HEAT EXCHANGER STAND 6-11-2001 BENGES 3/

Abstract

These are some of the multiple solution sets that can be found from the set of simultaneous equations obtained from diagram 1. Note that forces A, B, and C are exerted on two members, not one. Also, a negative value for a force means that, at that particular state, the member may be in tension. All positive values imply compression. All force values are in pounds.

1 Solution

Forces as they are in the free body.

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = 5000$
$F_{H4} = 5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = 5000$
$W = 10180$
$S = 1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45^\circ) = \mathbf{30443.78}$

~

$F_B = (1/160) * [28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W] = .00625 \times 1587668. = \mathbf{9922.925}$

~

$F_A = -F_B - F_C \sin(45^\circ) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * [28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W] - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45^\circ))\sin(45^\circ) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = -.00625 \times 1587668. + 8653.0 = \mathbf{-1269.925}$

2 Solution

Maximizing moment about point A, therefore maximizing force B.

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = 5000$
$F_{H4} = 5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = 5000$
$W = 10180$
$S = 1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45^\circ)) = \mathbf{30443.78}$

~

$F_B = (1/160) * [28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W] = .00625 \times 2927668. = \mathbf{18297.93}$

~

$F_A = -F_B - F_C \sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * [28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W] - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = -.00625 \times 2927668. - 21347.0 = \mathbf{-39644.93}$

3 Solution

Minimizing moment about point A, therefore minimizing force B.

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = -5000$
$F_{H4} = -5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = -5000$
$W = 10180$
$S = -1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) = \mathbf{-30444.}$

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) = .00625 * -1298868. = \mathbf{-8117.925}$

$F_A = -F_B - F_C \sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = \mathbf{46770.926}$

4 Solution

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = -5000$
$F_{H4} = -5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = 5000$
$W = 10180$
$S = -1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) = \mathbf{-30443.775}$

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) = \mathbf{3882.0742}$

$F_A = -F_B - F_C \sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = \mathbf{44770.926}$

5 Solution

All vertical forces going up and horizontal forces going in the opposite direction as in the free body..

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = -5000$
$F_{H4} = -5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = -5000$
$W = 10180$
$S = -1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) = \mathbf{-30443.775}$

~

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) = \mathbf{257.07422}$

~

$F_A = -F_B - F_C\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = \mathbf{8395.9258}$

6 Solution

All vertical forces going up and horizontal forces going in the same direction as in the free body..

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = 5000$
$F_{H4} = 5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = -5000$
$W = 10180$
$S = 1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) = \mathbf{30443.775}$

~

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) = \mathbf{6297.9258}$

~

$F_A = -F_B - F_C\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W =$ **−37644.926**

7 Solution

Maximizing the sum of moments about the center of mass.

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = 5000$
$F_{H4} = -5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = -5000$
$W = 10180$
$S = 1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) =$ **−11983**

~

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) =$ **−7491.1**

~

$F_A = -F_B - F_C\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W =$ **36144.**

8 Solution

Minimizing the sum of moments about the center of mass.

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = -5000$
$F_{H4} = 5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = -5000$
$F_{V4} = 5000$
$W = 10180$
$S = 1527.0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) =$ **16302.**

~

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) =$ **12806.**

~

$F_A = -F_B - F_C\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = \mathbf{-4152.7}$

9 Solution

Minimizing the sum of moments about point B, without taking into account any of the horizontal forces. This is ment to serve as a basis to calculate the maximum posible bending moments on members IX and X.

$F_{H1} = 0$
$F_{H2} = 0$
$F_{H3} = 0$
$F_{H4} = 0$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = 5000$
$W = 10180$
$S = 0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) = 0$

~

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) = \mathbf{15278.}$

~

$F_A = -F_B - F_C\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$

$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45°))\sin(45°) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W = \mathbf{-16625.}$

10 Solution

Maximizing the sum of moments about point B, without taking into account any of the horizontal forces. This is ment to serve as a basis to calculate the maximum posible bending moments on members IX and X.

$F_{H1} = 0$
$F_{H2} = 0$
$F_{H3} = 0$
$F_{H4} = 0$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = -5000$
$W = 10180$
$S = 0$

$Fc = (F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(45°)) = 0$

~

$F_B = (1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) = -5097.5$

~

$$F_A = -F_B - F_C \sin(45^\circ) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W$$

$$F_A = -(1/160) * (28.875(F_{H1} + F_{H2} + F_{H4}) + 4.875F_{H3} - 51(F_{V1} + F_{V3}) - 32F_{V2} + 192F_{V4} + S * 16.875 + 80W) - (F_{H1} + F_{H2} + F_{H3} + F_{H4} + 0.15W)/(\cos(45^\circ))\sin(45^\circ) + F_{V1} + F_{V2} + F_{V3} + F_{V4} + W =$$

23751

max force to calculate bending moment

HEAT EXCHANGER STAND 6-11-2001 BERGES 11/

Abstract

These are some of the multiple solution sets that can be found from the set of simultaneous equations obtained from diagram 2. Note that forces AB1, AB2, and D are exerted on two members, not one. Also, a negative value for a force means that, at that particular state, the member may be in tension. All positive values imply compression. All force values are in pounds.

1 Solution

Forces as they are in the free body.

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = 5000$
$F_{H4} = 5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = 5000$
$W = 10180$
$S = 1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)) = \mathbf{-43054.}$

~

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) = \mathbf{40525.}$

~

$F_{AB1} = -F_{AB2} - F_D \sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$

$F_{AB1} = -((1/19) * (4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°))) \sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{26941.}$

2 Solution

Maximizing force Fc

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = -5000$
$F_{H4} = -5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = 5000$
$W = 10180$
$S = -1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)). = \mathbf{43054.}$

~

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) = \mathbf{-10345.}$

~

$F_{AB1} = -F_{AB2} - F_D \sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$

$F_{AB1} = -((1/19) * (4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)))\sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{3239.3}$

3 Solution

Maximizing moment about point A

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = -5000$
$F_{H4} = -5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = -5000$
$W = 10180$
$S = -1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)) = \mathbf{43054.}$

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) = \mathbf{-30345.}$

$F_{AB1} = -F_{AB2} - F_D\sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$
$F_{AB1} = -((1/19) * (4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)))\sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{-16761.}$

4 Solution

Leaving horizontal forces as in the free body, but switching vertical forces (Fv's)

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = 5000$
$F_{H4} = 5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = -5000$
$W = 10180$
$S = 1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)) = \mathbf{-43054.}$

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) = \mathbf{20525.}$

$F_{AB1} = -F_{AB2} - F_D\sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$
$F_{AB1} = -((1/19) * (4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60°)))\sin(60°) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{6940.7}$

5 Solution

Maximizing moment about the center of mass, vertical forces going up.

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = 5000$
$F_{H4} = -5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = -5000$
$W = 10180$
$S = 1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)) = \mathbf{16946}$.

~

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) = \mathbf{-25067}$.

~

$F_{AB1} = -F_{AB2} - F_D\sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$

$F_{AB1} = -((1/19)*(4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)))\sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{571.27}$

6 Solution

Maximizing moment about the center of mass, vertical forces going down.

$F_{H1} = -5000$
$F_{H2} = -5000$
$F_{H3} = 5000$
$F_{H4} = -5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = 5000$
$W = 10180$
$S = 1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)) = \mathbf{16946}$.

~

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) = \mathbf{-5066.9}$

~

$F_{AB1} = -F_{AB2} - F_D\sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$

$F_{AB1} = -((1/19)*(4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)))\sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{20571}$.

7 Solution

Minimizing moment about the center of mass, vertical forces going down.

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = -5000$
$F_{H4} = 5000$
$F_{V1} = 5000$
$F_{V2} = 5000$
$F_{V3} = 5000$
$F_{V4} = 5000$
$W = 10180$
$S = 1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)) = \mathbf{-23054}$.

~

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) =$ **37959**.

~

$F_{AB1} = -F_{AB2} - F_D \sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$

$F_{AB1} = -((1/19) * (4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)))\sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{12186}$.

8 Solution

Minimizing moment about the center of mass, vertical forces going up.

$F_{H1} = 5000$
$F_{H2} = 5000$
$F_{H3} = -5000$
$F_{H4} = 5000$
$F_{V1} = -5000$
$F_{V2} = -5000$
$F_{V3} = -5000$
$F_{V4} = -5000$
$W = 10180$
$S = 1527.0$

$F_D = -(F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)) = \mathbf{-23054}$.

~

$F_{AB2} = (1/19)*(4.875F_{H3}+16.875S+28.875(F_{H1}+F_{H2}+F_{H4})+9.5(W+F_{V1}+F_{V2}+F_{V3}+F_{V4})) =$ **17959**.

~

$F_{AB1} = -F_{AB2} - F_D \sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4})$

$F_{AB1} = -((1/19) * (4.875F_{H3} + 16.875S + 28.875(F_{H1} + F_{H2} + F_{H4}) + 9.5(W + F_{V1} + F_{V2} + F_{V3} + F_{V4}))) + ((F_{H1} + F_{H2} + F_{H3} + F_{H4} + S)/(\cos(60^\circ)))\sin(60^\circ) + W + (F_{V1} + F_{V2} + F_{V3} + F_{V4}) = \mathbf{-7814.0}$