 100% under

**Design Member 10, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.133/24.0 + 0.218/26.4 + 7.243/30.0 = 0.255 \leq 1$  OK 74% under

**Design Member 10, wind on back, Bending + Compression**

$f_a/F_a = 0.0/18.546 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/18.546 + 0.218/26.4 + 7.243/30.0 = 0.25 \leq 1$  OK 75% under

Checked by:

**Checking design member 11**

Members: 11

Group: Custom1

Section: 1/4 x 2 link

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 9.0 / 0.577, 0.65 * 9.0 / 0.072) = 81.06$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 81.06^2 / (2 * 117.548^2)) * 40.0 / 1.884 = 16.181 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 11, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

**Design Member 11, wind on front, Minor Shear**

$$f_v \leq F_v, 0.018 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on front, Compression**

$$f_a \leq F_a, 0.108 \leq 16.181 \text{ OK } 99\% \text{ under}$$

**Design Member 11, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 2.525 / 30.0 = 0.084 \leq 1 \text{ OK } 92\% \text{ under}$$

**Design Member 11, wind on front, Bending + Compression**

$$f_a / F_a = 0.108 / 16.181 = 0.007 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.108 / 16.181 + 0.0 / 26.4 + 2.525 / 30.0 = 0.091 \leq 1 \text{ OK } 91\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 9.0 / 0.577, 0.65 * 9.0 / 0.072) = 81.06$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 81.06^2 / (2 * 117.548^2)) * 40.0 / 1.884 = 16.181 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 11, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 11, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.321 \leq 30.0 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.321 \leq 30.0 \text{ OK } 96\% \text{ under}$$

**Design Member 11, climber, Minor Shear**

$$f_v \leq F_v, 0.008 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 11, climber, Compression**

$$f_a \leq F_a, 0.022 \leq 16.181 \text{ OK } 100\% \text{ under}$$

**Design Member 11, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 1.321 / 30.0 = 0.044 \leq 1 \text{ OK } 96\% \text{ under}$$

**Design Member 11, climber, Bending + Compression**

$$f_a / F_a = 0.022 / 16.181 = 0.001 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.022 / 16.181 + 0.0 / 26.4 + 1.321 / 30.0 = 0.045 \leq 1 \text{ OK } 95\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 9.0 / 0.577, 0.65 * 9.0 / 0.072) = 81.06$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 81.06^2 / (2 * 117.548^2)) * 40.0 / 1.884 = 16.181 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 11, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

**Design Member 11, wind on back, Minor Shear**

$$f_v \leq F_v, 0.018 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 11, wind on back, Tension**On gross area  $f_t \leq F_t, 0.108 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.108 \leq 44.0$  OK 100% under

**Design Member 11, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 16.181$  OK 100% under

**Design Member 11, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.108/24.0 + 0.0/26.4 + 2.525/30.0 = 0.089 \leq 1$  OK 91% under

**Design Member 11, wind on back, Bending + Compression**

$f_a/F_a = 0.0/16.181 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/16.181 + 0.0/26.4 + 2.525/30.0 = 0.084 \leq 1$  OK 92% under

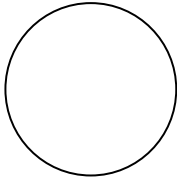
Checked by:

**Checking design member 12**

Members: 12

Group: Custom1

Section: 1/2" diameter bar

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.125, 1.0 * 4.0 / 0.125) = 32.0$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 32.0^2 / (2 * 119.63^2)) * 40.0 / 1.765 = 21.857 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 12, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 12, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 12, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

**Design Member 12, wind on front, Minor Shear**

$$f_v \leq F_v, 0.144 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 12, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.062 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.062 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 12, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 21.857 \text{ OK } 100\% \text{ under}$$

**Design Member 12, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.062 / 24.0 + 0.411 / 26.4 + 8.437 / 30.0 = 0.299 \leq 1 \text{ OK } 70\% \text{ under}$$

**Design Member 12, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 21.857 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 21.857 + 0.411 / 26.4 + 8.437 / 30.0 = 0.297 \leq 1 \text{ OK } 70\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.125, 1.0 * 4.0 / 0.125) = 32.0$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 32.0^2 / (2 * 119.63^2)) * 40.0 / 1.765 = 21.857 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 12, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.221 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.221 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 12, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 12, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 9.338 \leq 30.0 \text{ OK } 69\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 9.338 \leq 30.0 \text{ OK } 69\% \text{ under}$$

**Design Member 12, climber, Minor Shear**

$$f_v \leq F_v, 0.219 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 12, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 12, climber, Compression**

$$f_a \leq F_a, 0.007 \leq 21.857 \text{ OK } 100\% \text{ under}$$

**Design Member 12, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.221 / 26.4 + 9.338 / 30.0 = 0.32 \leq 1 \text{ OK } 68\% \text{ under}$$

**Design Member 12, climber, Bending + Compression**

$$f_a / F_a = 0.007 / 21.857 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.007 / 21.857 + 0.221 / 26.4 + 9.338 / 30.0 = 0.32 \leq 1 \text{ OK } 68\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.125, 1.0 * 4.0 / 0.125) = 32.0$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 32.0^2 / (2 * 119.63^2)) * 40.0 / 1.765 = 21.857 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 12, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 12, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 12, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

**Design Member 12, wind on back, Minor Shear**

$$f_v \leq F_v, 0.144 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 12, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 12, wind on back, Compression**

$f_a \leq F_a$ ,  $0.062 \leq 21.857$  OK 100% under

**Design Member 12, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.411/26.4 + 8.437/30.0 = 0.297 \leq 1$  OK 70% under

**Design Member 12, wind on back, Bending + Compression**

$f_a/F_a = 0.062/21.857 = 0.003 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.062/21.857 + 0.411/26.4 + 8.437/30.0 = 0.3 \leq 1$  OK 70% under

Checked by:

**Checking design member 13**

Members: 13

Group: Custom1

Section: 1/4 x 2 link

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.577, 1.0 * 4.0 / 0.072) = 55.426$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 55.426^2 / (2 * 117.548^2)) * 40.0 / 1.83 = 19.424 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 13, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

**Design Member 13, wind on front, Minor Shear**

$$f_v \leq F_v, 0.017 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on front, Compression**

$$f_a \leq F_a, 0.121 \leq 19.424 \text{ OK } 99\% \text{ under}$$

**Design Member 13, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 2.841 / 30.0 = 0.095 \leq 1 \text{ OK } 91\% \text{ under}$$

**Design Member 13, wind on front, Bending + Compression**

$$f_a / F_a = 0.121 / 19.424 = 0.006 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.121 / 19.424 + 0.0 / 26.4 + 2.841 / 30.0 = 0.101 \leq 1 \text{ OK } 90\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.577, 1.0 * 4.0 / 0.072) = 55.426$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 55.426^2 / (2 * 117.548^2)) * 40.0 / 1.83 = 19.424 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 13, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 13, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.967 \leq 30.0 \text{ OK } 93\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.967 \leq 30.0 \text{ OK } 93\% \text{ under}$$

**Design Member 13, climber, Minor Shear**

$$f_v \leq F_v, 0.009 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, climber, Tension**On gross area  $f_t \leq F_t, 0.086 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.086 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 13, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 19.424 \text{ OK } 100\% \text{ under}$$

**Design Member 13, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.086 / 24.0 + 0.0 / 26.4 + 1.967 / 30.0 = 0.069 \leq 1 \text{ OK } 93\% \text{ under}$$

**Design Member 13, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 19.424 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 19.424 + 0.0 / 26.4 + 1.967 / 30.0 = 0.066 \leq 1 \text{ OK } 93\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.577, 1.0 * 4.0 / 0.072) = 55.426$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 55.426^2 / (2 * 117.548^2)) * 40.0 / 1.83 = 19.424 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 13, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

**Design Member 13, wind on back, Minor Shear**

$$f_v \leq F_v, 0.017 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 13, wind on back, Tension**On gross area  $f_t \leq F_t, 0.121 \leq 24.0 \text{ OK } 99\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.121 \leq 44.0$  OK 100% under

**Design Member 13, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 19.424$  OK 100% under

**Design Member 13, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.121/24.0 + 0.0/26.4 + 2.841/30.0 = 0.1 \leq 1$  OK 90% under

**Design Member 13, wind on back, Bending + Compression**

$f_a/F_a = 0.0/19.424 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/19.424 + 0.0/26.4 + 2.841/30.0 = 0.095 \leq 1$  OK 91% under

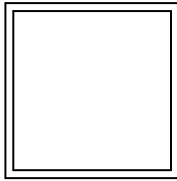
Checked by:

**Checking design member 14 (X Primary Beam)**

Members: 14

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 14, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.412 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.412 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 14, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 14, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.799 \leq 26.4 \text{ OK } 97\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.799 \leq 26.4 \text{ OK } 97\% \text{ under}$$

**Design Member 14, wind on front, Minor Shear**

$$f_v \leq F_v, 0.088 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 14, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 14, wind on front, Compression**

$$f_a \leq F_a, 0.05 \leq 18.849 \text{ OK } 100\% \text{ under}$$

**Design Member 14, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.412 / 26.4 + 0.799 / 26.4 = 0.159 \leq 1 \text{ OK } 84\% \text{ under}$$

**Design Member 14, wind on front, Bending + Compression**

$$f_a / F_a = 0.05 / 18.849 = 0.003 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.05 / 18.849 + 3.412 / 26.4 + 0.799 / 26.4 = 0.162 \leq 1 \text{ OK } 84\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 14, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.019 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.019 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 14, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 14, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.035 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.035 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 14, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 14, climber, Tension**On gross area  $f_t \leq F_t, 0.017 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.017 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 14, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 18.849 \text{ OK } 100\% \text{ under}$$

**Design Member 14, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.017 / 24.0 + 1.019 / 26.4 + 0.035 / 26.4 = 0.041 \leq 1 \text{ OK } 96\% \text{ under}$$

**Design Member 14, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 18.849 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.849 + 1.019 / 26.4 + 0.035 / 26.4 = 0.04 \leq 1 \text{ OK } 96\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 14, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.412 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.412 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 14, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 14, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.799 \leq 26.4 \text{ OK } 97\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.799 \leq 26.4 \text{ OK } 97\% \text{ under}$$

**Design Member 14, wind on back, Minor Shear**

$$f_v \leq F_v, 0.088 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 14, wind on back, Tension**On gross area  $f_t \leq F_t, 0.05 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.05 \leq 44.0$  OK 100% under

**Design Member 14, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 18.849$  OK 100% under

**Design Member 14, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.05/24.0 + 3.412/26.4 + 0.799/26.4 = 0.162 \leq 1$  OK 84% under

**Design Member 14, wind on back, Bending + Compression**

$f_a/F_a = 0.0/18.849 = 0.0 \leq 0.15 \therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/18.849 + 3.412/26.4 + 0.799/26.4 = 0.159 \leq 1$  OK 84% under

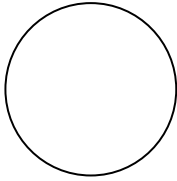
Checked by:

**Checking design member 15**

Members: 15

Group: Custom1

Section: 1/2" diameter bar

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 20.0 / 0.125, 1.0 * 20.0 / 0.125) = 160.0$$

$$F_a = 12 * \pi^2 * E / (23 * (Kl/r)^2) = 12 * \pi^2 * 29000.995 / (23 * 160.0^2) = 5.833 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 15, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.041 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.041 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 15, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 15, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 9.447 \leq 30.0 \text{ OK } 69\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 9.447 \leq 30.0 \text{ OK } 69\% \text{ under}$$

**Design Member 15, wind on front, Minor Shear**

$$f_v \leq F_v, 0.139 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 15, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 15, wind on front, Compression**

$$f_a \leq F_a, 0.179 \leq 5.833 \text{ OK } 97\% \text{ under}$$

**Design Member 15, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.041 / 26.4 + 9.447 / 30.0 = 0.316 \leq 1 \text{ OK } 68\% \text{ under}$$

**Design Member 15, wind on front, Bending + Compression**

$$f_a / F_a = 0.179 / 5.833 = 0.031 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.179 / 5.833 + 0.041 / 26.4 + 9.447 / 30.0 = 0.347 \leq 1 \text{ OK } 65\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 20.0 / 0.125, 1.0 * 20.0 / 0.125) = 160.0$$

Checked by:

$$F_a = 12 * \pi^2 * E / (23 * (KL/r)^2) = 12 * \pi^2 * 29000.995 / (23 * 160.0^2) = 5.833 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 15, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.097 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.097 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 15, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 15, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.492 \leq 30.0 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.492 \leq 30.0 \text{ OK } 98\% \text{ under}$$

**Design Member 15, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 15, climber, Tension**On gross area  $f_t \leq F_t, 0.06 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.06 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 15, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 5.833 \text{ OK } 100\% \text{ under}$$

**Design Member 15, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.06 / 24.0 + 0.097 / 26.4 + 0.492 / 30.0 = 0.023 \leq 1 \text{ OK } 98\% \text{ under}$$

**Design Member 15, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 5.833 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 5.833 + 0.097 / 26.4 + 0.492 / 30.0 = 0.02 \leq 1 \text{ OK } 98\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 20.0 / 0.125, 1.0 * 20.0 / 0.125) = 160.0$$

$$F_a = 12 * \pi^2 * E / (23 * (KL/r)^2) = 12 * \pi^2 * 29000.995 / (23 * 160.0^2) = 5.833 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 15, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.041 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.041 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 15, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 15, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 9.447 \leq 30.0 \text{ OK } 69\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 9.447 \leq 30.0 \text{ OK } 69\% \text{ under}$$

**Design Member 15, wind on back, Minor Shear**

$$f_v \leq F_v, 0.139 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 15, wind on back, Tension**On gross area  $f_t \leq F_t, 0.179 \leq 24.0 \text{ OK } 99\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.179 \leq 44.0$  OK 100% under

**Design Member 15, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 5.833$  OK 100% under

**Design Member 15, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.179/24.0 + 0.041/26.4 + 9.447/30.0 = 0.324 \leq 1$  OK 68% under

**Design Member 15, wind on back, Bending + Compression**

$f_a/F_a = 0.0/5.833 = 0.0 \leq 0.15$   $\therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/5.833 + 0.041/26.4 + 9.447/30.0 = 0.316 \leq 1$  OK 68% under

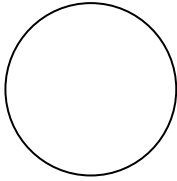
Checked by:

**Checking design member 16**

Members: 16

Group: Custom1

Section: 1/2" diameter bar

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.0 / 0.125, 1.0 * 28.0 / 0.125) = 224.0$$

$$F_a = 12 * \pi^2 * E / (23 * (Kl/r)^2) = 12 * \pi^2 * 29000.995 / (23 * 224.0^2) = 2.976 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 16, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.002 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.002 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 16, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 16, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.26 \leq 30.0 \text{ OK } 56\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.26 \leq 30.0 \text{ OK } 56\% \text{ under}$$

**Design Member 16, wind on front, Minor Shear**

$$f_v \leq F_v, 0.165 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 16, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.02 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.02 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 16, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 2.976 \text{ OK } 100\% \text{ under}$$

**Design Member 16, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.02 / 24.0 + 0.002 / 26.4 + 13.26 / 30.0 = 0.443 \leq 1 \text{ OK } 56\% \text{ under}$$

**Design Member 16, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 2.976 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 2.976 + 0.002 / 26.4 + 13.26 / 30.0 = 0.442 \leq 1 \text{ OK } 56\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.0 / 0.125, 1.0 * 28.0 / 0.125) = 224.0$$

Checked by:

$$F_a = 12 * \pi^2 * E / (23 * (KL/r)^2) = 12 * \pi^2 * 29000.995 / (23 * 224.0^2) = 2.976 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 16, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.135 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.135 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 16, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 16, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.29 \leq 30.0 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.29 \leq 30.0 \text{ OK } 96\% \text{ under}$$

**Design Member 16, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 16, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 16, climber, Compression**

$$f_a \leq F_a, 0.029 \leq 2.976 \text{ OK } 99\% \text{ under}$$

**Design Member 16, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.135 / 26.4 + 1.29 / 30.0 = 0.048 \leq 1 \text{ OK } 95\% \text{ under}$$

**Design Member 16, climber, Bending + Compression**

$$f_a / F_a = 0.029 / 2.976 = 0.01 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.029 / 2.976 + 0.135 / 26.4 + 1.29 / 30.0 = 0.058 \leq 1 \text{ OK } 94\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 28.0 / 0.125, 1.0 * 28.0 / 0.125) = 224.0$$

$$F_a = 12 * \pi^2 * E / (23 * (KL/r)^2) = 12 * \pi^2 * 29000.995 / (23 * 224.0^2) = 2.976 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 16, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.002 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.002 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 16, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 16, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.26 \leq 30.0 \text{ OK } 56\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.26 \leq 30.0 \text{ OK } 56\% \text{ under}$$

**Design Member 16, wind on back, Minor Shear**

$$f_v \leq F_v, 0.165 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 16, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 16, wind on back, Compression**

$f_a \leq F_a$ ,  $0.02 \leq 2.976$  OK 99% under

**Design Member 16, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.002/26.4 + 13.26/30.0 = 0.442 \leq 1$  OK 56% under

**Design Member 16, wind on back, Bending + Compression**

$f_a/F_a = 0.02/2.976 = 0.007 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.02/2.976 + 0.002/26.4 + 13.26/30.0 = 0.449 \leq 1$  OK 55% under

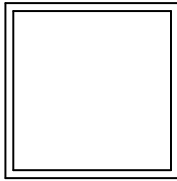
Checked by:

**Checking design member 17 (X Primary Beam)**

Members: 17

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 17, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.042 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.042 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 17, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 17, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.564 \leq 26.4 \text{ OK } 94\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.564 \leq 26.4 \text{ OK } 94\% \text{ under}$$

**Design Member 17, wind on front, Minor Shear**

$$f_v \leq F_v, 0.171 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 17, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.232 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.232 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 17, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 18.849 \text{ OK } 100\% \text{ under}$$

**Design Member 17, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.232 / 24.0 + 0.042 / 26.4 + 1.564 / 26.4 = 0.071 \leq 1 \text{ OK } 93\% \text{ under}$$

**Design Member 17, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 18.849 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.849 + 0.042 / 26.4 + 1.564 / 26.4 = 0.061 \leq 1 \text{ OK } 94\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 17, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.013 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.013 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 17, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 17, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.295 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.295 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 17, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 17, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 17, climber, Compression**

$$f_a \leq F_a, 0.029 \leq 18.849 \text{ OK } 100\% \text{ under}$$

**Design Member 17, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.013 / 26.4 + 0.295 / 26.4 = 0.012 \leq 1 \text{ OK } 99\% \text{ under}$$

**Design Member 17, climber, Bending + Compression**

$$f_a / F_a = 0.029 / 18.849 = 0.002 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.029 / 18.849 + 0.013 / 26.4 + 0.295 / 26.4 = 0.013 \leq 1 \text{ OK } 99\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 17, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.042 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.042 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 17, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 17, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.564 \leq 26.4 \text{ OK } 94\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.564 \leq 26.4 \text{ OK } 94\% \text{ under}$$

**Design Member 17, wind on back, Minor Shear**

$$f_v \leq F_v, 0.171 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 17, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 17, wind on back, Compression**

$f_a \leq F_a$ ,  $0.232 \leq 18.849$  OK 99% under

**Design Member 17, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.042/26.4 + 1.564/26.4 = 0.061 \leq 1$  OK 94% under

**Design Member 17, wind on back, Bending + Compression**

$f_a/F_a = 0.232/18.849 = 0.012 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.232/18.849 + 0.042/26.4 + 1.564/26.4 = 0.073 \leq 1$  OK 93% under

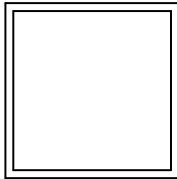
Checked by:

**Checking design member 18 (X Primary Beam)**

Members: 18

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 18, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.023 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.023 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 18, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 18, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.089 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.089 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 18, wind on front, Minor Shear**

$$f_v \leq F_v, 0.082 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 18, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.002 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.002 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 18, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 18.849 \text{ OK } 100\% \text{ under}$$

**Design Member 18, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.002 / 24.0 + 0.023 / 26.4 + 1.089 / 26.4 = 0.042 \leq 1 \text{ OK } 96\% \text{ under}$$

**Design Member 18, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 18.849 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.849 + 0.023 / 26.4 + 1.089 / 26.4 = 0.042 \leq 1 \text{ OK } 96\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 18, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.004 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.004 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 18, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 18, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.081 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.081 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 18, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 18, climber, Tension**On gross area  $f_t \leq F_t, 0.001 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.001 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 18, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 18.849 \text{ OK } 100\% \text{ under}$$

**Design Member 18, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.001 / 24.0 + 0.004 / 26.4 + 0.081 / 26.4 = 0.003 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 18, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 18.849 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.849 + 0.004 / 26.4 + 0.081 / 26.4 = 0.003 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 36.0 / 0.586, 1.0 * 36.0 / 0.586) = 61.433$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 61.433^2 / (2 * 119.63^2)) * 40.0 / 1.842 = 18.849 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 18, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.023 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.023 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 18, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 18, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.089 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.089 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 18, wind on back, Minor Shear**

$$f_v \leq F_v, 0.082 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 18, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 18, wind on back, Compression**

$f_a \leq F_a$ ,  $0.002 \leq 18.849$  OK 100% under

**Design Member 18, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.023/26.4 + 1.089/26.4 = 0.042 \leq 1$  OK 96% under

**Design Member 18, wind on back, Bending + Compression**

$f_a/F_a = 0.002/18.849 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.002/18.849 + 0.023/26.4 + 1.089/26.4 = 0.042 \leq 1$  OK 96% under

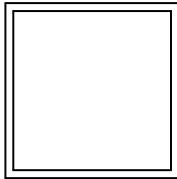
Checked by:

**Checking design member 19**

Members: 19

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 16.279 / 0.586, 1.0 * 16.279 / 0.586) = 27.78$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 27.78^2 / (2 * 119.63^2)) * 40.0 / 1.752 = 22.213 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 19, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

**Design Member 19, wind on front, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 19, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

**Design Member 19, wind on front, Minor Shear**

$$f_v \leq F_v, 0.162 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 19, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.177 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.177 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 19, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 22.213 \text{ OK } 100\% \text{ under}$$

**Design Member 19, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.177 / 24.0 + 7.927 / 26.4 + 1.798 / 26.4 = 0.376 \leq 1 \text{ OK } 62\% \text{ under}$$

**Design Member 19, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 22.213 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 22.213 + 7.927 / 26.4 + 1.798 / 26.4 = 0.368 \leq 1 \text{ OK } 63\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 16.279 / 0.586, 1.0 * 16.279 / 0.586) = 27.78$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 27.78^2 / (2 * 119.63^2)) * 40.0 / 1.752 = 22.213 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 19, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.0 \leq 26.4 \text{ OK } 92\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.0 \leq 26.4 \text{ OK } 92\% \text{ under}$$

**Design Member 19, climber, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 19, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.325 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.325 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 19, climber, Minor Shear**

$$f_v \leq F_v, 0.035 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 19, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 19, climber, Compression**

$$f_a \leq F_a, 0.047 \leq 22.213 \text{ OK } 100\% \text{ under}$$

**Design Member 19, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 2.0 / 26.4 + 0.325 / 26.4 = 0.088 \leq 1 \text{ OK } 91\% \text{ under}$$

**Design Member 19, climber, Bending + Compression**

$$f_a / F_a = 0.047 / 22.213 = 0.002 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.047 / 22.213 + 2.0 / 26.4 + 0.325 / 26.4 = 0.09 \leq 1 \text{ OK } 91\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 16.279 / 0.586, 1.0 * 16.279 / 0.586) = 27.78$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 27.78^2 / (2 * 119.63^2)) * 40.0 / 1.752 = 22.213 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 19, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.927 \leq 26.4 \text{ OK } 70\% \text{ under}$$

**Design Member 19, wind on back, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 19, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.798 \leq 26.4 \text{ OK } 93\% \text{ under}$$

**Design Member 19, wind on back, Minor Shear**

$$f_v \leq F_v, 0.162 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 19, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 19, wind on back, Compression**

$f_a \leq F_a$ ,  $0.177 \leq 22.213$  OK 99% under

**Design Member 19, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 7.927/26.4 + 1.798/26.4 = 0.368 \leq 1$  OK 63% under

**Design Member 19, wind on back, Bending + Compression**

$f_a/F_a = 0.177/22.213 = 0.008 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.177/22.213 + 7.927/26.4 + 1.798/26.4 = 0.376 \leq 1$  OK 62% under

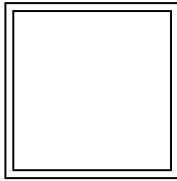
Checked by:

**Checking design member 20**

Members: 20

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 60.042 / 0.586, 1.0 * 60.042 / 0.586) = 102.46$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 102.46^2 / (2 * 119.63^2)) * 40.0 / 1.909 = 13.266 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 20, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

**Design Member 20, wind on front, Major Shear**

$$f_v \leq F_v, 0.299 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 20, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

**Design Member 20, wind on front, Minor Shear**

$$f_v \leq F_v, 0.083 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 20, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 20, wind on front, Compression**

$$f_a \leq F_a, 2.585 \leq 13.266 \text{ OK } 81\% \text{ under}$$

**Design Member 20, wind on front, Bending + Tension**

$$f_a / F_t + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 13.996 / 26.4 + 2.844 / 26.4 = 0.638 \leq 1 \text{ OK } 36\% \text{ under}$$

**Design Member 20, wind on front, Bending + Compression**

$$\text{Axial Ratio} = f_a / F_a = 2.585 / 13.266 = 0.195$$

$$\text{Major Ratio} = C_m * f_{bx} / ((1 - f_a / F'_{ex}) * F_{bx}) = 1.0 * 13.996 / ((1 - 2.585 / 14.225) * 26.4) = 0.648$$

$$\text{Minor Ratio} = C_m * f_{by} / ((1 - f_a / F'_{ey}) * F_{by}) = 1.0 * 2.844 / ((1 - 2.585 / 14.225) * 26.4) = 0.132$$

$$\text{Axial Ratio} + \text{Major Ratio} + \text{Minor Ratio} = 0.195 + 0.648 + 0.132 = 0.974 \leq 1 \text{ OK } 3\% \text{ under}$$

$$f_a / (0.6 * F_y) + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.585 / (0.6 * 40.0) + 13.996 / 26.4 + 2.844 / 26.4 = 0.746 \geq 1 \text{ OK } 25\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

Checked by:

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 60.042 / 0.586, 1.0 * 60.042 / 0.586) = 102.46$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 102.46^2 / (2 * 119.63^2)) * 40.0 / 1.909 = 13.266 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 20, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.63 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.63 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 20, climber, Major Shear**

$$f_v \leq F_v, 0.045 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 20, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.406 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.406 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 20, climber, Minor Shear**

$$f_v \leq F_v, 0.012 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 20, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.36 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.36 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 20, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 13.266 \text{ OK } 100\% \text{ under}$$

**Design Member 20, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.36 / 24.0 + 2.63 / 26.4 + 0.406 / 26.4 = 0.13 \leq 1 \text{ OK } 87\% \text{ under}$$

**Design Member 20, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 13.266 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 13.266 + 2.63 / 26.4 + 0.406 / 26.4 = 0.115 \leq 1 \text{ OK } 89\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 60.042 / 0.586, 1.0 * 60.042 / 0.586) = 102.46$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 102.46^2 / (2 * 119.63^2)) * 40.0 / 1.909 = 13.266 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 20, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.996 \leq 26.4 \text{ OK } 47\% \text{ under}$$

**Design Member 20, wind on back, Major Shear**

$$f_v \leq F_v, 0.299 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 20, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.844 \leq 26.4 \text{ OK } 89\% \text{ under}$$

**Design Member 20, wind on back, Minor Shear**

Checked by:

$$f_v \leq F_v, 0.083 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 20, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 2.585 \leq 24.0 \text{ OK } 89\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.585 \leq 44.0 \text{ OK } 94\% \text{ under}$$

**Design Member 20, wind on back, Compression**

$$f_a \leq F_a, 0.0 \leq 13.266 \text{ OK } 100\% \text{ under}$$

**Design Member 20, wind on back, Bending + Tension**

$$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.585/24.0 + 13.996/26.4 + 2.844/26.4 = 0.746 \leq 1 \text{ OK } 25\% \text{ under}$$

**Design Member 20, wind on back, Bending + Compression**

$$f_a/F_a = 0.0/13.266 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/13.266 + 13.996/26.4 + 2.844/26.4 = 0.638 \leq 1 \text{ OK } 36\% \text{ under}$$

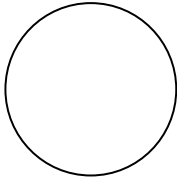
Checked by:

**Checking design member 21**

Members: 21

Group: Custom1

Section: 1/2" diameter bar

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 8.0 / 0.125, 1.0 * 8.0 / 0.125) = 64.0$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 64.0^2 / (2 * 119.63^2)) * 40.0 / 1.848 = 18.546 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 21, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 21, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 21, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

**Design Member 21, wind on front, Minor Shear**

$$f_v \leq F_v, 0.136 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 21, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 21, wind on front, Compression**

$$f_a \leq F_a, 0.133 \leq 18.546 \text{ OK } 99\% \text{ under}$$

**Design Member 21, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.218 / 26.4 + 7.243 / 30.0 = 0.25 \leq 1 \text{ OK } 75\% \text{ under}$$

**Design Member 21, wind on front, Bending + Compression**

$$f_a / F_a = 0.133 / 18.546 = 0.007 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.133 / 18.546 + 0.218 / 26.4 + 7.243 / 30.0 = 0.257 \leq 1 \text{ OK } 74\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 8.0 / 0.125, 1.0 * 8.0 / 0.125) = 64.0$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 64.0^2 / (2 * 119.63^2)) * 40.0 / 1.848 = 18.546 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 21, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.202 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.202 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 21, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 21, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.391 \leq 30.0 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.391 \leq 30.0 \text{ OK } 85\% \text{ under}$$

**Design Member 21, climber, Minor Shear**

$$f_v \leq F_v, 0.056 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 21, climber, Tension**On gross area  $f_t \leq F_t, 0.04 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.04 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 21, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 18.546 \text{ OK } 100\% \text{ under}$$

**Design Member 21, climber, Bending + Tension**

$$f_a / F_t + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.04 / 24.0 + 0.202 / 26.4 + 4.391 / 30.0 = 0.156 \leq 1 \text{ OK } 84\% \text{ under}$$

**Design Member 21, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 18.546 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.546 + 0.202 / 26.4 + 4.391 / 30.0 = 0.154 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 8.0 / 0.125, 1.0 * 8.0 / 0.125) = 64.0$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 64.0^2 / (2 * 119.63^2)) * 40.0 / 1.848 = 18.546 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 21, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.218 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 21, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 21, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 7.243 \leq 30.0 \text{ OK } 76\% \text{ under}$$

**Design Member 21, wind on back, Minor Shear**

$$f_v \leq F_v, 0.136 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 21, wind on back, Tension**On gross area  $f_t \leq F_t, 0.133 \leq 24.0 \text{ OK } 99\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.133 \leq 44.0$  OK 100% under

**Design Member 21, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 18.546$  OK 100% under

**Design Member 21, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.133/24.0 + 0.218/26.4 + 7.243/30.0 = 0.255 \leq 1$  OK 74% under

**Design Member 21, wind on back, Bending + Compression**

$f_a/F_a = 0.0/18.546 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/18.546 + 0.218/26.4 + 7.243/30.0 = 0.25 \leq 1$  OK 75% under

Checked by:

**Checking design member 22**

Members: 22

Group: Custom1

Section: 1/4 x 2 link

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 9.0 / 0.577, 0.65 * 9.0 / 0.072) = 81.06$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 81.06^2 / (2 * 117.548^2)) * 40.0 / 1.884 = 16.181 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 22, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

**Design Member 22, wind on front, Minor Shear**

$$f_v \leq F_v, 0.018 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on front, Compression**

$$f_a \leq F_a, 0.108 \leq 16.181 \text{ OK } 99\% \text{ under}$$

**Design Member 22, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 2.525 / 30.0 = 0.084 \leq 1 \text{ OK } 92\% \text{ under}$$

**Design Member 22, wind on front, Bending + Compression**

$$f_a / F_a = 0.108 / 16.181 = 0.007 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.108 / 16.181 + 0.0 / 26.4 + 2.525 / 30.0 = 0.091 \leq 1 \text{ OK } 91\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 9.0 / 0.577, 0.65 * 9.0 / 0.072) = 81.06$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 81.06^2 / (2 * 117.548^2)) * 40.0 / 1.884 = 16.181 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 22, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 22, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.321 \leq 30.0 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.321 \leq 30.0 \text{ OK } 96\% \text{ under}$$

**Design Member 22, climber, Minor Shear**

$$f_v \leq F_v, 0.008 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 22, climber, Compression**

$$f_a \leq F_a, 0.022 \leq 16.181 \text{ OK } 100\% \text{ under}$$

**Design Member 22, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 1.321 / 30.0 = 0.044 \leq 1 \text{ OK } 96\% \text{ under}$$

**Design Member 22, climber, Bending + Compression**

$$f_a / F_a = 0.022 / 16.181 = 0.001 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.022 / 16.181 + 0.0 / 26.4 + 1.321 / 30.0 = 0.045 \leq 1 \text{ OK } 95\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 9.0 / 0.577, 0.65 * 9.0 / 0.072) = 81.06$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 81.06^2 / (2 * 117.548^2)) * 40.0 / 1.884 = 16.181 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 22, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.525 \leq 30.0 \text{ OK } 92\% \text{ under}$$

**Design Member 22, wind on back, Minor Shear**

$$f_v \leq F_v, 0.018 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 22, wind on back, Tension**On gross area  $f_t \leq F_t, 0.108 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.108 \leq 44.0$  OK 100% under

**Design Member 22, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 16.181$  OK 100% under

**Design Member 22, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.108/24.0 + 0.0/26.4 + 2.525/30.0 = 0.089 \leq 1$  OK 91% under

**Design Member 22, wind on back, Bending + Compression**

$f_a/F_a = 0.0/16.181 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/16.181 + 0.0/26.4 + 2.525/30.0 = 0.084 \leq 1$  OK 92% under

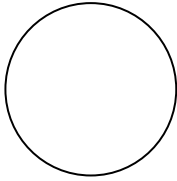
Checked by:

**Checking design member 23**

Members: 23

Group: Custom1

Section: 1/2" diameter bar

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.125, 1.0 * 4.0 / 0.125) = 32.0$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 32.0^2 / (2 * 119.63^2)) * 40.0 / 1.765 = 21.857 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 23, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 23, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 23, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

**Design Member 23, wind on front, Minor Shear**

$$f_v \leq F_v, 0.144 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 23, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.062 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.062 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 23, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 21.857 \text{ OK } 100\% \text{ under}$$

**Design Member 23, wind on front, Bending + Tension**

$$f_a / F_t + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.062 / 24.0 + 0.411 / 26.4 + 8.437 / 30.0 = 0.299 \leq 1 \text{ OK } 70\% \text{ under}$$

**Design Member 23, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 21.857 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 21.857 + 0.411 / 26.4 + 8.437 / 30.0 = 0.297 \leq 1 \text{ OK } 70\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.125, 1.0 * 4.0 / 0.125) = 32.0$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 32.0^2 / (2 * 119.63^2)) * 40.0 / 1.765 = 21.857 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 23, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.221 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.221 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 23, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 23, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 9.338 \leq 30.0 \text{ OK } 69\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 9.338 \leq 30.0 \text{ OK } 69\% \text{ under}$$

**Design Member 23, climber, Minor Shear**

$$f_v \leq F_v, 0.219 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 23, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 23, climber, Compression**

$$f_a \leq F_a, 0.007 \leq 21.857 \text{ OK } 100\% \text{ under}$$

**Design Member 23, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.221 / 26.4 + 9.338 / 30.0 = 0.32 \leq 1 \text{ OK } 68\% \text{ under}$$

**Design Member 23, climber, Bending + Compression**

$$f_a / F_a = 0.007 / 21.857 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.007 / 21.857 + 0.221 / 26.4 + 9.338 / 30.0 = 0.32 \leq 1 \text{ OK } 68\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.125, 1.0 * 4.0 / 0.125) = 32.0$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 32.0^2 / (2 * 119.63^2)) * 40.0 / 1.765 = 21.857 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 23, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.411 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 23, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 23, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.437 \leq 30.0 \text{ OK } 72\% \text{ under}$$

**Design Member 23, wind on back, Minor Shear**

$$f_v \leq F_v, 0.144 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 23, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 23, wind on back, Compression**

$f_a \leq F_a$ ,  $0.062 \leq 21.857$  OK 100% under

**Design Member 23, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.411/26.4 + 8.437/30.0 = 0.297 \leq 1$  OK 70% under

**Design Member 23, wind on back, Bending + Compression**

$f_a/F_a = 0.062/21.857 = 0.003 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.062/21.857 + 0.411/26.4 + 8.437/30.0 = 0.3 \leq 1$  OK 70% under

Checked by:

**Checking design member 24**

Members: 24

Group: Custom1

Section: 1/4 x 2 link

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.577, 1.0 * 4.0 / 0.072) = 55.426$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 55.426^2 / (2 * 117.548^2)) * 40.0 / 1.83 = 19.424 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 24, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

**Design Member 24, wind on front, Minor Shear**

$$f_v \leq F_v, 0.017 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on front, Compression**

$$f_a \leq F_a, 0.121 \leq 19.424 \text{ OK } 99\% \text{ under}$$

**Design Member 24, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 2.841 / 30.0 = 0.095 \leq 1 \text{ OK } 91\% \text{ under}$$

**Design Member 24, wind on front, Bending + Compression**

$$f_a / F_a = 0.121 / 19.424 = 0.006 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.121 / 19.424 + 0.0 / 26.4 + 2.841 / 30.0 = 0.101 \leq 1 \text{ OK } 90\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.577, 1.0 * 4.0 / 0.072) = 55.426$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 55.426^2 / (2 * 117.548^2)) * 40.0 / 1.83 = 19.424 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 24, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 24, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.967 \leq 30.0 \text{ OK } 93\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.967 \leq 30.0 \text{ OK } 93\% \text{ under}$$

**Design Member 24, climber, Minor Shear**

$$f_v \leq F_v, 0.009 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.086 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.086 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 19.424 \text{ OK } 100\% \text{ under}$$

**Design Member 24, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.086 / 24.0 + 0.0 / 26.4 + 1.967 / 30.0 = 0.069 \leq 1 \text{ OK } 93\% \text{ under}$$

**Design Member 24, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 19.424 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 19.424 + 0.0 / 26.4 + 1.967 / 30.0 = 0.066 \leq 1 \text{ OK } 93\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.577, 1.0 * 4.0 / 0.072) = 55.426$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 55.426^2 / (2 * 117.548^2)) * 40.0 / 1.83 = 19.424 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.75 * F_y = 0.75 * 40.0 = 30.0 \text{ ksi}$$

**Design Member 24, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.841 \leq 30.0 \text{ OK } 91\% \text{ under}$$

**Design Member 24, wind on back, Minor Shear**

$$f_v \leq F_v, 0.017 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 24, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 0.121 \leq 24.0 \text{ OK } 99\% \text{ under}$$

Checked by:

On net area  $f_t \leq F_t$ ,  $0.121 \leq 44.0$  OK 100% under**Design Member 24, wind on back, Compression** $f_a \leq F_a$ ,  $0.0 \leq 19.424$  OK 100% under**Design Member 24, wind on back, Bending + Tension** $f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.121/24.0 + 0.0/26.4 + 2.841/30.0 = 0.1 \leq 1$  OK 90% under**Design Member 24, wind on back, Bending + Compression** $f_a/F_a = 0.0/19.424 = 0.0 \leq 0.15 \therefore \phi_0$  $\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/19.424 + 0.0/26.4 + 2.841/30.0 = 0.095 \leq 1$  OK 91% under

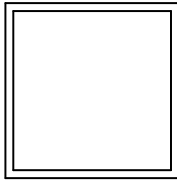
Checked by:

**Checking design member 25**

Members: 25

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.5 / 0.586, 1.0 * 28.5 / 0.586) = 48.635$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 48.635^2 / (2 * 119.63^2)) * 40.0 / 1.811 = 20.265 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

**Design Member 25, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 20.265 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 24.0 + 0.0 / 24.0 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 20.265 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.265 + 0.0 / 24.0 + 0.0 / 24.0 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.5 / 0.586, 1.0 * 28.5 / 0.586) = 48.635$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 48.635^2 / (2 * 119.63^2)) * 40.0 / 1.811 = 20.265 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 25, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 25, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 25, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 25, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 20.265 \text{ OK } 100\% \text{ under}$$

**Design Member 25, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 0.0 / 26.4 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 25, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 20.265 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.265 + 0.0 / 26.4 + 0.0 / 26.4 = 0.0 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 28.5 / 0.586, 1.0 * 28.5 / 0.586) = 48.635$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 48.635^2 / (2 * 119.63^2)) * 40.0 / 1.811 = 20.265 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

**Design Member 25, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on back, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 25, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 25, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 20.265$  OK 100% under

**Design Member 25, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.0/24.0 + 0.0/24.0 = 0.0 \leq 1$  OK 100% under

**Design Member 25, wind on back, Bending + Compression**

$f_a/F_a = 0.0/20.265 = 0.0 \leq 0.15 \therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/20.265 + 0.0/24.0 + 0.0/24.0 = 0.0 \leq 1$  OK 100% under

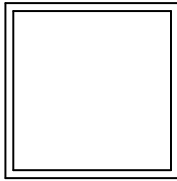
Checked by:

**Checking design member 26 (Column)**

Members: 26

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 51.42 / 0.586, 1.0 * 51.42 / 0.586) = 87.747$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_v / FS = (1 - 87.747^2 / (2 * 119.63^2)) * 40.0 / 1.892 = 15.451 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 26, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

**Design Member 26, wind on front, Major Shear**

$$f_v \leq F_v, 0.342 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 26, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.108 \leq 26.4 \text{ OK } 84\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.108 \leq 26.4 \text{ OK } 84\% \text{ under}$$

**Design Member 26, wind on front, Minor Shear**

$$f_v \leq F_v, 0.093 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 26, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 2.344 \leq 24.0 \text{ OK } 90\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.344 \leq 44.0 \text{ OK } 95\% \text{ under}$$

**Design Member 26, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 15.451 \text{ OK } 100\% \text{ under}$$

**Design Member 26, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.344 / 24.0 + 10.751 / 26.4 + 4.108 / 26.4 = 0.66 \leq 1 \text{ OK } 34\% \text{ under}$$

**Design Member 26, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 15.451 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 15.451 + 10.751 / 26.4 + 4.108 / 26.4 = 0.563 \leq 1 \text{ OK } 44\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 51.42 / 0.586, 1.0 * 51.42 / 0.586) = 87.747$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 87.747^2 / (2 * 119.63^2)) * 40.0 / 1.892 = 15.451 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 26, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.451 \leq 26.4 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.451 \leq 26.4 \text{ OK } 91\% \text{ under}$$

**Design Member 26, climber, Major Shear**

$$f_v \leq F_v, 0.042 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 26, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.256 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.256 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 26, climber, Minor Shear**

$$f_v \leq F_v, 0.03 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 26, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 26, climber, Compression**

$$f_a \leq F_a, 0.671 \leq 15.451 \text{ OK } 96\% \text{ under}$$

**Design Member 26, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 2.451 / 26.4 + 1.256 / 26.4 = 0.14 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 26, climber, Bending + Compression**

$$f_a / F_a = 0.671 / 15.451 = 0.043 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.671 / 15.451 + 2.451 / 26.4 + 1.256 / 26.4 = 0.184 \leq 1 \text{ OK } 82\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 51.42 / 0.586, 1.0 * 51.42 / 0.586) = 87.747$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 87.747^2 / (2 * 119.63^2)) * 40.0 / 1.892 = 15.451 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 26, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

**Design Member 26, wind on back, Major Shear**

$$f_v \leq F_v, 0.342 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 26, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.108 \leq 26.4 \text{ OK } 84\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.108 \leq 26.4 \text{ OK } 84\% \text{ under}$$

**Design Member 26, wind on back, Minor Shear**

$$f_v \leq F_v, 0.093 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 26, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under**Design Member 26, wind on back, Compression** $f_a \leq F_a$ ,  $2.344 \leq 15.451$  OK 85% under**Design Member 26, wind on back, Bending + Tension** $f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 10.751/26.4 + 4.108/26.4 = 0.563 \leq 1$  OK 44% under**Design Member 26, wind on back, Bending + Compression**Axial Ratio =  $f_a/F_a = 2.344/15.451 = 0.152$ Major Ratio =  $Cm_x * f_{bx} / ((1 - f_a/F_{ex}) * F_{bx}) = 1.0 * 10.751 / ((1 - 2.344/19.395) * 26.4) = 0.463$ Minor Ratio =  $Cm_y * f_{by} / ((1 - f_a/F_{ey}) * F_{by}) = 1.0 * 4.108 / ((1 - 2.344/19.395) * 26.4) = 0.177$ Axial Ratio + Major Ratio + Minor Ratio =  $0.152 + 0.463 + 0.177 = 0.792 \leq 1$  OK 21% under $f_a/(0.6 * F_y) + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.344/(0.6 * 40.0) + 10.751/26.4 + 4.108/26.4 = 0.66 \geq 1$  OK 34% under

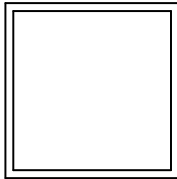
Checked by:

**Checking design member 27 (Column)**

Members: 27

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.373 / 0.586, 1.0 * 39.373 / 0.586) = 67.19$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 67.19^2 / (2 * 119.63^2)) * 40.0 / 1.855 = 18.161 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 27, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 27, wind on front, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 27, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 27, wind on front, Minor Shear**

$$f_v \leq F_v, 0.043 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 27, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 2.365 \leq 24.0 \text{ OK } 90\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.365 \leq 44.0 \text{ OK } 95\% \text{ under}$$

**Design Member 27, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 18.161 \text{ OK } 100\% \text{ under}$$

**Design Member 27, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.365 / 24.0 + 1.399 / 26.4 + 1.406 / 26.4 = 0.205 \leq 1 \text{ OK } 80\% \text{ under}$$

**Design Member 27, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 18.161 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.161 + 1.399 / 26.4 + 1.406 / 26.4 = 0.106 \leq 1 \text{ OK } 89\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.373 / 0.586, 1.0 * 39.373 / 0.586) = 67.19$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 67.19^2 / (2 * 119.63^2)) * 40.0 / 1.855 = 18.161 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 27, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 27, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 27, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.338 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.338 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 27, climber, Minor Shear**

$$f_v \leq F_v, 0.011 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 27, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 27, climber, Compression**

$$f_a \leq F_a, 0.68 \leq 18.161 \text{ OK } 96\% \text{ under}$$

**Design Member 27, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.0 / 26.4 + 0.338 / 26.4 = 0.013 \leq 1 \text{ OK } 99\% \text{ under}$$

**Design Member 27, climber, Bending + Compression**

$$f_a / F_a = 0.68 / 18.161 = 0.037 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.68 / 18.161 + 0.0 / 26.4 + 0.338 / 26.4 = 0.05 \leq 1 \text{ OK } 95\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 39.373 / 0.586, 1.0 * 39.373 / 0.586) = 67.19$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 67.19^2 / (2 * 119.63^2)) * 40.0 / 1.855 = 18.161 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 27, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.399 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 27, wind on back, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 27, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.406 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 27, wind on back, Minor Shear**

$$f_v \leq F_v, 0.043 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 27, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 27, wind on back, Compression**

$f_a \leq F_a$ ,  $2.365 \leq 18.161$  OK 87% under

**Design Member 27, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 1.399/26.4 + 1.406/26.4 = 0.106 \leq 1$  OK 89% under

**Design Member 27, wind on back, Bending + Compression**

$f_a/F_a = 2.365/18.161 = 0.13 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 2.365/18.161 + 1.399/26.4 + 1.406/26.4 = 0.237 \leq 1$  OK 76% under

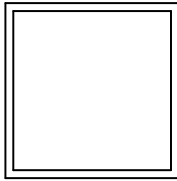
Checked by:

**Checking design member 28**

Members: 28

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.367 / 0.586, 1.0 * 41.367 / 0.586) = 70.593$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.593^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.74 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 28, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

**Design Member 28, wind on front, Major Shear**

$$f_v \leq F_v, 0.215 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 28, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 28, wind on front, Minor Shear**

$$f_v \leq F_v, 0.087 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 28, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 28, wind on front, Compression**

$$f_a \leq F_a, 2.52 \leq 17.74 \text{ OK } 86\% \text{ under}$$

**Design Member 28, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 13.653 / 26.4 + 4.055 / 26.4 = 0.671 \leq 1 \text{ OK } 33\% \text{ under}$$

**Design Member 28, wind on front, Bending + Compression**

$$f_a / F_a = 2.52 / 17.74 = 0.142 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 2.52 / 17.74 + 13.653 / 26.4 + 4.055 / 26.4 = 0.813 \leq 1 \text{ OK } 19\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.367 / 0.586, 1.0 * 41.367 / 0.586) = 70.593$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.593^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.74 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 28, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.728 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.728 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 28, climber, Major Shear**

$$f_v \leq F_v, 0.115 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 28, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.598 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.598 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 28, climber, Minor Shear**

$$f_v \leq F_v, 0.02 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 28, climber, Tension**On gross area  $f_t \leq F_t, 0.372 \leq 24.0 \text{ OK } 98\% \text{ under}$ On net area  $f_t \leq F_t, 0.372 \leq 44.0 \text{ OK } 99\% \text{ under}$ **Design Member 28, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 17.74 \text{ OK } 100\% \text{ under}$$

**Design Member 28, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.372 / 24.0 + 2.728 / 26.4 + 0.598 / 26.4 = 0.141 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 28, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 17.74 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 17.74 + 2.728 / 26.4 + 0.598 / 26.4 = 0.126 \leq 1 \text{ OK } 87\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 41.367 / 0.586, 1.0 * 41.367 / 0.586) = 70.593$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.593^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.74 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 28, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 13.653 \leq 26.4 \text{ OK } 48\% \text{ under}$$

**Design Member 28, wind on back, Major Shear**

$$f_v \leq F_v, 0.215 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 28, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 4.055 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 28, wind on back, Minor Shear**

$$f_v \leq F_v, 0.087 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 28, wind on back, Tension**On gross area  $f_t \leq F_t, 2.52 \leq 24.0 \text{ OK } 89\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $2.52 \leq 44.0$  OK 94% under

**Design Member 28, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 17.74$  OK 100% under

**Design Member 28, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.52/24.0 + 13.653/26.4 + 4.055/26.4 = 0.776 \leq 1$  OK 22% under

**Design Member 28, wind on back, Bending + Compression**

$f_a/F_a = 0.0/17.74 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/17.74 + 13.653/26.4 + 4.055/26.4 = 0.671 \leq 1$  OK 33% under

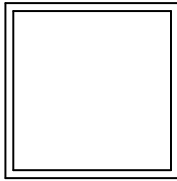
Checked by:

**Checking design member 29 (Column)**

Members: 29

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.85 / 0.586, 1.0 * 39.85 / 0.586) = 68.003$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 68.003^2 / (2 * 119.63^2)) * 40.0 / 1.857 = 18.061 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 29, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 29, wind on front, Major Shear**

$$f_v \leq F_v, 0.176 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 29, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 29, wind on front, Minor Shear**

$$f_v \leq F_v, 0.021 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 29, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 2.375 \leq 24.0 \text{ OK } 90\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 2.375 \leq 44.0 \text{ OK } 95\% \text{ under}$$

**Design Member 29, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 18.061 \text{ OK } 100\% \text{ under}$$

**Design Member 29, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 2.375 / 24.0 + 3.509 / 26.4 + 0.47 / 26.4 = 0.25 \leq 1 \text{ OK } 75\% \text{ under}$$

**Design Member 29, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 18.061 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 18.061 + 3.509 / 26.4 + 0.47 / 26.4 = 0.151 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 39.85 / 0.586, 1.0 * 39.85 / 0.586) = 68.003$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 68.003^2 / (2 * 119.63^2)) * 40.0 / 1.857 = 18.061 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 29, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.525 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.525 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 29, climber, Major Shear**

$$f_v \leq F_v, 0.012 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 29, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.131 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.131 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 29, climber, Minor Shear**

$$f_v \leq F_v, 0.004 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 29, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 29, climber, Compression**

$$f_a \leq F_a, 0.325 \leq 18.061 \text{ OK } 98\% \text{ under}$$

**Design Member 29, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.525 / 26.4 + 0.131 / 26.4 = 0.025 \leq 1 \text{ OK } 98\% \text{ under}$$

**Design Member 29, climber, Bending + Compression**

$$f_a / F_a = 0.325 / 18.061 = 0.018 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.325 / 18.061 + 0.525 / 26.4 + 0.131 / 26.4 = 0.043 \leq 1 \text{ OK } 96\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 39.85 / 0.586, 1.0 * 39.85 / 0.586) = 68.003$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 68.003^2 / (2 * 119.63^2)) * 40.0 / 1.857 = 18.061 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 29, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.509 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 29, wind on back, Major Shear**

$$f_v \leq F_v, 0.176 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 29, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.47 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 29, wind on back, Minor Shear**

$$f_v \leq F_v, 0.021 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 29, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 29, wind on back, Compression**

$f_a \leq F_a$ ,  $2.375 \leq 18.061$  OK 87% under

**Design Member 29, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 3.509/26.4 + 0.47/26.4 = 0.151 \leq 1$  OK 85% under

**Design Member 29, wind on back, Bending + Compression**

$f_a/F_a = 2.375/18.061 = 0.132 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 2.375/18.061 + 3.509/26.4 + 0.47/26.4 = 0.282 \leq 1$  OK 72% under

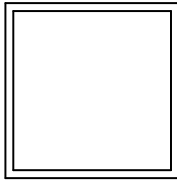
Checked by:

**Checking design member 30**

Members: 30

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.425 / 0.586, 1.0 * 41.425 / 0.586) = 70.69$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.69^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.727 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 30, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

**Design Member 30, wind on front, Major Shear**

$$f_v \leq F_v, 0.072 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 30, wind on front, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, wind on front, Compression**

$$f_a \leq F_a, 2.456 \leq 17.727 \text{ OK } 86\% \text{ under}$$

**Design Member 30, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.645 / 26.4 + 0.159 / 26.4 = 0.144 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 30, wind on front, Bending + Compression**

$$f_a / F_a = 2.456 / 17.727 = 0.139 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 2.456 / 17.727 + 3.645 / 26.4 + 0.159 / 26.4 = 0.283 \leq 1 \text{ OK } 72\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 41.425 / 0.586, 1.0 * 41.425 / 0.586) = 70.69$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.69^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.727 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 30, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.725 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.725 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 30, climber, Major Shear**

$$f_v \leq F_v, 0.07 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.399 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.399 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 30, climber, Minor Shear**

$$f_v \leq F_v, 0.007 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, climber, Tension**

$$\text{On gross area } f_t \leq F_t, 0.325 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.325 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 30, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 17.727 \text{ OK } 100\% \text{ under}$$

**Design Member 30, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.325 / 24.0 + 2.725 / 26.4 + 0.399 / 26.4 = 0.132 \leq 1 \text{ OK } 87\% \text{ under}$$

**Design Member 30, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 17.727 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 17.727 + 2.725 / 26.4 + 0.399 / 26.4 = 0.118 \leq 1 \text{ OK } 88\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 41.425 / 0.586, 1.0 * 41.425 / 0.586) = 70.69$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 70.69^2 / (2 * 119.63^2)) * 40.0 / 1.862 = 17.727 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 30, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.645 \leq 26.4 \text{ OK } 86\% \text{ under}$$

**Design Member 30, wind on back, Major Shear**

$$f_v \leq F_v, 0.072 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.159 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 30, wind on back, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 30, wind on back, Tension**

$$\text{On gross area } f_t \leq F_t, 2.456 \leq 24.0 \text{ OK } 90\% \text{ under}$$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $2.456 \leq 44.0$  OK 94% under

**Design Member 30, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 17.727$  OK 100% under

**Design Member 30, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 2.456/24.0 + 3.645/26.4 + 0.159/26.4 = 0.246 \leq 1$  OK 75% under

**Design Member 30, wind on back, Bending + Compression**

$f_a/F_a = 0.0/17.727 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/17.727 + 3.645/26.4 + 0.159/26.4 = 0.144 \leq 1$  OK 86% under

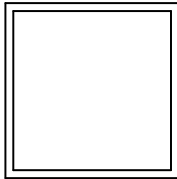
Checked by:

**Checking design member 31 (Column)**

Members: 31

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 26.5 / 0.586, 1.0 * 26.5 / 0.586) = 45.222$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 45.222^2 / (2 * 119.63^2)) * 40.0 / 1.802 = 20.615 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 31, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 31, wind on front, Major Shear**

$$f_v \leq F_v, 0.004 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 31, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 31, wind on front, Minor Shear**

$$f_v \leq F_v, 0.178 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 31, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 31, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 20.615 \text{ OK } 100\% \text{ under}$$

**Design Member 31, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 20.615 + 0.111 / 26.4 + 3.875 / 26.4 = 0.151 \leq 1 \text{ OK } 85\% \text{ under}$$

**Design Member 31, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 20.615 = 0.0 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.615 + 0.111 / 26.4 + 3.875 / 26.4 = 0.151 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 26.5 / 0.586, 1.0 * 26.5 / 0.586) = 45.222$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 45.222^2 / (2 * 119.63^2)) * 40.0 / 1.802 = 20.615 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 31, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.027 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.027 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 31, climber, Major Shear**

$$f_v \leq F_v, 0.001 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 31, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.0 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 31, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 31, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 31, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 20.615 \text{ OK } 100\% \text{ under}$$

**Design Member 31, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 0.027 / 26.4 + 0.0 / 26.4 = 0.001 \leq 1 \text{ OK } 100\% \text{ under}$$

**Design Member 31, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 20.615 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.615 + 0.027 / 26.4 + 0.0 / 26.4 = 0.001 \leq 1 \text{ OK } 100\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 26.5 / 0.586, 1.0 * 26.5 / 0.586) = 45.222$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 45.222^2 / (2 * 119.63^2)) * 40.0 / 1.802 = 20.615 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 31, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.111 \leq 26.4 \text{ OK } 100\% \text{ under}$$

**Design Member 31, wind on back, Major Shear**

$$f_v \leq F_v, 0.004 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 31, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.875 \leq 26.4 \text{ OK } 85\% \text{ under}$$

**Design Member 31, wind on back, Minor Shear**

$$f_v \leq F_v, 0.178 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 31, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 31, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 20.615$  OK 100% under

**Design Member 31, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 0.111/26.4 + 3.875/26.4 = 0.151 \leq 1$  OK 85% under

**Design Member 31, wind on back, Bending + Compression**

$f_a/F_a = 0.0/20.615 = 0.0 \leq 0.15$   $\therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/20.615 + 0.111/26.4 + 3.875/26.4 = 0.151 \leq 1$  OK 85% under

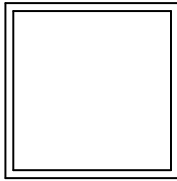
Checked by:

**Checking design member 32**

Members: 32

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 15.0 / 0.586, 1.0 * 15.0 / 0.586) = 25.597$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 25.597^2 / (2 * 119.63^2)) * 40.0 / 1.746 = 22.389 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 32, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

**Design Member 32, wind on front, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 32, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 32, wind on front, Minor Shear**

$$f_v \leq F_v, 0.145 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 32, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.181 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.181 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 32, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 22.389 \text{ OK } 100\% \text{ under}$$

**Design Member 32, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.181 / 24.0 + 8.772 / 26.4 + 1.283 / 26.4 = 0.388 \leq 1 \text{ OK } 61\% \text{ under}$$

**Design Member 32, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 22.389 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 22.389 + 8.772 / 26.4 + 1.283 / 26.4 = 0.381 \leq 1 \text{ OK } 62\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 15.0 / 0.586, 1.0 * 15.0 / 0.586) = 25.597$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 25.597^2 / (2 * 119.63^2)) * 40.0 / 1.746 = 22.389 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 32, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

**Design Member 32, climber, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 32, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.442 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.442 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 32, climber, Minor Shear**

$$f_v \leq F_v, 0.044 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 32, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 32, climber, Compression**

$$f_a \leq F_a, 0.045 \leq 22.389 \text{ OK } 100\% \text{ under}$$

**Design Member 32, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.196 / 26.4 + 0.442 / 26.4 = 0.138 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 32, climber, Bending + Compression**

$$f_a / F_a = 0.045 / 22.389 = 0.002 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.045 / 22.389 + 3.196 / 26.4 + 0.442 / 26.4 = 0.14 \leq 1 \text{ OK } 86\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 15.0 / 0.586, 1.0 * 15.0 / 0.586) = 25.597$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 25.597^2 / (2 * 119.63^2)) * 40.0 / 1.746 = 22.389 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 32, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

**Design Member 32, wind on back, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 32, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 32, wind on back, Minor Shear**

$$f_v \leq F_v, 0.145 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 32, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 32, wind on back, Compression**

$f_a \leq F_a$ ,  $0.181 \leq 22.389$  OK 99% under

**Design Member 32, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 8.772/26.4 + 1.283/26.4 = 0.381 \leq 1$  OK 62% under

**Design Member 32, wind on back, Bending + Compression**

$f_a/F_a = 0.181/22.389 = 0.008 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.181/22.389 + 8.772/26.4 + 1.283/26.4 = 0.389 \leq 1$  OK 61% under

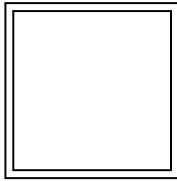
Checked by:

**Checking design member 33**

Members: 33

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 33, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

**Design Member 33, wind on front, Major Shear**

$$f_v \leq F_v, 4.348 \leq 16.0 \text{ OK } 73\% \text{ under}$$

**Design Member 33, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 33, wind on front, Minor Shear**

$$f_v \leq F_v, 0.19 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 33, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.508 \leq 24.0 \text{ OK } 98\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.508 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 33, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 23.658 \text{ OK } 100\% \text{ under}$$

**Design Member 33, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.508 / 24.0 + 10.751 / 26.4 + 1.146 / 26.4 = 0.472 \leq 1 \text{ OK } 53\% \text{ under}$$

**Design Member 33, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 23.658 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.658 + 10.751 / 26.4 + 1.146 / 26.4 = 0.451 \leq 1 \text{ OK } 55\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 33, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

**Design Member 33, climber, Major Shear**

$$f_v \leq F_v, 1.257 \leq 16.0 \text{ OK } 92\% \text{ under}$$

**Design Member 33, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.535 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.535 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 33, climber, Minor Shear**

$$f_v \leq F_v, 0.062 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 33, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 33, climber, Compression**

$$f_a \leq F_a, 0.178 \leq 23.658 \text{ OK } 99\% \text{ under}$$

**Design Member 33, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.196 / 26.4 + 0.535 / 26.4 = 0.141 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 33, climber, Bending + Compression**

$$f_a / F_a = 0.178 / 23.658 = 0.008 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.178 / 23.658 + 3.196 / 26.4 + 0.535 / 26.4 = 0.149 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 33, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

**Design Member 33, wind on back, Major Shear**

$$f_v \leq F_v, 4.348 \leq 16.0 \text{ OK } 73\% \text{ under}$$

**Design Member 33, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 33, wind on back, Minor Shear**

$$f_v \leq F_v, 0.19 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 33, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 33, wind on back, Compression**

$f_a \leq F_a$ ,  $0.508 \leq 23.658$  OK 98% under

**Design Member 33, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 10.751/26.4 + 1.146/26.4 = 0.451 \leq 1$  OK 55% under

**Design Member 33, wind on back, Bending + Compression**

$f_a/F_a = 0.508/23.658 = 0.021 \leq 0.15 \therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.508/23.658 + 10.751/26.4 + 1.146/26.4 = 0.472 \leq 1$  OK 53% under

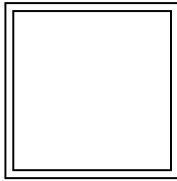
Checked by:

**Checking design member 34**

Members: 34

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 15.0 / 0.586, 1.0 * 15.0 / 0.586) = 25.597$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 25.597^2 / (2 * 119.63^2)) * 40.0 / 1.746 = 22.389 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 34, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

**Design Member 34, wind on front, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 34, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 34, wind on front, Minor Shear**

$$f_v \leq F_v, 0.145 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 34, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.181 \leq 24.0 \text{ OK } 99\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.181 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 34, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 22.389 \text{ OK } 100\% \text{ under}$$

**Design Member 34, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.181 / 24.0 + 8.772 / 26.4 + 1.283 / 26.4 = 0.388 \leq 1 \text{ OK } 61\% \text{ under}$$

**Design Member 34, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 22.389 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 22.389 + 8.772 / 26.4 + 1.283 / 26.4 = 0.381 \leq 1 \text{ OK } 62\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 15.0 / 0.586, 1.0 * 15.0 / 0.586) = 25.597$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 25.597^2 / (2 * 119.63^2)) * 40.0 / 1.746 = 22.389 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 34, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

**Design Member 34, climber, Major Shear**

$$f_v \leq F_v, 0.095 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 34, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.442 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.442 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 34, climber, Minor Shear**

$$f_v \leq F_v, 0.044 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 34, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 34, climber, Compression**

$$f_a \leq F_a, 0.045 \leq 22.389 \text{ OK } 100\% \text{ under}$$

**Design Member 34, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.196 / 26.4 + 0.442 / 26.4 = 0.138 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 34, climber, Bending + Compression**

$$f_a / F_a = 0.045 / 22.389 = 0.002 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.045 / 22.389 + 3.196 / 26.4 + 0.442 / 26.4 = 0.14 \leq 1 \text{ OK } 86\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 15.0 / 0.586, 1.0 * 15.0 / 0.586) = 25.597$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 25.597^2 / (2 * 119.63^2)) * 40.0 / 1.746 = 22.389 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 34, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.772 \leq 26.4 \text{ OK } 67\% \text{ under}$$

**Design Member 34, wind on back, Major Shear**

$$f_v \leq F_v, 0.081 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 34, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.283 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 34, wind on back, Minor Shear**

$$f_v \leq F_v, 0.145 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 34, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 34, wind on back, Compression**

$f_a \leq F_a$ ,  $0.181 \leq 22.389$  OK 99% under

**Design Member 34, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 8.772/26.4 + 1.283/26.4 = 0.381 \leq 1$  OK 62% under

**Design Member 34, wind on back, Bending + Compression**

$f_a/F_a = 0.181/22.389 = 0.008 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.181/22.389 + 8.772/26.4 + 1.283/26.4 = 0.389 \leq 1$  OK 61% under

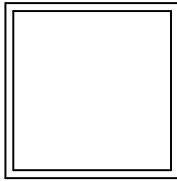
Checked by:

**Checking design member 35**

Members: 35

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 35, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

**Design Member 35, wind on front, Major Shear**

$$f_v \leq F_v, 4.348 \leq 16.0 \text{ OK } 73\% \text{ under}$$

**Design Member 35, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 35, wind on front, Minor Shear**

$$f_v \leq F_v, 0.19 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 35, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.508 \leq 24.0 \text{ OK } 98\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.508 \leq 44.0 \text{ OK } 99\% \text{ under}$$

**Design Member 35, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 23.658 \text{ OK } 100\% \text{ under}$$

**Design Member 35, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.508 / 24.0 + 10.751 / 26.4 + 1.146 / 26.4 = 0.472 \leq 1 \text{ OK } 53\% \text{ under}$$

**Design Member 35, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 23.658 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.658 + 10.751 / 26.4 + 1.146 / 26.4 = 0.451 \leq 1 \text{ OK } 55\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 35, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.196 \leq 26.4 \text{ OK } 88\% \text{ under}$$

**Design Member 35, climber, Major Shear**

$$f_v \leq F_v, 1.257 \leq 16.0 \text{ OK } 92\% \text{ under}$$

**Design Member 35, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.535 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.535 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 35, climber, Minor Shear**

$$f_v \leq F_v, 0.062 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 35, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 35, climber, Compression**

$$f_a \leq F_a, 0.178 \leq 23.658 \text{ OK } 99\% \text{ under}$$

**Design Member 35, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.196 / 26.4 + 0.535 / 26.4 = 0.141 \leq 1 \text{ OK } 86\% \text{ under}$$

**Design Member 35, climber, Bending + Compression**

$$f_a / F_a = 0.178 / 23.658 = 0.008 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.178 / 23.658 + 3.196 / 26.4 + 0.535 / 26.4 = 0.149 \leq 1 \text{ OK } 85\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 35, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 10.751 \leq 26.4 \text{ OK } 59\% \text{ under}$$

**Design Member 35, wind on back, Major Shear**

$$f_v \leq F_v, 4.348 \leq 16.0 \text{ OK } 73\% \text{ under}$$

**Design Member 35, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.146 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 35, wind on back, Minor Shear**

$$f_v \leq F_v, 0.19 \leq 16.0 \text{ OK } 99\% \text{ under}$$

**Design Member 35, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 35, wind on back, Compression**

$f_a \leq F_a$ ,  $0.508 \leq 23.658$  OK 98% under

**Design Member 35, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 10.751/26.4 + 1.146/26.4 = 0.451 \leq 1$  OK 55% under

**Design Member 35, wind on back, Bending + Compression**

$f_a/F_a = 0.508/23.658 = 0.021 \leq 0.15 \therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.508/23.658 + 10.751/26.4 + 1.146/26.4 = 0.472 \leq 1$  OK 53% under

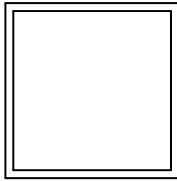
Checked by:

**Checking design member 36**

Members: 36

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 2.0 / 0.586, 1.0 * 2.0 / 0.586) = 3.413$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 3.413^2 / (2 * 119.63^2)) * 40.0 / 1.677 = 23.837 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 36, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

**Design Member 36, wind on front, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 36, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 36, wind on front, Minor Shear**

$$f_v \leq F_v, 2.151 \leq 16.0 \text{ OK } 87\% \text{ under}$$

**Design Member 36, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 36, wind on front, Compression**

$$f_a \leq F_a, 0.125 \leq 23.837 \text{ OK } 99\% \text{ under}$$

**Design Member 36, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 5.545 / 26.4 + 3.309 / 26.4 = 0.335 \leq 1 \text{ OK } 66\% \text{ under}$$

**Design Member 36, wind on front, Bending + Compression**

$$f_a / F_a = 0.125 / 23.837 = 0.005 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.125 / 23.837 + 5.545 / 26.4 + 3.309 / 26.4 = 0.341 \leq 1 \text{ OK } 66\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 2.0 / 0.586, 1.0 * 2.0 / 0.586) = 3.413$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 3.413^2 / (2 * 119.63^2)) * 40.0 / 1.677 = 23.837 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 36, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.247 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.247 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 36, climber, Major Shear**

$$f_v \leq F_v, 0.701 \leq 16.0 \text{ OK } 96\% \text{ under}$$

**Design Member 36, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.446 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.446 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 36, climber, Minor Shear**

$$f_v \leq F_v, 0.258 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 36, climber, Tension**On gross area  $f_t \leq F_t, 0.005 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.005 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 36, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 23.837 \text{ OK } 100\% \text{ under}$$

**Design Member 36, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.005 / 24.0 + 1.247 / 26.4 + 0.446 / 26.4 = 0.064 \leq 1 \text{ OK } 94\% \text{ under}$$

**Design Member 36, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 23.837 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.837 + 1.247 / 26.4 + 0.446 / 26.4 = 0.064 \leq 1 \text{ OK } 94\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 2.0 / 0.586, 1.0 * 2.0 / 0.586) = 3.413$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 3.413^2 / (2 * 119.63^2)) * 40.0 / 1.677 = 23.837 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 36, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

**Design Member 36, wind on back, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 36, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 36, wind on back, Minor Shear**

$$f_v \leq F_v, 2.151 \leq 16.0 \text{ OK } 87\% \text{ under}$$

**Design Member 36, wind on back, Tension**On gross area  $f_t \leq F_t, 0.125 \leq 24.0 \text{ OK } 99\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.125 \leq 44.0$  OK 100% under

**Design Member 36, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 23.837$  OK 100% under

**Design Member 36, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.125/24.0 + 5.545/26.4 + 3.309/26.4 = 0.341 \leq 1$  OK 66% under

**Design Member 36, wind on back, Bending + Compression**

$f_a/F_a = 0.0/23.837 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/23.837 + 5.545/26.4 + 3.309/26.4 = 0.335 \leq 1$  OK 66% under

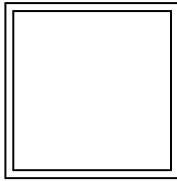
Checked by:

**Checking design member 37**

Members: 37

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 8.0 / 0.586, 1.0 * 8.0 / 0.586) = 13.652$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 13.652^2 / (2 * 119.63^2)) * 40.0 / 1.709 = 23.249 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 37, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

**Design Member 37, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.52 \leq 26.4 \text{ OK } 94\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.52 \leq 26.4 \text{ OK } 94\% \text{ under}$$

**Design Member 37, wind on front, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 23.249 \text{ OK } 100\% \text{ under}$$

**Design Member 37, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 23.249 + 5.545 / 26.4 + 1.52 / 26.4 = 0.268 \leq 1 \text{ OK } 73\% \text{ under}$$

**Design Member 37, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 23.249 = 0.0 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.249 + 5.545 / 26.4 + 1.52 / 26.4 = 0.268 \leq 1 \text{ OK } 73\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 8.0 / 0.586, 1.0 * 8.0 / 0.586) = 13.652$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 13.652^2 / (2 * 119.63^2)) * 40.0 / 1.709 = 23.249 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 37, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.247 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.247 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 37, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.133 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.133 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 37, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 37, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 23.249 \text{ OK } 100\% \text{ under}$$

**Design Member 37, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 1.247 / 26.4 + 0.133 / 26.4 = 0.052 \leq 1 \text{ OK } 95\% \text{ under}$$

**Design Member 37, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 23.249 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.249 + 1.247 / 26.4 + 0.133 / 26.4 = 0.052 \leq 1 \text{ OK } 95\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 8.0 / 0.586, 1.0 * 8.0 / 0.586) = 13.652$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 13.652^2 / (2 * 119.63^2)) * 40.0 / 1.709 = 23.249 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 37, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

**Design Member 37, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.52 \leq 26.4 \text{ OK } 94\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.52 \leq 26.4 \text{ OK } 94\% \text{ under}$$

**Design Member 37, wind on back, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 37, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 37, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 23.249$  OK 100% under

**Design Member 37, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 5.545/26.4 + 1.52/26.4 = 0.268 \leq 1$  OK 73% under

**Design Member 37, wind on back, Bending + Compression**

$f_a/F_a = 0.0/23.249 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/23.249 + 5.545/26.4 + 1.52/26.4 = 0.268 \leq 1$  OK 73% under

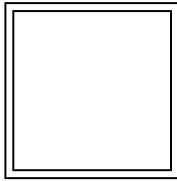
Checked by:

**Checking design member 38**

Members: 38

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 2.0 / 0.586, 1.0 * 2.0 / 0.586) = 3.413$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 3.413^2 / (2 * 119.63^2)) * 40.0 / 1.677 = 23.837 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 38, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

**Design Member 38, wind on front, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 38, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 38, wind on front, Minor Shear**

$$f_v \leq F_v, 2.151 \leq 16.0 \text{ OK } 87\% \text{ under}$$

**Design Member 38, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 38, wind on front, Compression**

$$f_a \leq F_a, 0.125 \leq 23.837 \text{ OK } 99\% \text{ under}$$

**Design Member 38, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 5.545 / 26.4 + 3.309 / 26.4 = 0.335 \leq 1 \text{ OK } 66\% \text{ under}$$

**Design Member 38, wind on front, Bending + Compression**

$$f_a / F_a = 0.125 / 23.837 = 0.005 \leq 0.15 \therefore \phi 0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.125 / 23.837 + 5.545 / 26.4 + 3.309 / 26.4 = 0.341 \leq 1 \text{ OK } 66\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 2.0 / 0.586, 1.0 * 2.0 / 0.586) = 3.413$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 3.413^2 / (2 * 119.63^2)) * 40.0 / 1.677 = 23.837 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 38, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 1.247 \leq 26.4 \text{ OK } 95\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 1.247 \leq 26.4 \text{ OK } 95\% \text{ under}$$

**Design Member 38, climber, Major Shear**

$$f_v \leq F_v, 0.701 \leq 16.0 \text{ OK } 96\% \text{ under}$$

**Design Member 38, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.446 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.446 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 38, climber, Minor Shear**

$$f_v \leq F_v, 0.258 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 38, climber, Tension**On gross area  $f_t \leq F_t, 0.005 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.005 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 38, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 23.837 \text{ OK } 100\% \text{ under}$$

**Design Member 38, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.005 / 24.0 + 1.247 / 26.4 + 0.446 / 26.4 = 0.064 \leq 1 \text{ OK } 94\% \text{ under}$$

**Design Member 38, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 23.837 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.837 + 1.247 / 26.4 + 0.446 / 26.4 = 0.064 \leq 1 \text{ OK } 94\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 2.0 / 0.586, 1.0 * 2.0 / 0.586) = 3.413$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 3.413^2 / (2 * 119.63^2)) * 40.0 / 1.677 = 23.837 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 38, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 5.545 \leq 26.4 \text{ OK } 79\% \text{ under}$$

**Design Member 38, wind on back, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 38, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.309 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 38, wind on back, Minor Shear**

$$f_v \leq F_v, 2.151 \leq 16.0 \text{ OK } 87\% \text{ under}$$

**Design Member 38, wind on back, Tension**On gross area  $f_t \leq F_t, 0.125 \leq 24.0 \text{ OK } 99\% \text{ under}$

Checked by:

On net area  $f_t \leq F_t$ ,  $0.125 \leq 44.0$  OK 100% under**Design Member 38, wind on back, Compression** $f_a \leq F_a$ ,  $0.0 \leq 23.837$  OK 100% under**Design Member 38, wind on back, Bending + Tension** $f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.125/24.0 + 5.545/26.4 + 3.309/26.4 = 0.341 \leq 1$  OK 66% under**Design Member 38, wind on back, Bending + Compression** $f_a/F_a = 0.0/23.837 = 0.0 \leq 0.15 \therefore \phi_0$  $\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/23.837 + 5.545/26.4 + 3.309/26.4 = 0.335 \leq 1$  OK 66% under

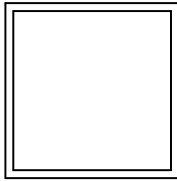
Checked by:

**Checking design member 39**

Members: 39

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 39, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

**Design Member 39, wind on front, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 39, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

**Design Member 39, wind on front, Minor Shear**

$$f_v \leq F_v, 0.635 \leq 16.0 \text{ OK } 96\% \text{ under}$$

**Design Member 39, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.023 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.023 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 39, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 23.658 \text{ OK } 100\% \text{ under}$$

**Design Member 39, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.023 / 24.0 + 11.331 / 26.4 + 2.429 / 26.4 = 0.522 \leq 1 \text{ OK } 48\% \text{ under}$$

**Design Member 39, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 23.658 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.658 + 11.331 / 26.4 + 2.429 / 26.4 = 0.521 \leq 1 \text{ OK } 48\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 39, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.486 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.486 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 39, climber, Major Shear**

$$f_v \leq F_v, 1.352 \leq 16.0 \text{ OK } 92\% \text{ under}$$

**Design Member 39, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.977 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.977 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 39, climber, Minor Shear**

$$f_v \leq F_v, 0.258 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 39, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 39, climber, Compression**

$$f_a \leq F_a, 0.009 \leq 23.658 \text{ OK } 100\% \text{ under}$$

**Design Member 39, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.486 / 26.4 + 0.977 / 26.4 = 0.169 \leq 1 \text{ OK } 83\% \text{ under}$$

**Design Member 39, climber, Bending + Compression**

$$f_a / F_a = 0.009 / 23.658 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.009 / 23.658 + 3.486 / 26.4 + 0.977 / 26.4 = 0.169 \leq 1 \text{ OK } 83\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 39, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

**Design Member 39, wind on back, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 39, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

**Design Member 39, wind on back, Minor Shear**

$$f_v \leq F_v, 0.635 \leq 16.0 \text{ OK } 96\% \text{ under}$$

**Design Member 39, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 39, wind on back, Compression**

$f_a \leq F_a$ ,  $0.023 \leq 23.658$  OK 100% under

**Design Member 39, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 11.331/26.4 + 2.429/26.4 = 0.521 \leq 1$  OK 48% under

**Design Member 39, wind on back, Bending + Compression**

$f_a/F_a = 0.023/23.658 = 0.001 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.023/23.658 + 11.331/26.4 + 2.429/26.4 = 0.522 \leq 1$  OK 48% under

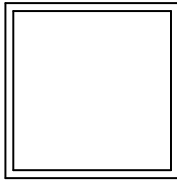
Checked by:

**Checking design member 40**

Members: 40

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.0 / 0.586, 1.0 * 28.0 / 0.586) = 47.782$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 47.782^2 / (2 * 119.63^2)) * 40.0 / 1.808 = 20.354 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 40, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.555 \leq 26.4 \text{ OK } 68\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.555 \leq 26.4 \text{ OK } 68\% \text{ under}$$

**Design Member 40, wind on front, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.423 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.423 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 40, wind on front, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 20.354 \text{ OK } 100\% \text{ under}$$

**Design Member 40, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 20.354 + 8.555 / 26.4 + 0.423 / 26.4 = 0.34 \leq 1 \text{ OK } 66\% \text{ under}$$

**Design Member 40, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 20.354 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.354 + 8.555 / 26.4 + 0.423 / 26.4 = 0.34 \leq 1 \text{ OK } 66\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 28.0 / 0.586, 1.0 * 28.0 / 0.586) = 47.782$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 47.782^2 / (2 * 119.63^2)) * 40.0 / 1.808 = 20.354 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 40, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.586 \leq 26.4 \text{ OK } 90\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.586 \leq 26.4 \text{ OK } 90\% \text{ under}$$

**Design Member 40, climber, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.181 \leq 26.4 \text{ OK } 99\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.181 \leq 26.4 \text{ OK } 99\% \text{ under}$$

**Design Member 40, climber, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 40, climber, Compression**

$$f_a \leq F_a, 0.0 \leq 20.354 \text{ OK } 100\% \text{ under}$$

**Design Member 40, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 2.586 / 26.4 + 0.181 / 26.4 = 0.105 \leq 1 \text{ OK } 90\% \text{ under}$$

**Design Member 40, climber, Bending + Compression**

$$f_a / F_a = 0.0 / 20.354 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\zeta} / \Phi_{\beta\zeta} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 20.354 + 2.586 / 26.4 + 0.181 / 26.4 = 0.105 \leq 1 \text{ OK } 90\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

On gross area  $F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$ On net area  $F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$ 

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 28.0 / 0.586, 1.0 * 28.0 / 0.586) = 47.782$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 47.782^2 / (2 * 119.63^2)) * 40.0 / 1.808 = 20.354 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 40, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 8.555 \leq 26.4 \text{ OK } 68\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 8.555 \leq 26.4 \text{ OK } 68\% \text{ under}$$

**Design Member 40, wind on back, Major Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.423 \leq 26.4 \text{ OK } 98\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.423 \leq 26.4 \text{ OK } 98\% \text{ under}$$

**Design Member 40, wind on back, Minor Shear**

$$f_v \leq F_v, 0.0 \leq 16.0 \text{ OK } 100\% \text{ under}$$

**Design Member 40, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 40, wind on back, Compression**

$f_a \leq F_a$ ,  $0.0 \leq 20.354$  OK 100% under

**Design Member 40, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 8.555/26.4 + 0.423/26.4 = 0.34 \leq 1$  OK 66% under

**Design Member 40, wind on back, Bending + Compression**

$f_a/F_a = 0.0/20.354 = 0.0 \leq 0.15 \therefore \phi_0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.0/20.354 + 8.555/26.4 + 0.423/26.4 = 0.34 \leq 1$  OK 66% under

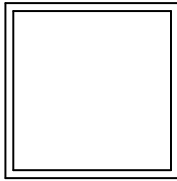
Checked by:

**Checking design member 41**

Members: 41

Group: Custom1

Section: RT1.5 x 1.5 x 0.064

**Load Case: wind on front**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (Kl/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 41, wind on front, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

**Design Member 41, wind on front, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 41, wind on front, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

**Design Member 41, wind on front, Minor Shear**

$$f_v \leq F_v, 0.635 \leq 16.0 \text{ OK } 96\% \text{ under}$$

**Design Member 41, wind on front, Tension**

$$\text{On gross area } f_t \leq F_t, 0.023 \leq 24.0 \text{ OK } 100\% \text{ under}$$

$$\text{On net area } f_t \leq F_t, 0.023 \leq 44.0 \text{ OK } 100\% \text{ under}$$

**Design Member 41, wind on front, Compression**

$$f_a \leq F_a, 0.0 \leq 23.658 \text{ OK } 100\% \text{ under}$$

**Design Member 41, wind on front, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.023 / 24.0 + 11.331 / 26.4 + 2.429 / 26.4 = 0.522 \leq 1 \text{ OK } 48\% \text{ under}$$

**Design Member 41, wind on front, Bending + Compression**

$$f_a / F_a = 0.0 / 23.658 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.0 / 23.658 + 11.331 / 26.4 + 2.429 / 26.4 = 0.521 \leq 1 \text{ OK } 48\% \text{ under}$$

**Load Case: climber**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$Kl/r = \max(K_x * l/r_x, K_y * l/r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

Checked by:

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 41, climber, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 3.486 \leq 26.4 \text{ OK } 87\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 3.486 \leq 26.4 \text{ OK } 87\% \text{ under}$$

**Design Member 41, climber, Major Shear**

$$f_v \leq F_v, 1.352 \leq 16.0 \text{ OK } 92\% \text{ under}$$

**Design Member 41, climber, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 0.977 \leq 26.4 \text{ OK } 96\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 0.977 \leq 26.4 \text{ OK } 96\% \text{ under}$$

**Design Member 41, climber, Minor Shear**

$$f_v \leq F_v, 0.258 \leq 16.0 \text{ OK } 98\% \text{ under}$$

**Design Member 41, climber, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$ On net area  $f_t \leq F_t, 0.0 \leq 44.0 \text{ OK } 100\% \text{ under}$ **Design Member 41, climber, Compression**

$$f_a \leq F_a, 0.009 \leq 23.658 \text{ OK } 100\% \text{ under}$$

**Design Member 41, climber, Bending + Tension**

$$f_a / F_a + f_{bx} / F_{bx} + f_{by} / F_{by} = 0.0 / 44.0 + 3.486 / 26.4 + 0.977 / 26.4 = 0.169 \leq 1 \text{ OK } 83\% \text{ under}$$

**Design Member 41, climber, Bending + Compression**

$$f_a / F_a = 0.009 / 23.658 = 0.0 \leq 0.15 \therefore \phi_0$$

$$\phi_\alpha / \Phi_\alpha + \phi_{\beta\xi} / \Phi_{\beta\xi} + \phi_{\beta\psi} / \Phi_{\beta\psi} = 0.009 / 23.658 + 3.486 / 26.4 + 0.977 / 26.4 = 0.169 \leq 1 \text{ OK } 83\% \text{ under}$$

**Load Case: wind on back**

$$F_y = 40.0 \text{ ksi}$$

$$\text{On gross area } F_t = 0.6 * F_y = 0.6 * 40.0 = 24.0 \text{ ksi}$$

$$\text{On net area } F_t = 0.5 * F_u = 0.5 * 88.0 = 44.0 \text{ ksi}$$

$$F_v = 0.4 * F_y = 0.4 * 40.0 = 16.0 \text{ ksi}$$

$$KL/r = \max(K_x * l / r_x, K_y * l / r_y) = \max(1.0 * 4.0 / 0.586, 1.0 * 4.0 / 0.586) = 6.826$$

$$F_a = (1 - (KL/r)^2 / (2 * Cc^2)) * F_y / FS = (1 - 6.826^2 / (2 * 119.63^2)) * 40.0 / 1.688 = 23.658 \text{ ksi}$$

*Major Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

*Minor Axis:*

$$F_b = 0.66 * F_y = 0.66 * 40.0 = 26.4 \text{ ksi}$$

**Design Member 41, wind on back, Major Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 11.331 \leq 26.4 \text{ OK } 57\% \text{ under}$$

**Design Member 41, wind on back, Major Shear**

$$f_v \leq F_v, 4.428 \leq 16.0 \text{ OK } 72\% \text{ under}$$

**Design Member 41, wind on back, Minor Bending**

Tensile Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

Compressive Bending Stress:

$$f_b \leq F_b, 2.429 \leq 26.4 \text{ OK } 91\% \text{ under}$$

**Design Member 41, wind on back, Minor Shear**

$$f_v \leq F_v, 0.635 \leq 16.0 \text{ OK } 96\% \text{ under}$$

**Design Member 41, wind on back, Tension**On gross area  $f_t \leq F_t, 0.0 \leq 24.0 \text{ OK } 100\% \text{ under}$

Calc by: FJC

AquaClimb

11/24/2009

Checked by:

On net area  $f_t \leq F_t$ ,  $0.0 \leq 44.0$  OK 100% under

**Design Member 41, wind on back, Compression**

$f_a \leq F_a$ ,  $0.023 \leq 23.658$  OK 100% under

**Design Member 41, wind on back, Bending + Tension**

$f_a/F_t + f_{bx}/F_{bx} + f_{by}/F_{by} = 0.0/44.0 + 11.331/26.4 + 2.429/26.4 = 0.521 \leq 1$  OK 48% under

**Design Member 41, wind on back, Bending + Compression**

$f_a/F_a = 0.023/23.658 = 0.001 \leq 0.15 \therefore \phi 0$

$\phi_\alpha/\Phi_\alpha + \phi_{\beta\xi}/\Phi_{\beta\xi} + \phi_{\beta\psi}/\Phi_{\beta\psi} = 0.023/23.658 + 11.331/26.4 + 2.429/26.4 = 0.522 \leq 1$  OK 48% under

REACTIONS AT ANCHORS

Joint #

		Wind on Back		
27		<u>-46.49</u>	<u>-850.266</u>	<u>412.966</u> GOVERNS
28		46.49	-850.266	412.967
29		-8.714	850.266	-121.935
30		8.714	850.266	-121.935
Total	(Global)	Rx=0.000	Ry=0.000	Rz=582.063
		Climber		
27		-1.814	-134.615	49.501
28		1.814	-134.615	49.501
29		-3.457	259.615	-49.501
30		3.457	259.615	-49.501
Total	(Global)	Rx=0.000	Ry=250.000	Rz=-0.000
		Wind on Front		
27		46.49	850.266	-412.966
28		-46.49	850.266	-412.967
29		8.714	-850.266	121.935
30		-8.714	-850.266	121.935
Total	(Global)	Rx=-0.000	Ry=0.000	Rz=-582.063

USE 5/8" diameter A304 stainless steel threaded rod & HILTI HDI drop in anchor

In 4000 psi concrete T allow = 2,630 lbs & V allow=4,510 lbs by inspection OK

Note: Others to check material in which anchors are embedded for capacity to support anchor forces.