EXAMPLE #1

SINGLE WALER SYSTEM

#1
15’ High Wall X 100’ Long

Assuming a pour rate of 4’ hour and a temperature of 70º
Using this equation

$$P = 150 + \frac{R \times 9000}{T}$$

P = Lateral Form Pressure
R = Rate of Placement
T = Outside Temperature

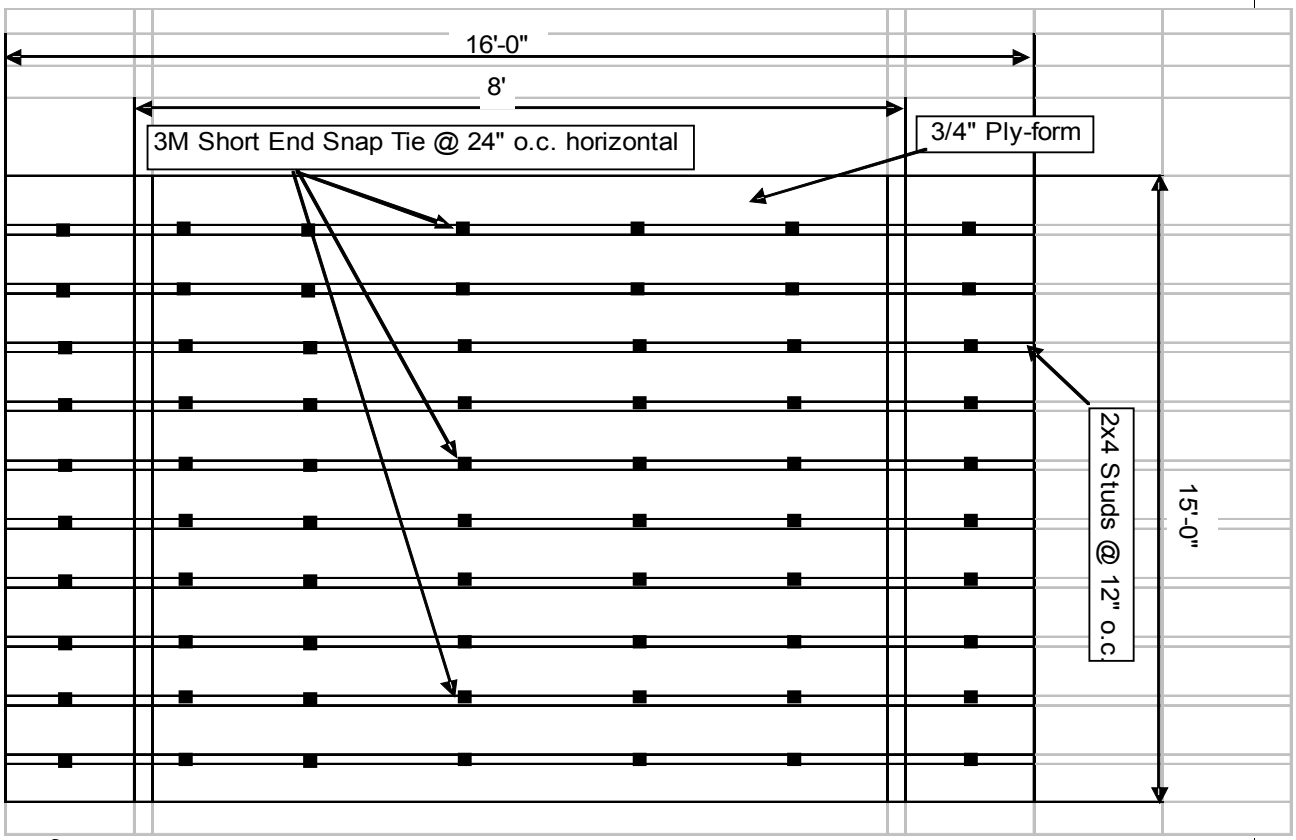
$$P = 150 + \frac{4 \times 9000}{70} = 664 \text{ PSF}$$

#2
Using the plywood charts on page ___, we select our plywood size and direction of use to determine a stud support spacing to maintain 1/360 design criteria.

¾” plywood supported perpendicular to the grain must be supported 12” O.C. to maintain 1/360.

#3
To determine the uniform load transferred to this supporting stud we take the design lateral load and multiply it by the spacing requirements in step #2.

664 X 1 = 664 Pounds Per Lineal Foot (PLF)



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To calculate the horizontal spacing of the snapties we can use two methods.

#1
We know to achieve 1/360 that our plywood must be supported 12" O.C. We also know that short-end ties for single waler use are rated at 2250# SWL. If we divide the design lateral form pressure by the tie SWL, we can determine the maximum spacing for tie utilization.

$$\frac{3000}{664} = 4.52 \text{ SF/Per Tie Maximum}$$

Now reviewing the safe spacing of support, chart on page ___, we use our 664 lbs/lf uniform stud load and determine that the stud only needs to be supported about 28" O.C.

Using our 12" O.C. vertical stud spacing and 28" O.C. horizontal tie spacing we arrive at 2.5 sf of wall being supported per tie.

2.5 X 664 = 1660 Tie Load

Another sensible factor to look at is symmetrical spacing and ease of construction. 28" O.C. tie spacing do not work out well on 4' x 8' plywood. A logical selection for example would be:

2 x 4 studs on 12" center to support plywood, single waler snap ties. 24" on center to support studs.

EXAMPLE #2

SINGLE WALER SYSTEM

#1

15" High X 100' Long

This time we assume a pour rate of 5'/Hr, but a temperature of 55º.

$$P = 150 + \frac{5 \times 9000}{55} = 968 \text{ PSF}$$

#2
Again using the plywood charts on page ___. Using ¾" plywood supported perpendicular to grain.

We now see our 2 x 4 stud spacing is reduced to around 10" O.C. to maintain 1/360 on the plywood.

#3
Determining the uniform load transferred to supporting stud.

968 x .833 = 806 LB/LF

This reduces our 2 x 4 horizontal support span to 24" O.C.

So again, we calculate tie loads at

1.67 SF X 968 = 1613 LB/Tie

To use this example to evaluate adding a waler behind the stud as a load-gathering member we use the safe spacing of ledgers or walers. Chart on page___.

968 X 2.0 = 1936 LB/LF

Using the double 2 x 4 column we see that these walers, (strong backs), can be supported at 24" O.C. With this stud and waler system we should order high strength long end snap ties which have a SWL of 3.35#.

We know that our 2 x 4 studs must be supported at 24" O.C. and our walers must be supported on 24" centers, this calculates to:

2 X 2 = 4.0 SF/Tie
4.0 X 968 PSF = 3872#/Tie Load

This produces a well-balanced system that utilizes each component of the system near its maximum SWL.

This is a true load gathered forming system. If you use a single waler system with short end ties, and add long end ties at your strong backs, you have not added to the design strength of your form system.

Design Questions

1. We need to determine how fast you can, or would like to fill the form with concrete.

2. What is the outside temperature likely to be at the time of concrete placement?

3. How will you be placing and consolidating the concrete (vibrating)?

    a. Pumping the concrete from the bottom of the form increases the lateral pressure and must be considered in your design.

    b. External vibrating of the form system to consolidate the concrete reduces the value of the form material members and must be considered in your design.

4. What type of form do you want to use?

    a. Plywood size and type.

    b. Supporting stud size and type 2 x 4, 2 x 6 etc.

    c. Supporting waler size and type 2 x 4, 2 x 6, aluminum, etc.

    d. Tie system, snap ties, taper ties, she bolts, fiberglass rod, etc.

Once these questions are answered, we start at determining what kind of pressure are we going to subject the plywood sheeting material to. This is called “Lateral Form Pressure”.

Knowing the lateral form pressure, we can determine a support spacing behind the sheeting to prevent it from deflecting.

Once a stud, (sheeting support), spacing is determined, we can calculate the lateral form pressure into a continuous uniform load being taken by this stud.

Knowing this continuous uniform load on the stud allows us to determine a tie spacing on a Single Waler System or a waler, (strong back), spacing for Double Waler Systems.

Once all spacings are determined, you can calculate the tie loads.

EXAMPLE #3

Using the previous example lets assume you were building form panels in lieu of loose lumber forming. Your panels are built at:

10’ 0” High X 20’ 0” Long **Pour Rate 5’/Hr**
3/4 MDO Plywood **Temp 70º**
2 X 6 Studs on 10” Centers
2 X 6 Walers **P = 150 = 5 X 9000 = 793 PSF**
70

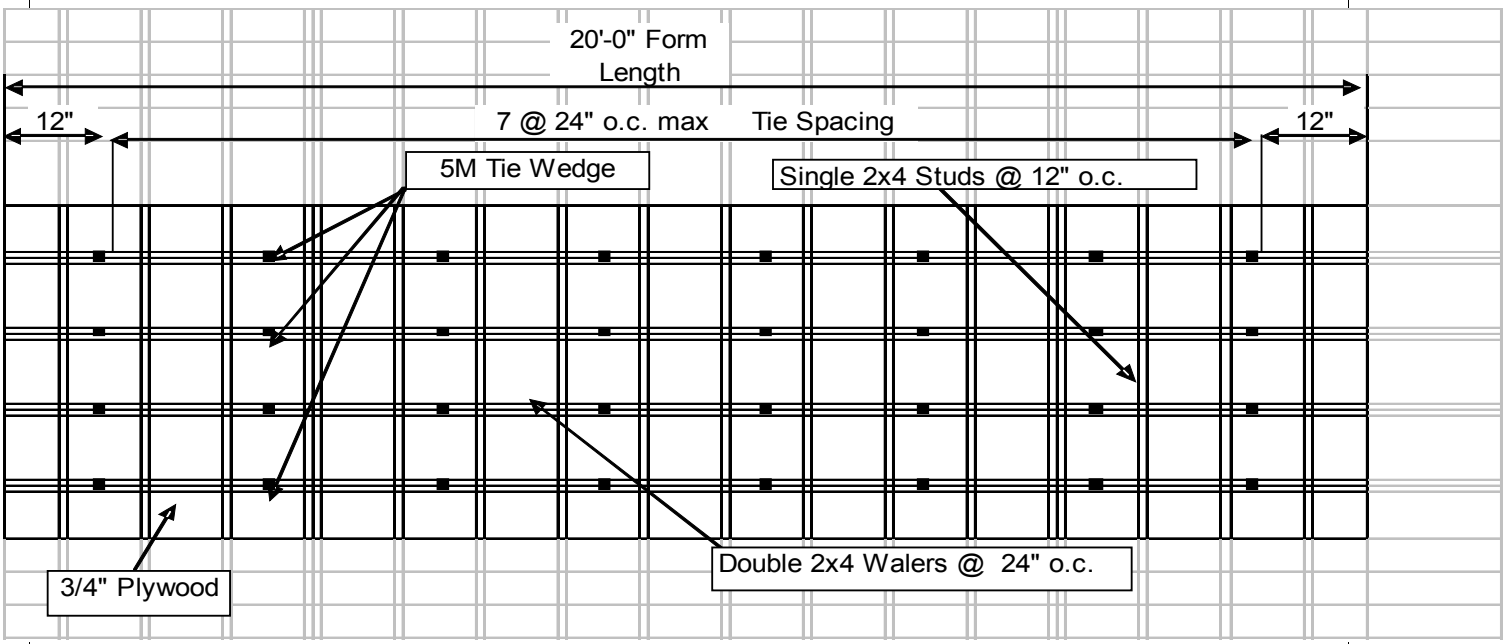
793 x .833 = 1321#/LF IN THE 2 X 6 STUD

Using the chart on page___ , under the 2 X 6 column at1300 lb/lf shows a spacing of 41” O.C. to support these 2 X 6 studs.

793 x 3.416 = 2709 lb/lf uniform load transferred to the double 2 X 6 waler. Using the chart on page ___, we determine these walers need to be supported at 20” O.C.

The spacing is 20” X 41” O.C. OR 1.67 X 3.416 = 5.70/SF

5.70 x 793 = 4523#/Per Tie



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Calculating the lateral form pressures in columns is similar to wall forms with slight variations. Smaller columns tend to be poured at full liquid height that requires the equation 150H to calculate lateral form pressures. Assuming a 15'-0" tall column.

$$P = 150 \times 15 = 2250 \text{ PSF}$$

Since most columns are poured full liquid head, it is reasonable to prepare your formwork for these pressures.

In the event that your column size will not allow for full liquid head be aware of the different equations for calculating lateral form pressures, based on your planned placement rate.

BELOW 7'/HR	7'/HR AND ABOVE
$P = 150 + \frac{R9000}{T}$	$P = 150 + 43{,}400 + \frac{2800R}{T}$

If your column slopes or batters you must consider uplift loading in your design, (see Battered Walls).

If pumping the column from the bottom is required, Sub It Out!!

This type of placement creates tremendous pressures within the formwork and must be carefully considered and designed by a registered engineer.

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Load gathering job built systems, simply mean you design in larger supporting members to eliminate deflection at higher loads. In this section, you will see an example of how to increase your tie spacings and reduce your labor while maintaining or increasing your placement pour rates. In the following example, we will design our form for full liquid head or 8' per hour pour rate.

Utilize 7-ply plyform and aluminum stringers (studs), and double 8" aluminum walers we can achieve fast setting, fast pouring, fast stripping gang form.

GANG SIZE:	**8' HIGH X 24' WIDE**
PLYWOOD:	**¾" 7-PLY PLYFORM**
STUD:	**J-400 ALUMINUM JOIST**
WALER:	**8" DOUBLE ALUMINUM WALER**

LATERAL FORM PRESSURE

$$P = 150 + \frac{43{,}400}{T} + \frac{2800R}{T}$$

P = 150 + 620 + 320

P = 1090 PSF

To calculate the uniform load transferred to the stud we multiply the lateral pressure by the stud spacing.

1090 X 1.0 = 1090 LB/LF

To calculate the uniform load transferred to the stud we multiply the lateral load by the waler spacing.

1090 X 8.0 = 8720 LB/LF

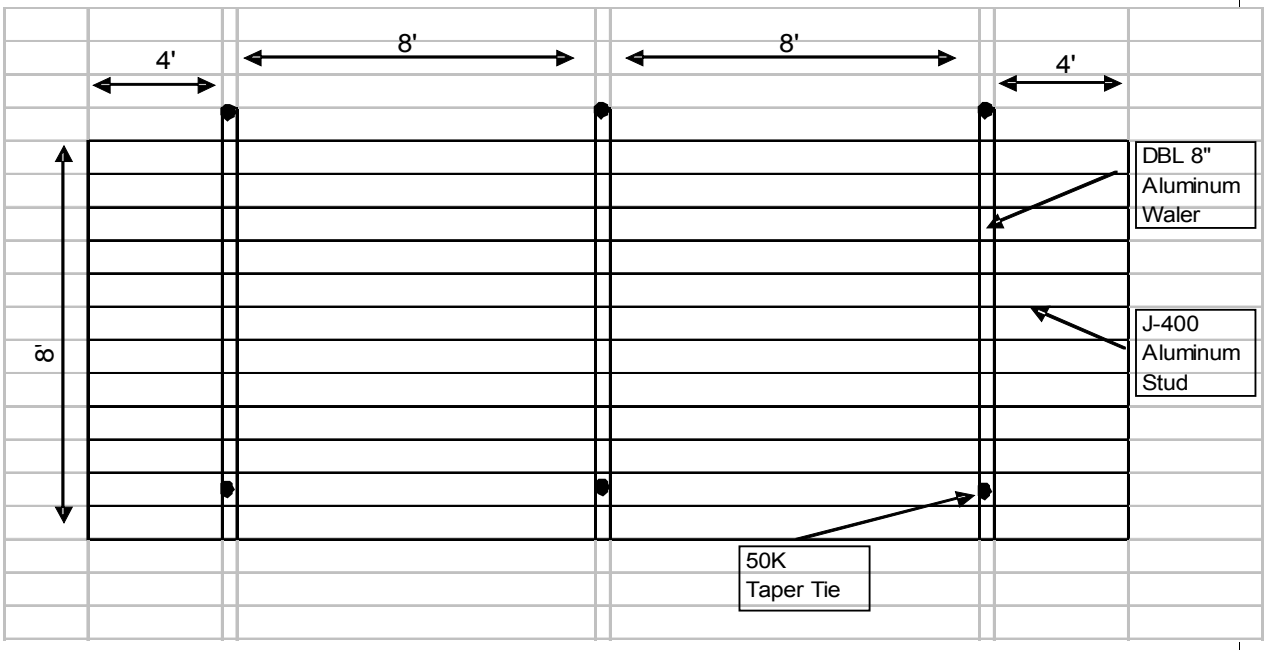
To calculate the tie load we multiply the SF of wall being collected by each tie and multiply this SF by the lateral load.

In this example we are told by patent that our tie spacing is 8'–0" x 4'–0".

Each tie collects 32/sf of wall

32 x 1090 = 34,880 LB/Tie Load

Gang Form – Aluminum Supports



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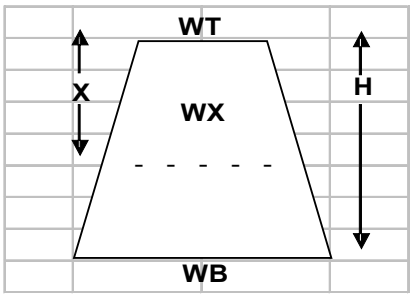
Let's walk through an example of calculating tie lengths on battered walls. Using the equation:

$$WX = WT \times \frac{WB-WT}{H}$$

ASSUMING
WT = 12"
WB = 24"
H = 10'-0"



We will solve WX using various X factors.

X = 5'-0"

$$WX = 12 + 60 \mid \frac{24-12}{120}$$

WX = 18

****

X = 7'-0"

$$WX = 12 + 96 \mid \frac{24-12}{120}$$

WX = 21.6"

****

X = 9'-6"

$$WX = 12 + 114 \mid \frac{24-12}{120}$$

WX = 23.4"

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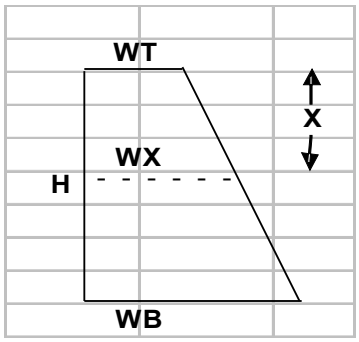
We can apply the same formula to single sided battered walls.

WT = 12”
WB = 24”
H = 10’-0”



X = 5’-0”

$$WX = 12 + 60 \;\Big|\; \frac{24-12}{120}$$

WX = 18”

Remember this calculates the **Concrete Dimension Only**. Be sure to add your forming material and wedge or bracket space requirements to your tie length if you’re using snap ties.

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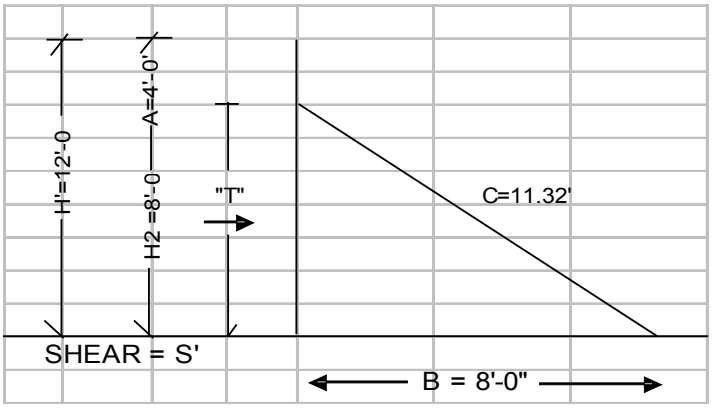
When designing single sided, truss type forming systems you must consider two additional forces, uplift and shear. Below are the calculations to estimate these forces.

ASSUMING: LATERAL LOAD = 600 PSF



1 Calculate Shear Load = AP

S' = 4'-0" x 600 = 2400#

2. Calculate Tributary Load PH^2

T = 8'-0" x 600 = 4800#

3. Solve "C"

$$\mathbf{C = \sqrt{H^2 + B^2} = \sqrt{128} = 11.32'}$$

4. Solve "Y"

$$\frac{\mathbf{T}}{\mathbf{H^2}} \Big| \mathbf{C} = \frac{\mathbf{4800}}{\mathbf{8}} \mathbf{X} \ \mathbf{11.32 = 6792\#/LF}$$

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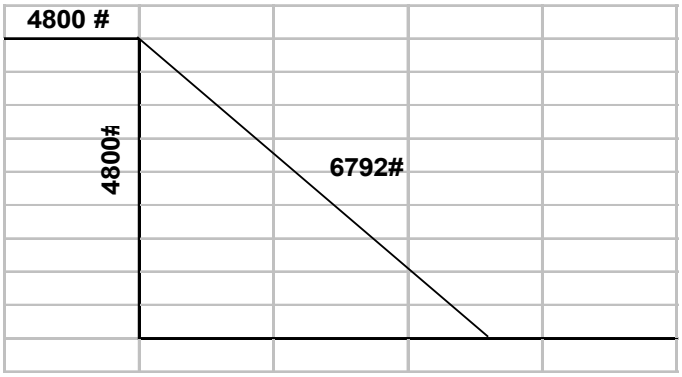
Assuming a brace spacing of 3'-0" O.C. Your brace load is calculated:

Y3 = 20,376#LF

We can now look at shear and uplift loads.



1. Shear load at the slab is solved

   S' + T = 2400 + 4800 = 7200#/LF

2. Uplift is solved

   U = PH² = 600 x 8 = 4800#/LF

Assuming a connection devise spaced at 8'-0" O.C. Your anchoring requirements are:

U x Spacing = 4800 x 8 = 38,400#/ea anchor

8' x Spacing = 7200 x 8 = 57,600#/ea anchor