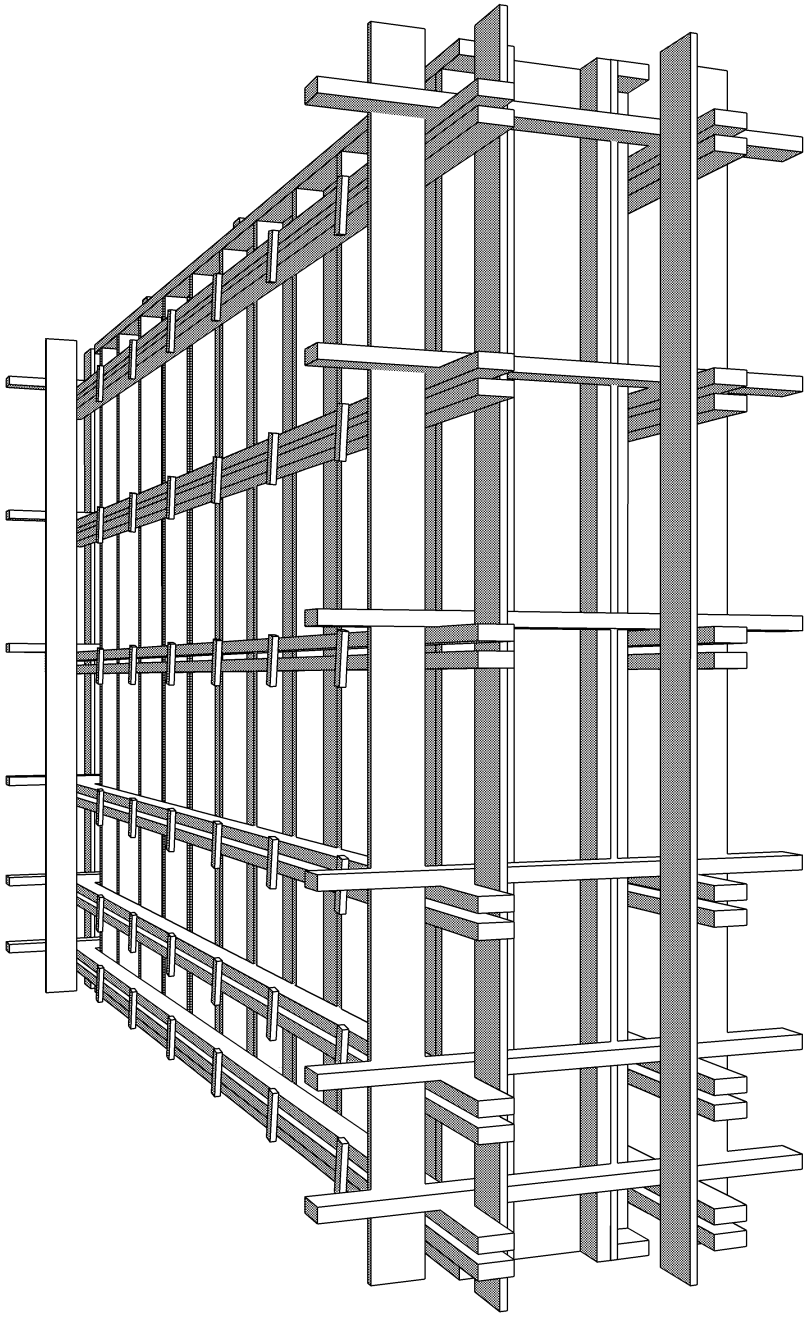
CONCRETE FORMWORK 007



Carpenters Training Committee for Northern California (CTCNC)

CARPENTER APPRENTICESHIP PROGRAM

Course of Instruction

Year	Class#	Class Title (All classes 36 hours - Four (4) Days)
1	001	Introduction to Apprenticeship I
	002	Introduction to Apprenticeship II **(UBC Fall Protection, UBC Scaffold User, UBC MEWP & Discrimination in the Workplace, Union Benefits Presentation)**
	004	Foundations & Floors
	006	Wood Framing
2	019	Rigging **(This is a Non-Qualification Course)**
	005	Blueprint Reading – Basic
	007	Concrete Formwork **(NCCRC Certification)**
	009	Blueprint Reading – Advanced
3	012	Layout Instruments
	013	Engineered Structural Systems **(UBC Powered Industrial Truck Operator – Rough Terrain)**
	010	Concrete Bridge Building **(NCCRC Certification)**
	017	Introduction to Welding & Cutting
4	014	Commercial Steel Framing
	018	Commercial Concrete
	011	Interior Finish
	008	Exterior Finish
	015	Stair Building
	016	Roof Framing

007
CONCRETE FORMWORK

Carpenters Training
Committee for Northern
California

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7/1/97,

Revisions

8/1/97/.llr, 9/12/97 .llr, 6/1/98 .llr

6/1/00

Revised 4/08/15 .rh

COURSE OBJECTIVES

At the end of the lesson the student will be able to recognize and use the correct terminology employed in form construction. The student will be able to plan, construct, erect, and strip a variety of forms in a safe manner.

SPECIFIC OBJECTIVES

Upon completion of this unit the student will be able to:

1. Identify the common types of form material and hardware used in concrete form construction.
2. Recognize the purpose of bucks and blockouts.
3. Correctly construct, install and strip a blockout.
4. Build a form to a standard form detail.
5. Plan, construct, erect, and dismantle single waler wall forms in a safe manner.
6. Plan, construct, erect, and dismantle double waler wall forms in a safe manner.
7. Construct a pilaster as part of a wall form.
8. Plan, construct, erect, and dismantle concrete stair forms in a safe manner.

CARPENTERS TRAINING COMMITTEE

FOR NORTHERN CALIFORNIA

SEXUAL HARASSMENT & APPRENTICE CONDUCT

Sexual harassment in any form or degree by an employee or apprentice against another individual, regardless of their relationship or respective status, is strictly against the policy of the Carpenters Training Committee for Northern California and will not be tolerated. Any such action or activity shall be reported immediately to the person in charge of the training facility. The matter will be promptly investigated and appropriate action will be taken. Copies of all complaints and actions are to be forwarded to the Assistant Director of Field Operations.

Apprentices shall not use lewd and vulgar language while they are on the premises of the Carpenter's Training Center. Any such action shall be reported immediately to the person in charge of the training facility. The matter will be promptly investigated and appropriate action will be taken.

Any person violating the above policies shall be subject to disciplinary action, which may include suspension or expulsion from the training center and/or cancellation from the program.

JB:llr
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CARPENTER APPRENTICE TOOL LIST

Minimum of tools required <u>before</u> dispatch as Carpenter should include

1. Tool Box - 12″ x 12″ x 32″ (wood or metal, should be lockable)
2. Carpenters Pencils and Keil (lumber crayon)
3. Chalk Box with Chalk
4. Measuring Tape 1″ x 20′ min.
5. Combination Square
6. Framing Hammer, 16 or 20 oz.
7. OSHA approved Eye Protection
8. Carpenters Overalls or Nail Belt with two leather pouches
9. Hand Saw, 8 pt. Cross Cut
10. Wood Chisel, $^{3}/_{4}$″ min.
11. Pliers, 8″ Side Cutters
12. Screwdriver, 8″
13. Utility Knife
14. Nail Puller, "Cat's Paw"
15. Nail Bar

Additional tools to be obtained as the employer requires or class requires:

1. Hand Saw, 8 pt. Cross cut (spare)
2. Hand Saw, 10 or 11 pt.
3. Claw Hammer, 16 oz. curved claw
4. Hand Level, 24″ or 28″
5. Framing Square with rafter tables
6. Wood Chisels, $^{1}/_{2}$″ through $1^{1}/_{2}$″
7. Brace
8. Wood bits, #6, #8, #9, #13, #14, #16
9. Wrench, 12″ adjustable open end
10. Block Plane
11. Sharpening Stone
12. Hand Axe, Carpenters
13. Layout Tape, 50′ min.
14. Plumb Bob, 16 oz.
15. Nail Sets, as required
16. Stripping Bar, 30″ min.
17. Straight Cut Aviation Snip

Failure on the part of the student to obtain these <u>required</u> tools could result in:

1. A delay in wage re-rates until requirements are met.
2. Possible job termination for failure to supply proper hand tools.

* You are encouraged to purchase one (1) tool a week to spread out the cost. Tools required for specific classes (listed in class notice) are <u>mandatory</u> and must be in your possession.

opeiu-3-afl-cio-211/llr
Revised: 06/01/98

Form #139-C

CARPENTERS GRADING AND EVALUATION SCHEDULE

Grading

A uniform weighing system will be used as follows:

1. Class Participation and Attitude 10%
2. All Tests Except Final Exam 10%
3. Manipulative Lessons 50%
4. Final Exam 30%

Assignment of grades will be as follows:

A. 92 -100%

B. 82 - 91%

C. 73 - 81%

D. 68 - 72%

E. Less than 68%

Criteria for Evaluation

1. Safe Work Practices
2. Accuracy
3. Speed
4. Fastening
5. Plan Reading

Date Instructor Name

PRE-TEST
007 - CONCRETE FORMWORK

Instructions: Circle whether each question is True or False.

1.	T	F	A device called a "batter board" is used to locate concrete forms accurately on the job site.
2.	T	F	Batter boards are placed on the building line.
3.	T	F	Plywood is generally not used for architectural concrete forms.
4.	T	F	Redwood is a good material for architectural form work.
5.	T	F	A section view on blueprints reveals what would be seen if the object were "cut" through.
6.	T	F	The type of footing and foundation needed for a structure has little to do with the soil conditions upon which they rest.
7.	T	F	In a concrete slab the effect of climate change is controlled by a device called an expansion joint.
8.	T	F	Expansion joint material can be a tarred felt strip as used in sidewalks and concrete floor slabs.
9.	T	F	A cubic yard of concrete contains 27 cubic feet.
10.	T	F	Plyform is a special plywood manufactured for concrete forms.
11.	T	F	Concrete should always be "placed" not "poured".
12.	T	F	After adding water to a concrete mix it should be placed within 1-1/2 hours.
13.	T	F	Concrete columns do not require reinforcing steel.
14.	T	F	When aligning a wall form, always start at the middle of the wall and work toward each end.
15.	T	F	When using a plumb bob to align a wall, care must be exercised to compensate for "Magnetic North"
16.	T	F	Walers are wall alignment devices.

17.	T	F	Walers are usually installed in pairs.
18.	T	F	A single wall form, due to reduced load pressure, will require only half as much bracing as a double wall form.
19.	T	F	Forms for beams and girders must be well supported by shores before the concrete is poured.
20.	T	F	When a guard rail is required on a scaffold, the top rail shall be install between 42 inches and 45 inches above the platform?
21.	T	F	Use a small stripping bar between a form panel and the concrete surface to strip the panel.
22.	T	F	In general, forms should be stripped in the same order as erection
23.	T	F	The plywood sheathing is fastened plywood grain is parallel to the studs for maximum strength.
24.	T	F	The stress concrete places on bucks and blockout is called tension.
25.	T	F	The concrete placed between two horizontal construction joints is called a lift.

Chapter 1 Single Waler Form Construction

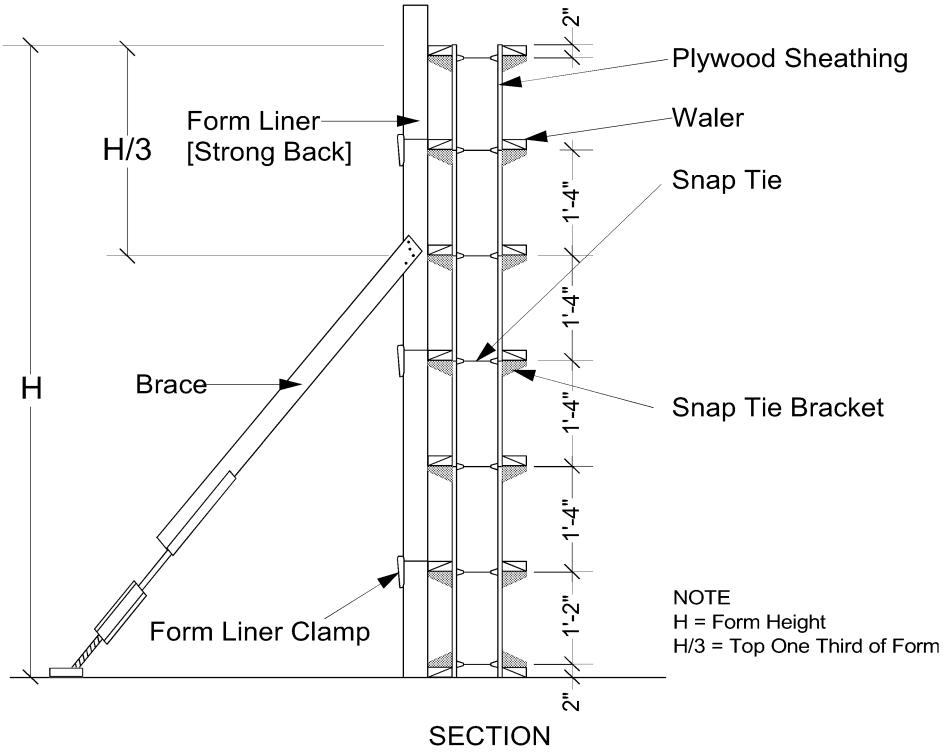
THIS CHAPTER IS PLANNED TO PROVIDE ANSWERS TO THE FOLLOWING QUESTIONS:

- **What is the purpose of a form?**
- **What must the carpenter consider during form construction?**
- **What is a single waler form?**
- **What part of the form contains the concrete pressure?**

INTRODUCTION

The form is the structure that gives the concrete it's final size, shape and location. The quality of the final concrete structure depends upon the quality of the workmanship achieved in the construction of the forms. Although it is a temporary structure, it must be accurately built and rigid enough resisted the pressure of the concrete. Also, the form must support it's own weight; and it must safely support the weight of the people and machinery used to place the concrete.

Fig. 1-1 Single Waler Form Components



SINGLE WALER FORMS

Concrete forms are often built in place using the single waler forming system. The forms are assembled piece by piece using plywood and walers. Both straight and curve walls can be formed. The walers may be installed horizontally or vertically.

It is a modular system using regular 4′ x 8′ plywood sheets and plywood filler panels. The plywood panels are usually installed vertically so the grain of the plywood is at a right angle to the waler. The filler panels are used to make up dimensions that are not increments of four feet.

The concrete pressure is contained by using snap ties and walers. The forms are aligned vertically using form liners and form liner clamps. Braces are used to keep the forms plumb and straight.

Figure 1-1 shows the form in section view. It is important you learn the correct terminology when working with forming systems. Normally $^{3}/_{4}$″ plywood is used. The snap ties are spaced 16″ vertically and 24″ horizontally. This spacing will be changed if the concrete pressures are abnormally high.

MATH FOR THIS CHAPTER

After the form has been built, concrete will have to be ordered.

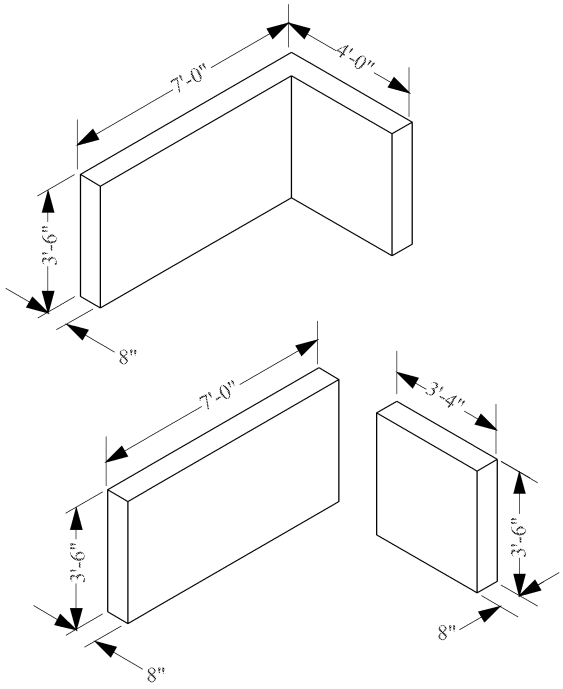
The carpenter Foreman will often determine the quantity of concrete required.

Concrete walls are usually a rectangular shape.

The formula for the volume of a rectangular solids is V=LxWxH.

If the wall has a complex shape, separate the structure into simple rectangular solids. Find the volume of each shape. Add the volumes together.

Fig. 1-2 Example



V = LxWxH
V = 7′-0″ x 8″ x 3′-6″
V = 7′ x 0.67′ x 3.5′
V = 16.42 cu ft.

V = LxWxH
V = 3′-4″ x 8″ x 3′-6″
V = 3.33′ x 0.67′ x 3.5′
V = 7.80 cu ft.

V(total) = 16.42 cu ft. + 7.80 cu ft.
V(total) = 24.23 cu ft.

To convert cubic feet of concrete to cubic yards divide by 27 cubic feet per cubic yard.

V(total) = 24.23 cu ft. ÷ 27

V(total) = 0.9 cu yd

Order 1 cu. yd.

Lesson 1 Single Waler Form Construction

INTRODUCTION

In this lesson you will build a single waler form. Carpenters construct concrete wall forms with three major forming systems. They are single waler forms, double waler forms, and gang forms. On a construction site; one, two or all three may be used.

LESSON OBJECTIVES

Working as a member of a team, each student will layout and erect a concrete form using a single waler forming system.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. Use the plan provided to lay out a concrete wall.
2. Layout snap tie holes and gang drill panels.
3. Determine the size and location of filler panels.
4. In a logical sequence, safely erect panels, install snap ties, snap tie brackets, walers, and form liners.
5. Plumb and brace the forms.
6. Install bulks heads.
7. Use a plan and elevation to determine the volume of concrete required for a concrete wall.

APPLICATION IN THE FIELD

When the concrete wall being constructed is one of a kind, single waler forms are often used. Also a curved or round wall is readily formed with the single waler forming system. Since the form is assembled piece by piece, it is a practicable method to build formwork when lifting equipment is not available. A carpenter must be prepared to perform this work.

EVALUATION:

A post test will be administered after the lesson is completed. Each student will be evaluated on their participation in the construction, the quality of their work, and the score on the post test.

EQUIPMENT

To be supplied by the training facility [per 4 to 5 students]

1. Two skill saws
2. Two extension cords
3. Two pair saw horses
4. One $^{1}/_{2}$″ drill motor
5. One $^{9}/_{16}$″ ∅ auger bit

STUDENT TOOLS

1. One [1] 16 or 20 ounce smooth face hammer
2. One [1] pocket tape measure
3. One [1] sharp 8 point cross cut saw
4. One [1] 24″ level
5. One [1] combination square or speed square
6. One [1] pencil
7. One [1] chalk box with chalk

PROCEDURES

The order in which the forms are erected is very important. The basic sequence is as follows. First completely erect, brace and plumb the outside forms. Then install the bulkheads and establish the top of concrete (TOC). At this point on the job site, the iron workers will install the reinforcing steel, then the carpenters will double up the inside forms, finish installing the walers, and install the lacing.

Use the plans provided and the following instructions to build a single waler form.

1. Layout concrete wall lines

   Layout the outside edge of the concrete wall on the footing.
   Layout the inside edge of the concrete wall on the footing.
   Using a chalk line mark the lines.
   Use a framing square and tape measure to layout the ends of the wall.
   Use a chalk box to mark the lines, lapping the wall lines 6 to 8 inches.
   Use 3-4-5 triangle to check corner for square. (as shown in Fig. 1-1)

Fig. 1-1

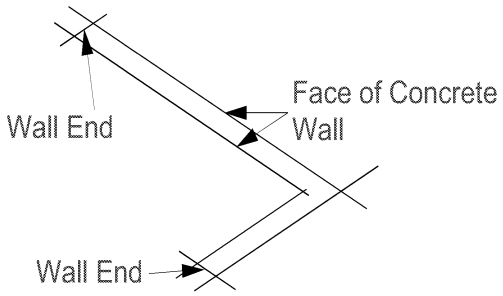


Fig. 1-2

2. Gang drill snap tie holes.

   Count the number of $^{5}/_{8}$″ plywood sheets needed for the job and stack them with the edges flush.

   Using the drawings provided, layout snap tie holes on the top sheet.

   Drill stacked plywood sheets with a $^{9}/_{16}$″ Ø drill bit. (as shown in Fig. 1-2)

To maintain control of a $^{1}/_{2}$″ drill motor use an extension handle

Fig. 1-3

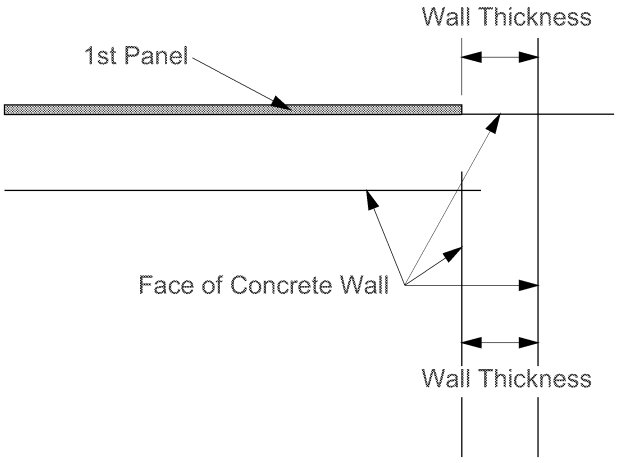
3. Fasten 2x4 starter plate to the footing.

Set a 2x4 on the footing $^{5}/_{8}$″ (the plywood thickness) back from outside face of concrete.

Use a powdered actuated tool or a concrete nail to fasten the 2x4 to the footing.
(as shown in Fig. 1-3)

Fig. 1-4

4. Install first plywood panel.



Start at a corner.
Use a tape measure to transfer the inside face of the concrete wall to the outside concrete line.
Set panel corner to this mark.
Use a level to plumb the panel.
Fasten the panel to the kicker.
Brace first sheet.
(as shown in Fig. 1-4)

5. Continue to install regular panels.

Fasten them to the starter plate with a couple nails or a snap tie and a snap tie bracket installed upside down. (as shown in Fig. 1-5)

To keep the plywood panel joints tight and prevent leaks, cleat adjacent panels.

Fig. 1-5

Brace panels as they are erected.

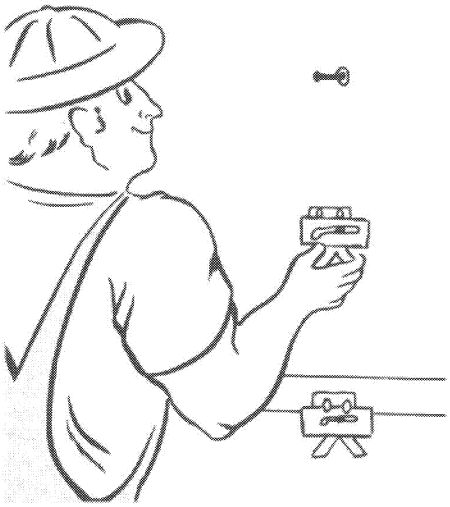
6. Install snap ties.

Place short end snap ties through the pre-drilled holes. (as shown in Fig. 1-6)

Fig. 1-6

7. Install walers.

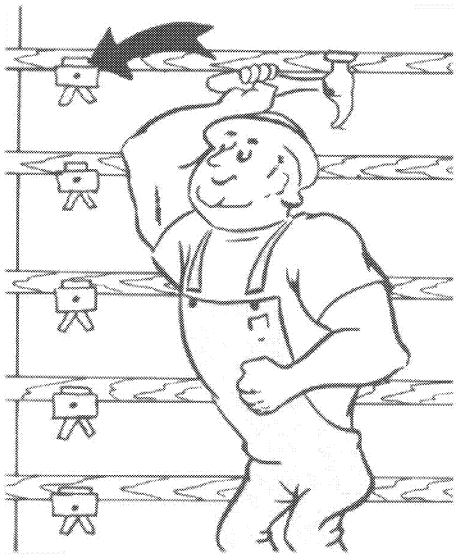
Fig. 1-7



Attach snap brackets and hand tighten one row.
Install 2x4 waler. (as shown in Fig. 1-7)
Extend wales at least one foot beyond the ends of the concrete wall.
Proceed to next row and repeat.

Fig. 1-8

8. Tighten snap tie wedges.



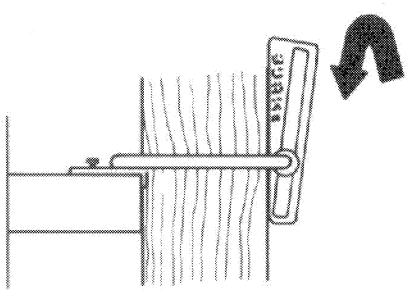
Tighten snap tie bracket wedge with a hammer. Because you can damage and weaken the snap tie, do not over tighten the wedge.
Secure wedge with a 6 penny nail into the waler. Do not drive the nail home. The purpose of the nail is to prevent the wedge from vibrating loose.(as shown in Fig. 1-8)

9. Install filler panel.

Determine the filler panel width by adding the concrete wall thickness and the plywood panel thickness. Do not cut the filler panel from the pre-drilled sheets.
Lightly nail the filler panel to the walers with 6 or 8 penny box nails.

Fig. 1-9

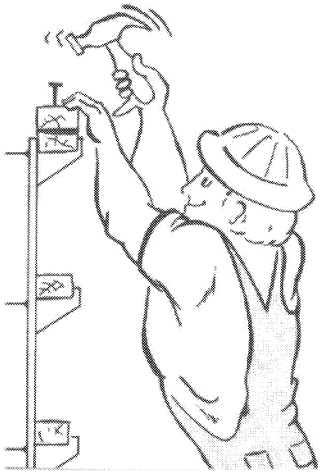
10. Install 2x4 strong backs.



Strong backs are used to align and not strengthen the forms.
They are usually used on one side only.
They are spaced about 6 feet horizontally.
Attach liner clamps to the waler with two 8 penny duplex nails.
Install 2x4 through the open side of the liner clamp with the wedge hanging loose.
Rotate the wedge and tighten with a hammer. (as shown in Fig. 1-9)

Fig. 1-10

11. Walls over 8′
[4′ for our project]



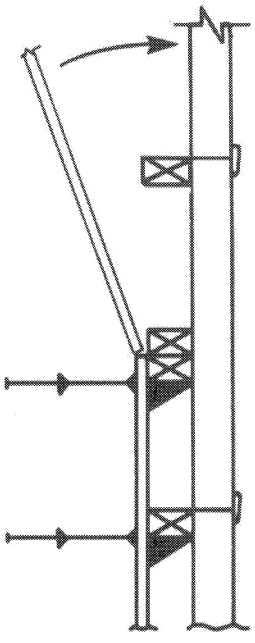
Install vertical strong back to full height.

Nail a 2x4 to the top waler to act as a starter plate for the plywood above.

Attach one waler to vertical strong back with liner clamps at the proper level to engage a row of ties.

Plywood then can be set in place and easily secured with a few ties and snap tie brackets.

Use scaffold as required.
(as shown in Fig. 1-10)



12. Plumb and brace both wall form ends.

13. Form adjacent wall.

Fasten 2x4 starter plate to the footing.
Install filler panel (Determine the filler panel width by adding the concrete wall thickness and the plywood panel thickness).
Install regular 4 foot panels.
Install snap tie brackets and walers.
Plumb and secure both wall form ends.

14. Install bulk heads.

Nail through plywood into bulk head 2x4's with 8 penny duplex nails spaced 6 to 8 inches O.C.

15. Establish top of concrete

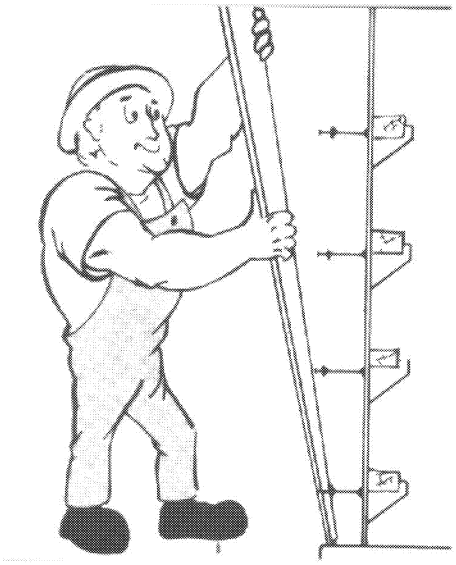
Use a builder's or electronic level to layout T.O.C.
Use a chalk box to mark top of concrete.

16. Double up inside forms

To double up the inside form panels, thread the plywood over the snap ties.

Hand the brackets and install the waler, snapping the brackets into position for the final tightening. (as shown in Fig. 1-11)

Fig. 1-11



17. Lace the bulk heads.

At the wall end place a 2x4 on top of and at right angles to each pair of walers. Extend the 2x4 8 to 12 inches past the walers.
Lace in both directions and both sides with 1x6. Use 3 - 8 penny duplex nails at each waler pair.
If there is a gap between the 1x6 and the 2x4, wedge with a feather wedge.

18. Secure the outside corner.

At the outside corner nail the over lapping walers together with 3 -16 penny duplex nails.
Lace in both directions and both sides with 1x6. Use 3 - 8 penny duplex nails at each waler.

DO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT

SINGLE WALER FORM

Do's	• Pre drill panels with $^{9}/_{16}$″ Ø drill bit. • Install panels at right angle to the walers. • Use filler panels. • Attach panels to starter plate with snap tie bracket installed upside down. • Secure snap tie bracket to the waler with a nail.
Don'ts	• Do not cut the pre drilled regular 4′ panels. • Do not over tighten snap tie brackets. • Do not allow snap tie holes in opposite panels to be offset.

NOTES:

Chapter 2 Bucks and Blockouts

THIS CHAPTER IS PLANNED TO PROVIDE ANSWERS TO THE FOLLOWING QUESTIONS:

- **Where are bucks and blockouts used?**
- **What type of stress will the plastic concrete exert on bucks and blockouts?**
- **What factors are considered in buck and blockout construction?**

INTRODUCTION

There must be some provision for the installation of doors and windows in a concrete wall. Mechanical heating and cooling ducts, plumbing pipes, fire sprinkler lines, electrical conduit, and other services will pass through concrete walls and floors. Also steel beams, wood beams, and metal decks will set in pockets or recesses in the concrete walls. It is not convenient or efficient to install these materials and then place the concrete around them. An opening is provided in the concrete wall to accommodate them. This opening is created by a form called a buck for a door or window and a blockout for other openings.

CONSTRUCTION

Both bucks and blockouts must be built rigid enough so they are not distorted by the pressure of the plastic concrete around them. The concrete will compress the form and can collapse it. Bucks and blockouts must be constructed to resist this compression and still be easy to remove (that is strip) after the concrete has hardened. Also, the form must be tight to prevent cement paste leakage.

DOOR BUCKS

Using the plans, the foreman will provide the carpenter with buck width and height, and the wall thickness. The carpenter will build the buck.

Bucks can be constructed with either 2 inch nominal material or with thinner sheathing supported by a 2x4 frame. The latter is called a built up buck; and it is the most common in Northern California.

We will illustrate a method of constructing a built up door buck.

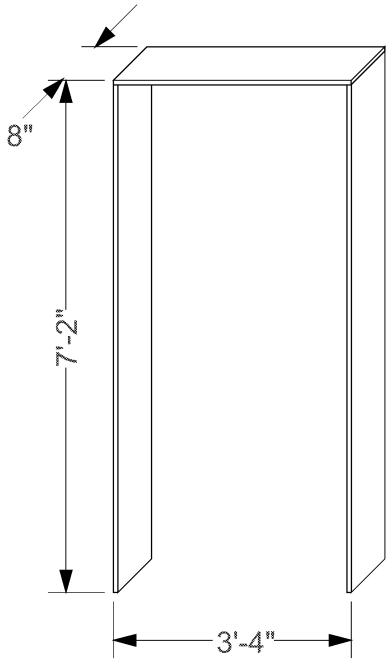


Fig. 2-1 The plywood sheathing gives the shape to the opening

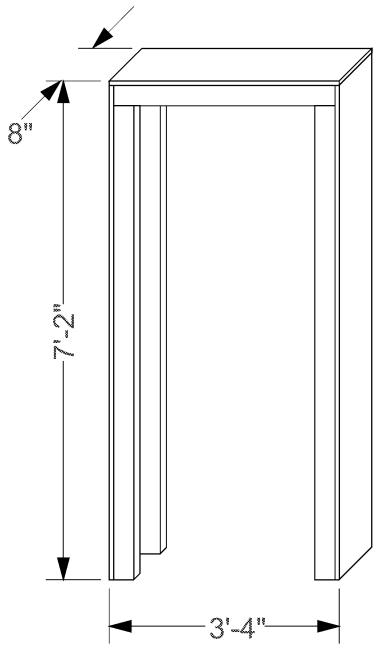


Fig. 2-2 2x4's provide rigidity to the sheathing.

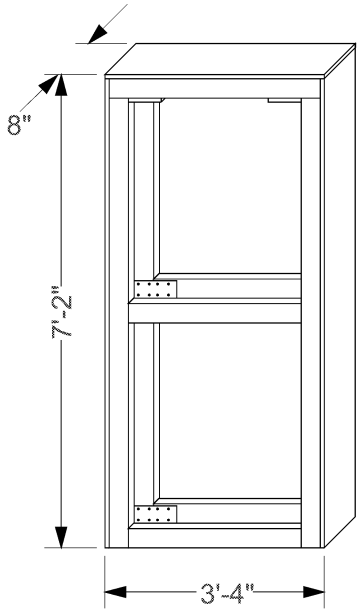


Fig. 2-3 2x4 spreaders prevent the buck from collapsing.

When installing the 2x4 spreaders (Figure 2-3) nail cleats across butt joints. Do not toe nail because toe nails are more difficult to strip. Since they are easy to remove, use duplex nails when ever possible.

Build the frame and then apply the sheathing. Nail the sheathing to the frame with box nails. Do not nail sheathing to sheathing; because it makes it more difficult to strip.

BLOCKOUT

Blockouts are used to provide openings in concrete walls and floors for the material and equipment installed by mechanics in other trades. The subcontractor will provide the opening dimensions and locations; the carpenter will build and install the blockout.

As with a buck, a blockout can be constructed with either 2 inch nominal material or with thinner sheathing supported by a 2x4 frame. The blockout is built similar to a door buck. However it may be more difficult to strip since the pieces of sheathing are shorter and are more likely to be wedged between the concrete sides of the opening. A way to eliminate this problem is to cut the sheathing. This cut is sometimes called a courtesy cut. There are a number of different ways to provide this cut. See Figure 2-4 for some examples

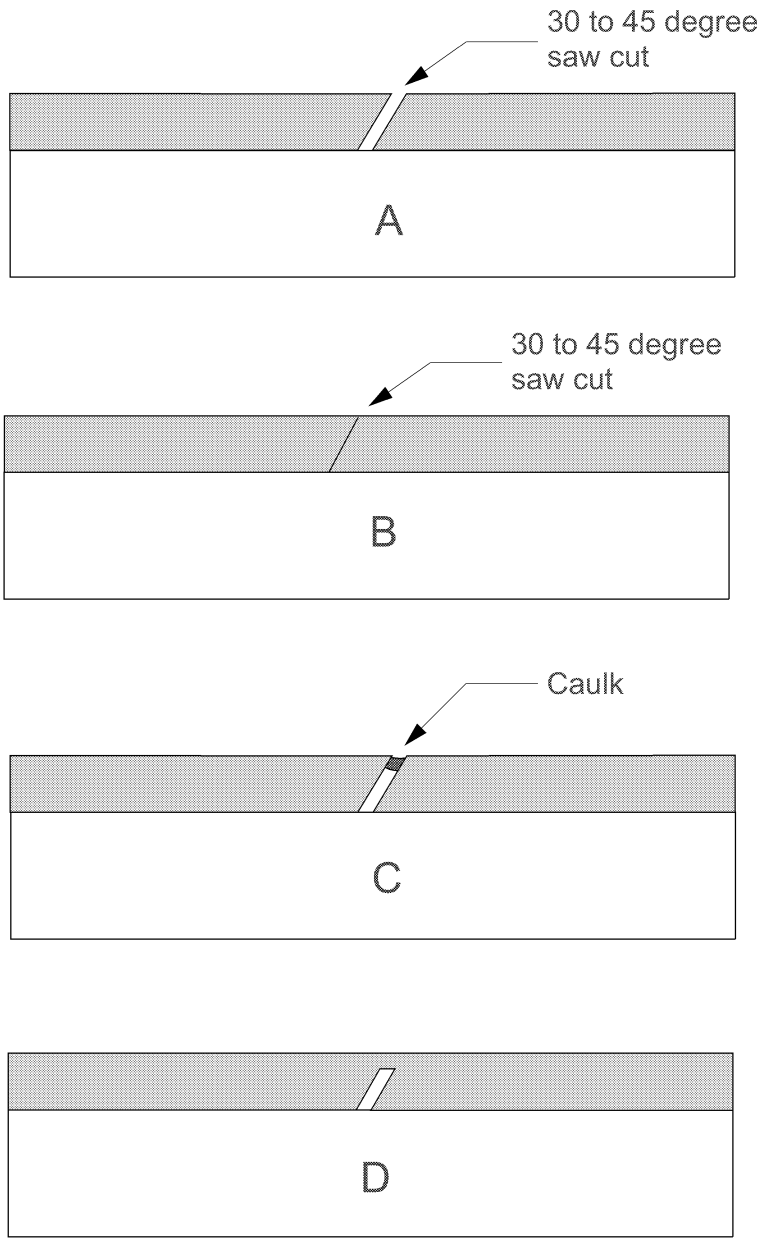


Fig. 2-4

MATH FOR THIS CHAPTER

Only fractions with the same, or common, denominators can be added and subtracted.

$^1/_5 + {}^1/_5 = {}^2/_5$

When the denominators are the same, add the numerators and write the sum over the denominator.

$^2/_3 - {}^1/_3 = {}^1/_3$

When the denominators are the same, subtract the numerators and write the difference over the denominator.

When the denominators are different, the fractions must be converted to equivalent fractions having the same denominator.

For example add together the thickness of three different materials in Figure 2-5.

$^1/_4" + {}^1/_2" + {}^3/_{16}"$

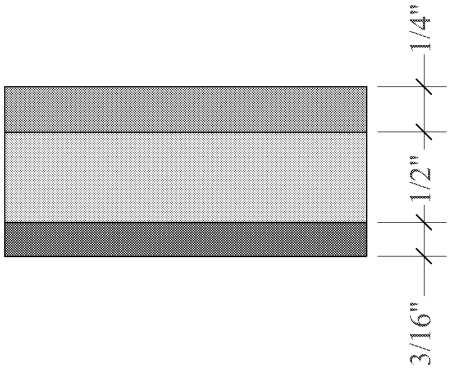


Fig. 2-5

Find the sum of: $^1/_4 + {}^1/_2 + {}^3/_{16} =$

First find the common denominator of $^1/_4$, $^1/_2$ & $^3/_{16}$.

16 is the smallest number that can be evenly divided by 2, 4 & 16. So 16 is the common denominator.

Second, convert each fraction to a fraction with the common denominator.

$16 \div 4 = 4$ then $^1/_4 = {}^4/_{16}$

$16 \div 2 = 8$ then $^1/_2 = {}^8/_{16}$

$16 \div 16 = 1$ then $^3/_{16} = {}^3/_{16}$

Add the fractions together.

$^4/_{16} + {}^8/_{16} + {}^3/_{16} = {}^{15}/_{16}$

In the example the numerator was smaller than the denominator so the fraction is called a proper fraction.

Often the answers will have the number in the numerator will be larger than the number in the denominator. The fraction is then called an improper fraction.

Sometimes the answers will have both whole numbers and fractions. These numbers are called mixed numbers.

Examples:

proper fraction: $^{15}/_{16}$

improper fraction: $^{19}/_{16}$

mixed number: $1^3/_{16}$

To convert a improper fraction into a mixed number divide the numerator by the denominator and express the remainder as a fraction.

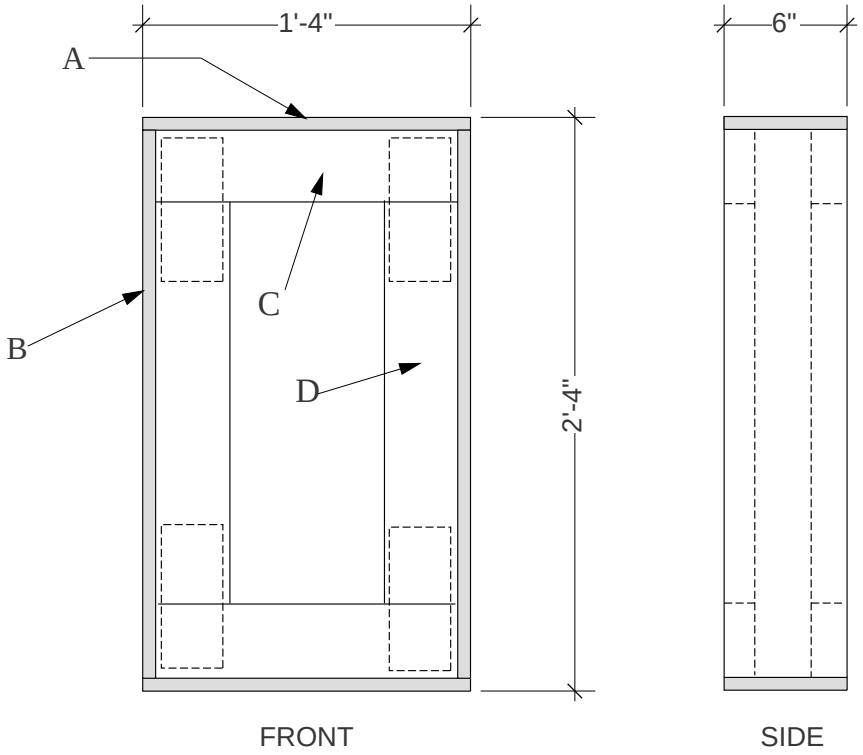
EXERCISE

INSTRUCTIONS FOR EXERCISE

Determine the length and width of the two piecesof sheathing (indicated by the letters A & B).

Also, determine the length width of the 2x4 frame components (indicated by C & D).

The sheathing is $^{3}/_{4}$″ plywood.



A _____

B _____

C _____

D _____

NOTES:

Lesson 2 Blockouts

INTRODUCTION

In this lesson you will build a blockout. Blockouts provide notches, recesses, and all openings in concrete walls [except doors and windows]. Blockouts can be formed from different materials and assembled in different ways.

LESSON OBJECTIVES

Each student will construct a blockout in such a manner that it may be stripped at a later date.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. Use the drawings provided to construct a blockout to the dimensions indicated.
2. Determine the dimensions of the blockout components.
3. Assembled the blockout so it will retain its shape until the plastic concrete has set, that is harden.
4. Make provisions so the blockout is easily stripped.

APPLICATION IN THE FIELD

Although the openings created by blockouts are used by the other trades, they are built and installed by the carpenter. They are installed in nearly every concrete structure. In addition to building the blockout, the carpenter will be required to strip it. Skilled carpenters use their ingenuity to make that job as efficient as possible.

EVALUATION:

A post test will be administered after the lesson is completed. Each student will be evaluated on their participation in the construction, the quality of their work, and the score on the post test.

EQUIPMENT

To be supplied by the training facility [per 4 to 5 students]

1. One skill saw
2. One extension cord
3. One pair saw horses
4. One chamfer shear or dove tail saw

STUDENT TOOLS

1. One [1] 16 or 20 ounce smooth face hammer
2. One [1] pocket tape measure
3. One [1] sharp 8 point cross cut saw
4. One [1] combination square or speed square
5. One [1] pencil

PROCEDURES

Use the plans provided and the following directions to build a blockout.

1. Determine sheathing dimensions.
2. Cut sheathing to length.
3. Determine 2x4 frame component dimensions.
4. Cut 2x4 to length.
5. Determine cleat dimensions.
6. Cut cleats to width and length.
7. Assemble two 2x4 frames with cleats nailed across the butt joints with 2 - 6 penny duplex nails to each 2x4.
8. Provide courtesy cuts in sheathing on two adjacent sides. [Job conditions may require them on all blockout sides with short dimensions.]
9. Nail sheathing, to 2x4 frames with 6 penny box nails.
10. Chamfer one edge of blockout.

NOTE:

The blockout may be installed in a wall form in lesson #3.

The blockout will be stripped in lesson #5

Chapter 3 Double Waler Form Construction

THIS CHAPTER IS PLANNED TO PROVIDE ANSWERS TO THE FOLLOWING QUESTIONS:

- **What is a double waler form?**
- **When is a double waler form used?**
- **What type form ties are used with double waler forms?**
- **What is a pilaster?**

INTRODUCTION

Double waler forming systems, often called conventional forms, use 2x4 studs sheathed with $^{5}/_{8}$″ or $^{3}/_{4}$″ plywood, and backed with double 2x4 walers. The design has been in use for over fifty years.

Since double walers can span greater distance than single walers, the double waler form systems allow the tie spacing to be increased. In the single waler system, tie and waler spacing is determined by the deflection of the plywood. In the double waler system the plywood is support by the studs. The studs are spaced to prevent deflection.

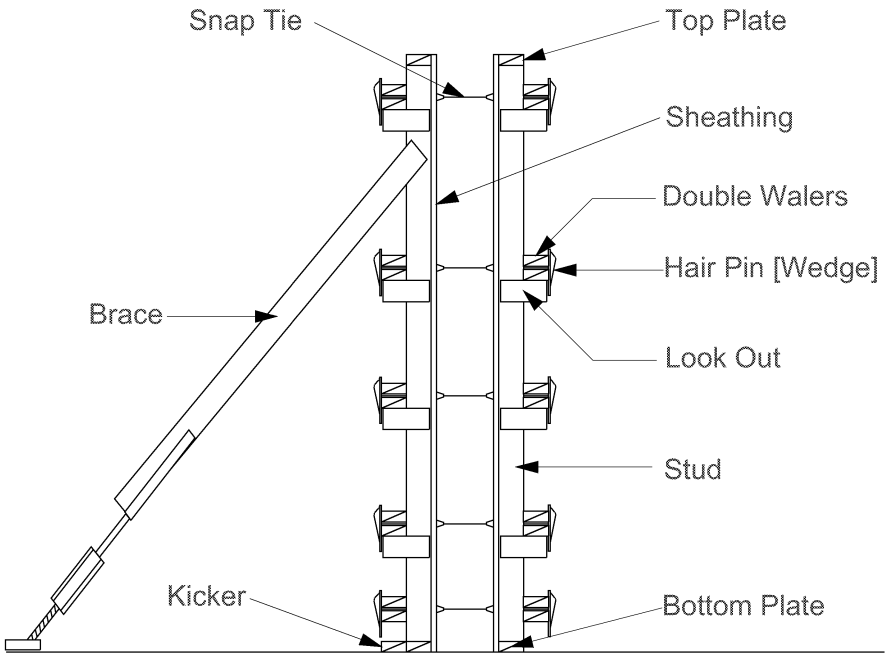


Fig. 3-1 SECTION

Conventional forms are used when there are high concrete pressure due to usually high pour rates. For example: short, high walls that require small amounts of concrete; the crane can be used for only a short time; or the architect wants to avoid "pour lines". Also the architect may want to use the tie hole pattern as part of the design. Also he or she may want to hide the tie holes in the rustication joints and indentations. Conventional forms offer enough flexibility to satisfy the architect's wishes.

DOUBLE WALER FORMS

Double waler forms are used as panel forms and gang forms.

Panel forms are built in sections so they may be handled efficiently. They are often made up in standard sizes and filler panels are used to made up the non modular dimensions. This is the same principle used the single waler forming system. Or they can be the length of the concrete wall and raised from floor to floor. They are efficient if reused. And they increase the speed of building and setting forms.

Standard panels can be ganged together to make large panels. These large panels are usually designed to be hoisted as a unit for convenience in erecting, stripping, and reuse. Often the standard panels are assembled with patented form system. Generally all parts of the forms including the hardware is permanently attached and the form ties are the only loose pieces. Both the inside and outside gang forms are set; and the ties are fed through the panel from the outside. This allows the crane to be used elsewhere on the site.

COMPONENTS

Figure 3-1 shows a double waler form in section view.

The sheathing gives shape and texture to finished concrete. Since plywood surface conditions (grain, flaws, panel joints) photograph onto finished concrete surface, care must be used when applying the sheathing.

The studs and plates support the sheathing and hold it in alignment. The concrete pressure will cause the sheathing to bend and twist. Use framing lumber to provide the necessary strength. The maximum stud spacing for $^{5}/_{8}$″ plywood is 12″ O.C. The maximum stud spacing for $^{3}/_{4}$″ plywood is 16″ O.C.

The ties contain the concrete pressure and prevent the forms from spreading. The walers hold the panels straight and provide rigidity by containing and distributing the concrete pressure.

FORM TIES

There are many types of ties. Two of the most common are snap ties and she bolts.

Figure 3-2 shows a snap tie.

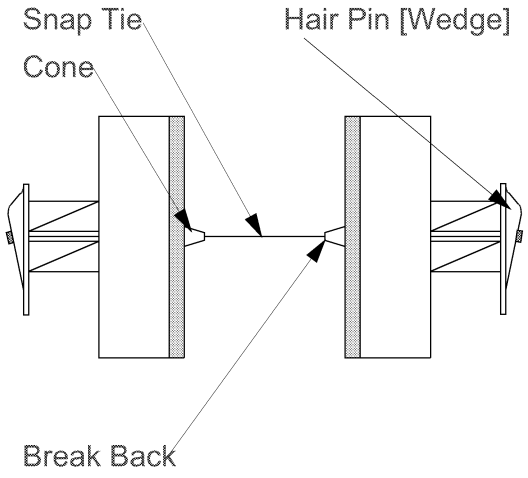


Fig. 3-2

The snap tie is one piece and used with a wedge, called a hair pin, on the end. A pair of cones maintain the spacing between the forms and allow the concrete wall surface to be patched. The snap tie also has a breakback. The ends of the tie are removed during stripping by putting a socket wrench on the end and turning until the tie breaks at the breakback. The center portion remains in the wall. Notice the part remaining is not close to the wall surface. This prevents corrosion and possible damage to the finish concrete. Snap ties are installed before doubling up the inside panel.

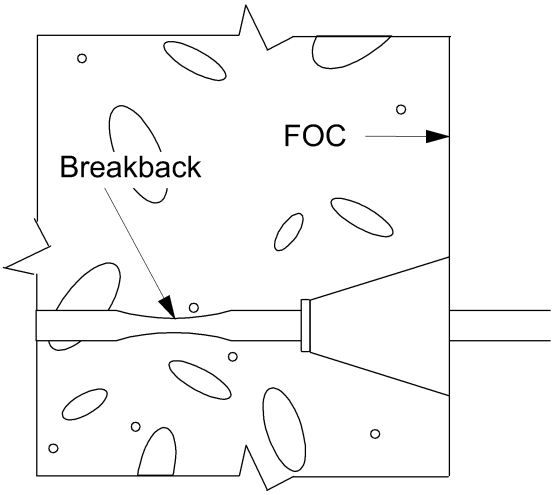


Fig. 3-3

She bolts are shown in Figure 3-4.

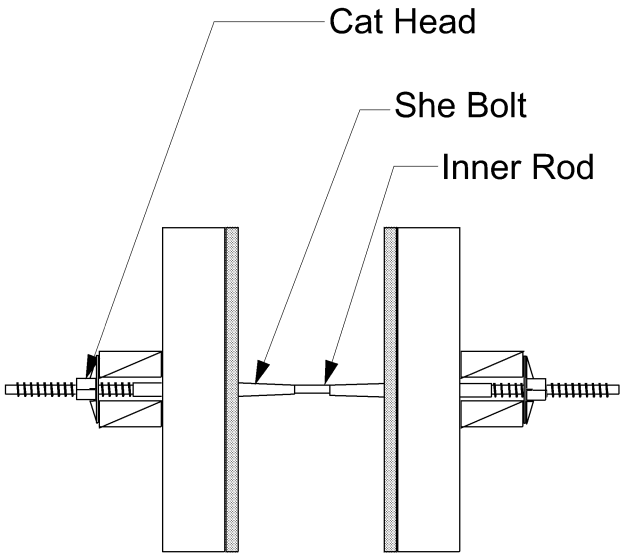


Fig. 3-4

The parts are a nut washer, (cat head), waler rod (she bolt), and an inner rod (tie rod). After the concrete hardens the cat head is loosened and the she bolt is removed. The inner rod remains in the concrete. Apply a light coat of grease to the she bolt to prevent it from bonding with the concrete. It is good practice, the day after the pour, to loosen the cat head and back off the she bolt one half turn. This will facilitate removal at a later time. Wall spacing and break back will determine the inner rod length. Rod length is wall thickness minus two inches.

Rebar has razor sharp ends. Cover the ends with a protective cover when working above exposed reinforcing steel.

She bolts are insert after both the outside and inside panels have been set.

She bolts are not self spacing and are often used with out a spreader. Care must be used when tightening the cat head. If the cat head is over tightened the wall will be too narrow. To prevent this, use a string line out side the form as a gauge. See Figure 3-5.

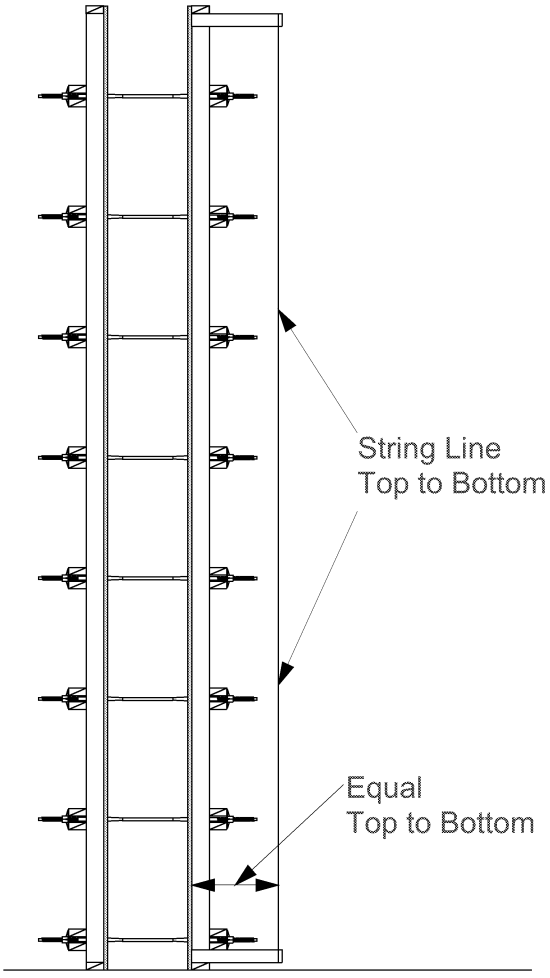
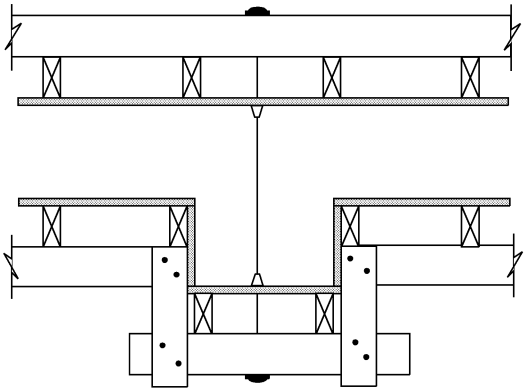


Fig. 3-5

PILASTERS

Pilasters are formed in conjunction with concrete walls. A pilaster is a column that incorporated with a wall. It is used to support the ends of concrete, wood, or steel beams. It may also be used to give lateral support to the wall. Like columns, pilasters are located by giving dimensions to their center line. Usually the pilaster face is formed with one panel. There are many form configurations. See Figure 3-6 illustrate some of them.

The bottom of the pilaster form, like a column form, is secured by using a collar or template.



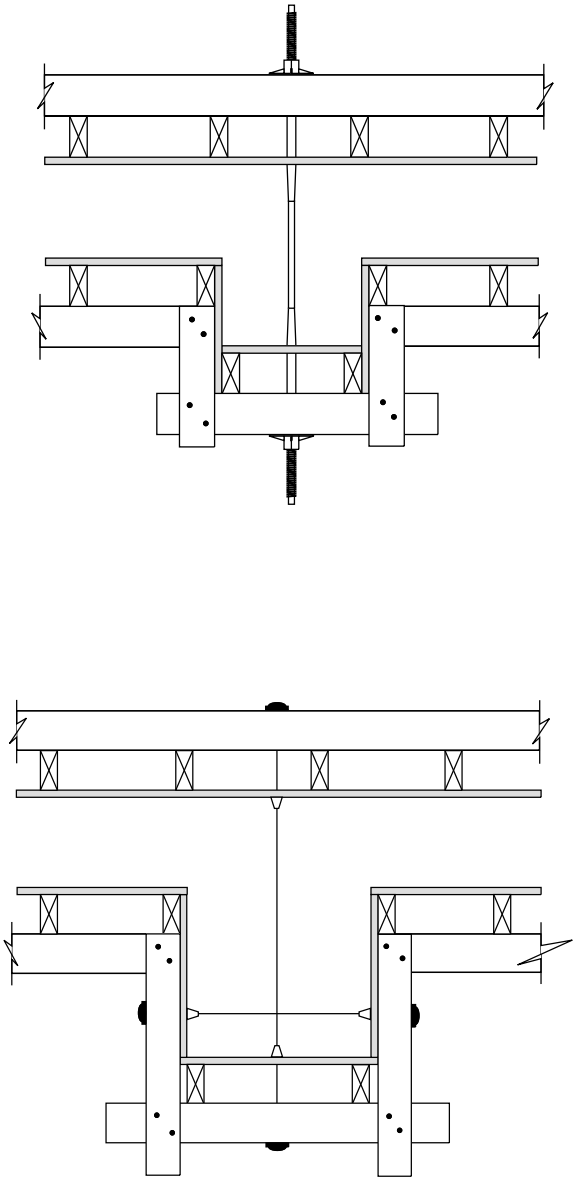


Fig. 3-6

BULKHEADS

In addition to forming pilasters you will have to form bulk heads. A bulk head is a "Vertical partition set in the form work to stop fresh concrete from entering another area of the form". A bulk head is used at the end of a wall, where a top of a wall changes elevation, or at a construction joint. If it is at a wall end, use the same material as the panel sheathing. A construction joint is often called a cold joint. It is created when fresh concrete is placed against existing hardened concrete. If the reinforcing steel continues into to the next portion of the concrete wall, the bulkhead must be built around the rebar and still be easy to strip. Instead of using a continuous piece of plywood, the material is ripped to the rebar spacing. Then a notch is cut in the top edge to accommodate the reinforcing steel. See Figure 3-7.

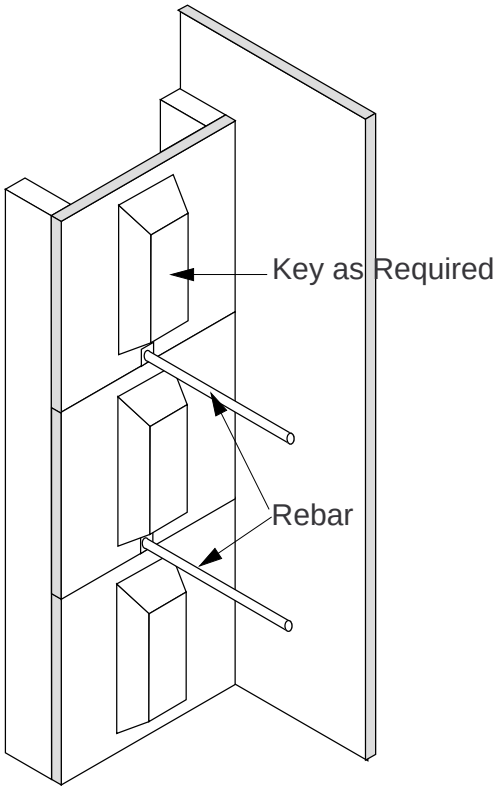


Fig. 3-7

Concrete walls below grade are subject to hydrostatic pressure and may require water stop at the construction joint.

PANEL ERECTION

Usually the outside form panels are erected first. Panel joints must be tight to prevent motar leaks; and panel faces must be flush.

After the first pour, when the panels are raised and reinstalled for subsequent pours, the bottoms of the outside form panels are usually held to the wall by form clamps screwed to tie rods or J bolts that were embedded in the concrete of the previous pour. See Figure 3-8. At the top of the forms, at the proper elevation, form clamps or J bolts are used again in preparation for succeeding pours.

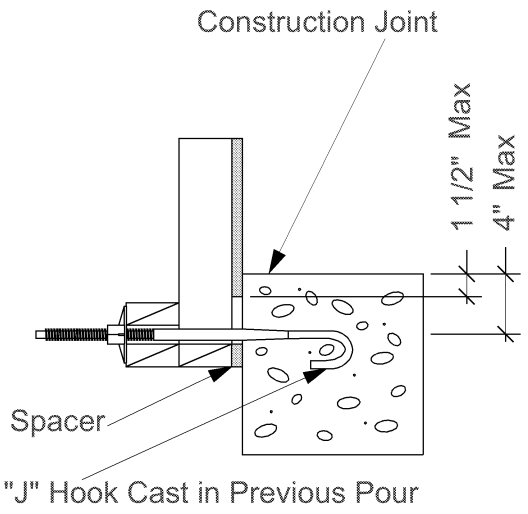


Fig. 3-8

When the wall forms are securely anchored at the bottom and are temporarily braced, they are ready to be aligned.

The first step in aligning the panels is to plumb the corners of the outside wall panels.

Permanent reference points should be established at each corner for plumbing the wall. This should be done at the time the forms are set for the first pour. These points may then be used as reference for each story as the forms are set for each subsequent pour. Unless this is done, slight errors in each floor can accumulate, resulting in a building whose outside walls lean either in or out.

Plumbing operations sometime involve working from exposed positions. It is important that ladders, work platforms, or other safe access be provided to these positions; if not, safety belts and lifelines must be used.

After the corners are plumbed, the forms are aligned at intermediate points with a taut wire. A wire is used rather than a string line because it can be stretched much tighter and is less affected by wind. This is especially important in long wall. If the distance is unusually great, the center of the wall may be brought to line by sight so that the final alignment can be accomplished in two shorter intervals. If a builder's level, or level-transit is available, it can be used to simplify the alignment of long forms.

When the wall forms have been brought to proper alignment, they are braced to blocks bolted to the floor, to columns, or to some other anchor previously provided.

The forms are now ready for the placement of bulkheads, window and door bucks, rustication strips, chamfer, and embedded items. Then the reinforcement steel is installed.

The forms are doubled up by installing the inside panels, walers, and lacing.

SAFETY

Responsibility for safety on the job site belongs to everyone. However the carpenter performs the work; and it is in the carpenter's best interest to work safely. When the panels are erected on the building for the first time, scaffolds may be provided on the back of the form structure. Scaffolds must meet the requirements set forth in the CAL/OSHA, State of California Construction Safety Orders. The use of bracket scaffolds in construction work is permitted only when such scaffolds are through bolted to walls, welded to steel tanks, or hooked over a well-secured and adequately strong supporting member. Adequate handrails must be provided, and the scaffold planks must be of sound material. If scaffolding is not provided for work at heights, the use of safety belts and lifelines is mandatory.

NOTES:

Lesson 3 Double Waler Form Construction

INTRODUCTION

In this lesson you will erect a double waler form. Double waler forms are usually designed for reuse, either as individual panels or gang forms.

LESSON OBJECTIVES

Working as a member of a team each student will layout and erect a concrete form using a double waler forming system.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. Use the plan provided, lay out a concrete wall to the dimensions indicated. (Project Drawing - A1)
2. Using the panel details provided, construct panels. (Project Drawing - Shop 2 and Shop 3)
3. In a logical sequence, safely erect panels, brace and align panels, install snap ties, and she bolts.
4. Install bulks heads.
5. Install a blockout.
6. Install pilaster forms.
7. Install lacing at bulk heads and corners.
8. Strip in reverse order of construction.
9. Use the plan and elevation views to determine the volume of concrete required for a concrete wall. (Project Drawing - A1)

APPLICATION IN THE FIELD

Double waler forming systems are used for a substantial portion of cast in place concrete work. Since they are often designed for reuse, they must be built with care and accuracy. The carpenter will be required to safely build, erect, and strip a variety of double waler forms.

EVALUATION:

A post test will be administered after the lesson is completed. Each student will be evaluated on their participation in the construction, the quality of their work, and the score on the post test.

EQUIPMENT

To be supplied by the training facility (per 4 to 5 students)

1. Two skill saws
2. Two extension cords
3. Two pair saw horses
4. One $^{1}/_{2}$″ drill motor
5. One $^{9}/_{16}$″ Ø auger bit
6. One $^{13}/_{16}$″ Ø auger bit

STUDENT TOOLS

1. One [1] 16 or 20 ounce smooth face hammer
2. One [1] pocket tape measure
3. One [1] sharp 8 point cross cut saw
4. One [1] 24" level
5. One [1] 12" adjustable wrench
6. One [1] combination square or speed square
7. One [1] pencil
8. One [1] chalk box with chalk
9. One [1] offset ripping chisel [Commonly called a flat bar.]

PROCEDURES

Use the plan and form details provided and the following directions to build a double waler form.

The order in which the forms are erected is very important. The basic sequence is as follows. First completely erect, brace, and plumb the outside form panels. Then install the bulkheads, blockouts, and establish the top of concrete (TOC). At this point on the job site, the iron workers will install the reinforcing steel., Then the carpenters will double up the inside form panels, finish installing the walers, and install the lacing.

1. Layout concrete wall lines

   Layout the outside edge of the concrete wall on the footing.
   Layout the inside edge of the concrete wall.
   Using a chalk line mark the lines.
   Use a framing square and tape measure to layout the ends of the wall.
   Use a chalk box to mark the lines, lapping the wall lines 6 to 8 inches.
   Use a tape measure and a framing square to layout the pilaster.
   Mark the lines with a chalk line, lapping corners 6 to 8 inches

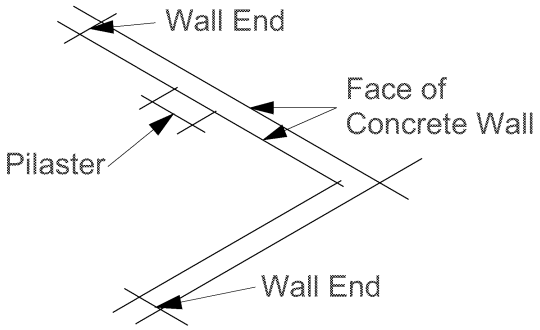


Fig. 3-1

2. Fasten 2x4 kickers to footing.

   On the footing measure back from the outside concrete wall face the thickness of the panel ($4\ ^{1}/_{8}''$).

   Use a powder actuated tool or a rotor hammer and nails to fast the 2x4 kickers to the footing.

   At the ends of the wall fasten a position block to the footing. Hold the kicker back from the layout line the thickness of the bulkhead.

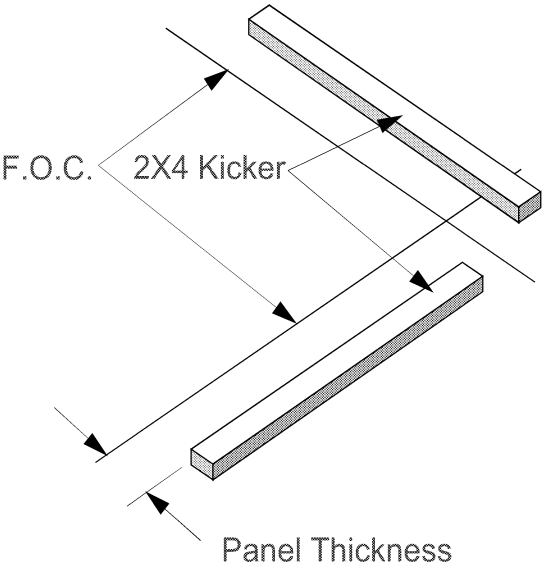
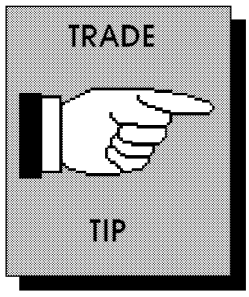


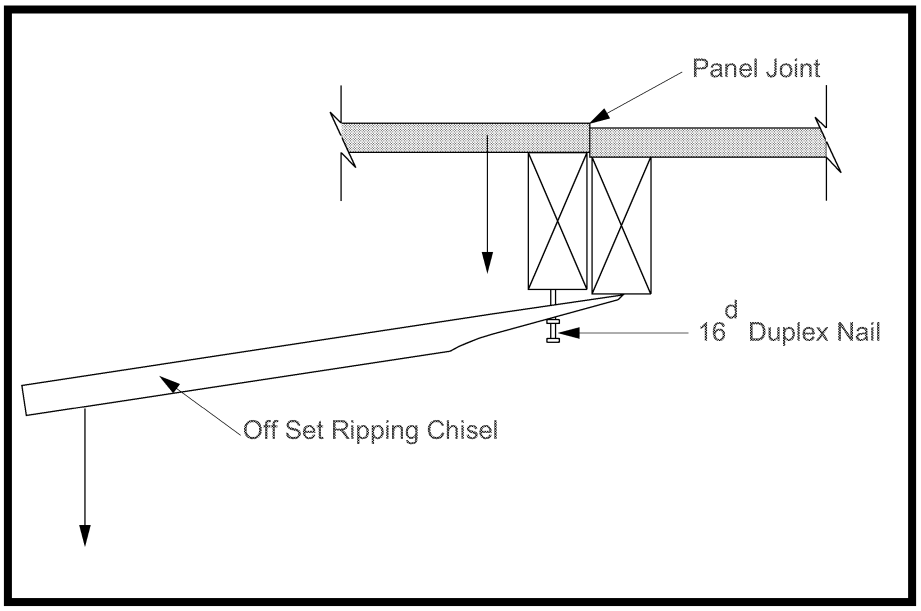
Fig. 3-2

3. Build form panels.

Use the panel drawings to make a cutting list.
Cut studs and plates to length.
Assemble the frame with 2 - 16 penny nails at each end of each stud.
With a fence cut the plywood to size.
Sheath the frame with plywood. The nailing schedule will depend upon the number of times the panel is expected to be used. For this lesson use 6 penny box nails and nail the perimeter 16 inches on center. Nail both sides of the plywood joint at every stud with 6 penny box nails.
When the panel butts another panel hold the plate and the end stud back $^{1}/_{8}$ inch. This will permit the carpenter to nail the two panels tightly together and prevent cement motar from leaking at the panel joint.
Layout snap tie and she bolt holes.
Snap tie holes are $^{9}/_{16}$″ Ø and she bolt holes are $^{13}/_{16}$″ Ø.
Use a $^{1}/_{2}$ inch drill motor and the correct drill bit to bore the holes.

ALIGN FORM PANELS





4. Erect outside forms.

Determine the panel erection order. For this lesson panel O.S. #2 will be erected first; then panel O.S. #1 will be erected.
Place the panel O.S. #1 against the position blocks kicker. Locate the end of the panel so it laps $4^1/_8$″ past the wall end layout mark. ($4^1/_8$″ is the thickness of the bulkhead.)
Hold the bottom plate of the panel against the position block kicker and fasten them together with a 3″ x 7″plywood cleats spaced 4 to 6 feet on center. Do not attach the panel bottom plate to the footing. (as shown in Fig. 3-4)
Attach the braces to the panel with 3 - 16 penny duplex nails.
Put a brace at each end of the panel and space them no more than 10 feet apart.
Remember brace requirements are determined by job conditions and will vary from job site to job site.
Position the top of the brace within the top one third of the panel. Put it is just below and clear of the top pair of walers.
Brace slope for this lesson is 1 to 1.
The brace has a turnbuckle form aligner at the bottom. It has $5^1/_2$ inches adjustment. Adjust the turnbuckle so it can be turned an equal amount in or out.
Bring the panel to rough plumb and secure the bottom of the brace with 16 penny duplex nails.
Using a plumb bob or a level, plumb the ends of the wall.
Using a string line align the rest of the wall.
Put panel O.S. #1 against the position blocks and tight to panel O.S. #2.
Secure the bottom plate of the panel to the position blocks with cleats.
Plumb both ends of the panel.
Nail the two panels together at the corner with 8 penny duplex nails through the plywood into the stud at the end of panel O.S. #1.
Brace the other end of the panel and plumb it.

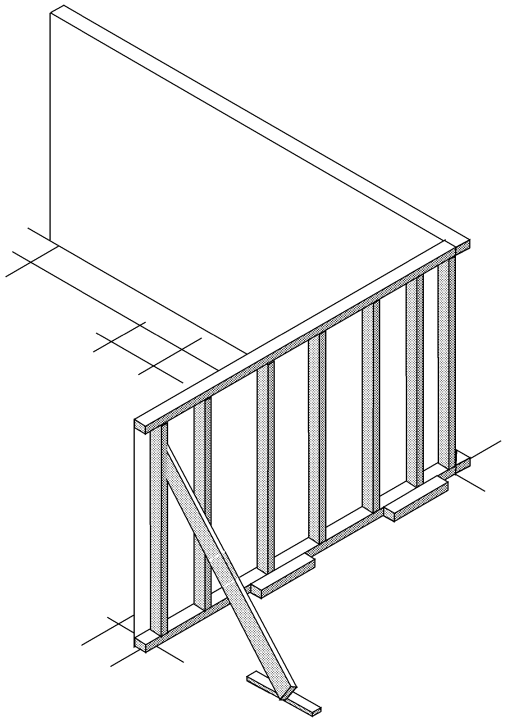


Fig. 3-3

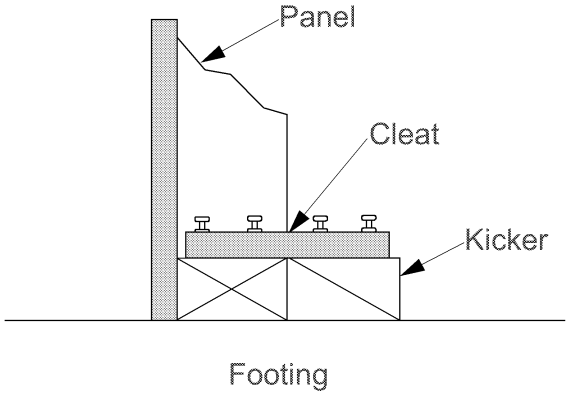


Fig. 3-4

5. Establish T.O.C. (Top of Concrete)

Use an optical, electronic, or laser level to layout T.O.C. on the outside forms.
Use a chalk line to mark T.O.C.
If a pour strip is used, nail a 1x2 above the chalk line with 6 penny duplex nails at 8 to 12 inches on center.
If chamfer is required, nail the chamfer below the chalk line with 3 penny blue lath nails spaced 6 to 8 inches on center.

6. Install bulkheads.

Use a plumb bob or a level to transfer the wall end layout line from the footing to the top of the outside panel.
Mark the line with a chalk line.
If a chamfer has been nailed on the bulkhead, measure over the width of the chamfer and layout a parallel line.
[Remember, any place on the concrete wall where there is a step up or down in the T.O.C. will require a bulkhead. Use the process describe above to layout the changes in elevation.
Hold the bulkhead in position and nail it to the outside form. In order to ensure a good seal, nail through the outside form plywood into the bulkhead with 8 penny duplex nails spaced 6 to 8 inches on center.

7. Install blockouts and bucks.

Layout the location the blockout on the outside form.
On the outside form mark the perimeter of the bulkhead. If necessary, make an allowance for chamfer.
Hold the blockout in position and nail through the outside form plywood into the blockout with 8 penny duplex nails. To insure a good seal between the wall forms and the bulkhead, space the nails 6 to 8 inches on center.
Install chamfer as necessary.

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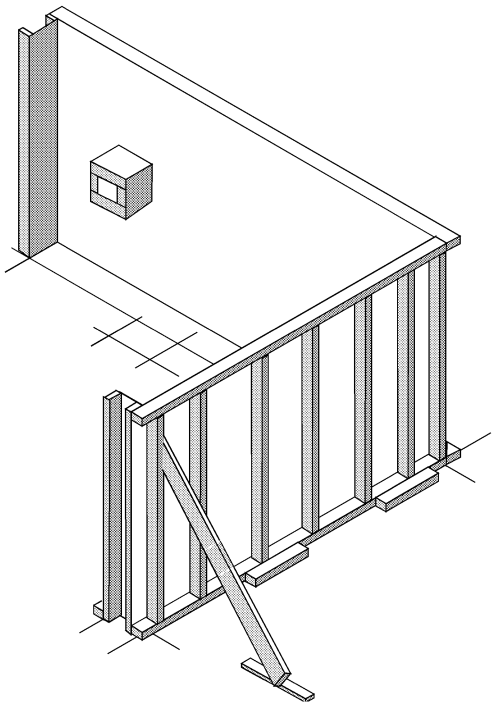
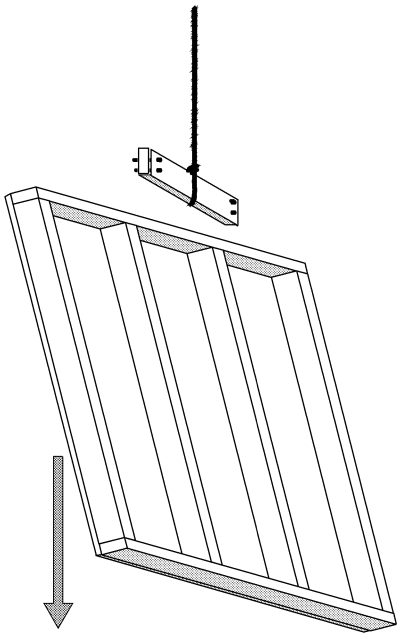


Fig. 3-5

8. Install rustication strips.

Layout the location of the rustication strips. If there are multiple rustication strips or the layout is complex, the carpenter may find a story pole useful.
Mark the lines with a chalk line.
Usually rustication strip is not rectangular. Look at the appropriate section views on the drawings and note the shape, sometimes called profile, and orientation.
Position the rustication strip and fasten it to the out side form. If you want to leave the rustication strip in place when the forms are striped, nail through the form plywood into the rustication strip with 8 penny duplex nails. Space nails 6 to 8 inches on center. A second method is to nail the rustication strip through the face into the panel plywood with casing nails spaced 6 to 8 inches on center.

DO NOT USE NAILED PANEL LIFTING ATTACHMENTS.



9. Double up inside forms.

Check the outside forms for plumb and alignment. It is difficult and time consuming to move the forms after the ties have been installed and tightened.
Layout on the footing the end of the first inside panel (I.S. #3).
Insert the snap ties in the outside form.
Place the bottom of the panel on the footing at the layout mark.
Tip the top of the panel back and insert the snap tie in the bottom row of holes.
Insert the snap ties in each row in turn.
Push the panel tight against the snap tie cones.
At the top of the panel use a cleat at each end to secure the inside panel to the outside panel. For this lesson, the wall thickness is 8 inches. The inside and outside panels are spaced 8 inches apart with a cleat.
Do not fasten the panel bottom plate to the footing.
Erect the remaining panels.
Fasten adjacent panels with 16 penny duplex nails at 12 inches on center through the end panel studs. Be sure the panel faces are flush. Be sure the panel joint is tight to prevent cement paste leakage.
Nail the bulkheads with 8 penny duplex nails at 8 inches on center. Be certain the bottom of the bulkhead is against the position block and the top is square with the panels.

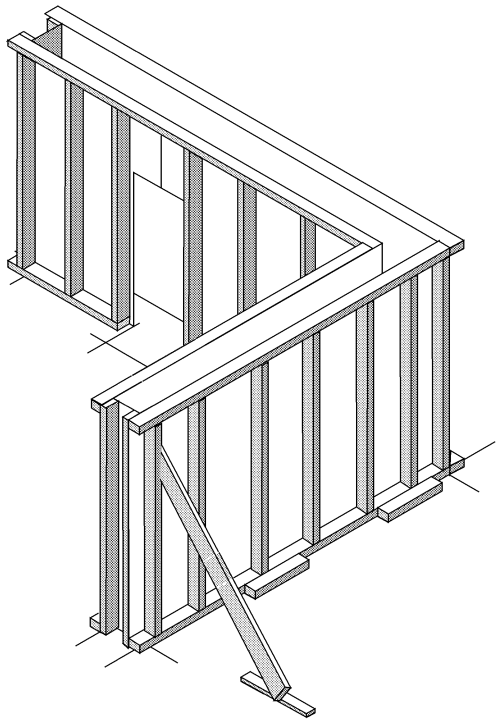


Fig. 3-6

10. Install pilaster forms.

Fasten pilaster template to the footing.
If pilaster requires chamfer, nail the chamfer to the pilaster side form with 3 penny blue lath nails spaced 6 to 8 inches.
Set the side panel in place and nail through the inside wall form plywood into the pilaster side.
Place the third pilaster panel on the footing and nail it to the pilaster sides with 6 penny nails spaced about 8 inches.
Choose an inner rod to provide the required set back.
Assemble two she bolts and the inner rod.
Put a cat head on one she bolt and position it so when the cat head is tight against the waler the inner rod will have the required set back.
Insert the she bolt assembly through the outside wall form then through the pilaster form.

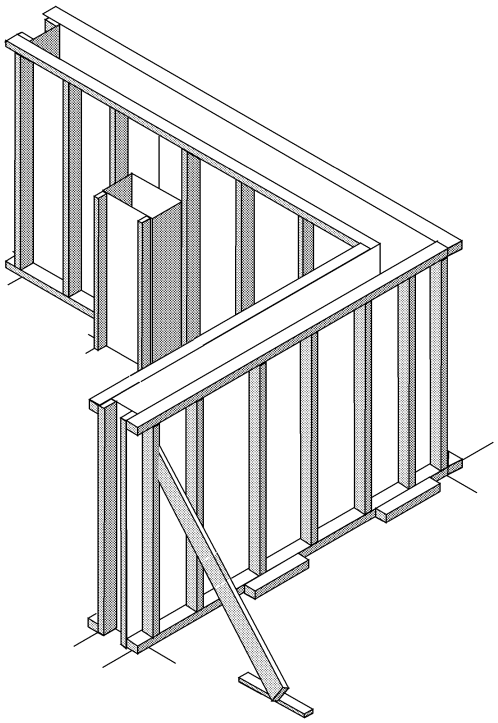


Fig. 3-7

11. Install walers.

Support each row of walers with waler brackets.
Install waler brackets at each end of the wall and at 4 feet on center.
Nail the bracket to the stud with 3 - 8 penny duplex nails.
Install the walers on the outside first.
Place the walers on the brackets.
Extend the walers past the end of the wall by about 1 foot.
For each pair of walers stagger the joints at least two snap ties.
Install the hairpin and tighten. To not over tighten, it can weaken the snap tie.
Tack hairpin to the waler with a 6 penny nail or 8 penny duplex nail. Since the nail only prevents the hairpin from vibrating loose, do not drive it home.
Push the cat head against the waler and tack so it will not vibrate loose.
Lace the outside corner with 2 - 1x6. Nail the 1x6 to each pair of walers with 3 - 8 penny duplex nails.
Install inside walers.
Lap of pair of walers at inside corner.
Extend the walers past end of wall about 1 foot.
Install and tack hairpins. Do not over tighten hair pins. Over tightening hair pins can weaken them. This may cause them to fail during placement of the concrete.

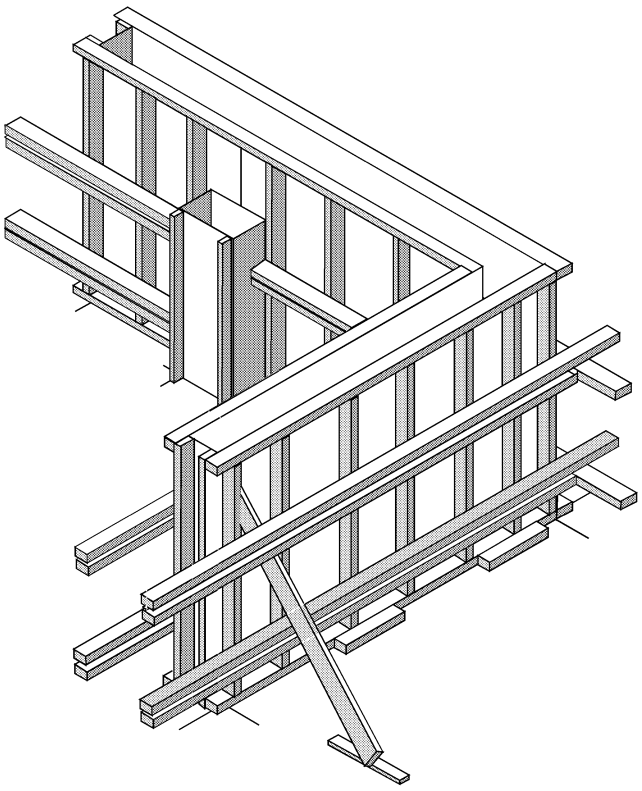


Fig. 3-8

12. Lace corners and bulkheads

At the wall end place a 2x4 on top of and at right angles to each pair of walers. Extend the 2x4 8 to 12 inches past the walers.
Lace in both directions and both sides with 1x6. Use 3 - 8 penny duplex nails at each waler pair.
If there is a gap between the 1x6 and the 2x4, wedge with a feather wedge.
Support walers at the pilaster on lookouts. Extend walers past the pilaster panel 8 to 12 inches.
Use an adjustable wrench a tighten the cat head. Use an 8 penny duplex nail to prevent the cat head from backing off. Be careful, do not over tighten. You can collapse the form by over tightening the cat head.
Support the pilaster side panels by nailing 3″ x 8″ plywood cleats across the wall panel walers and the pilaster walers.
Nail each of the cleat with 2- 8 penny duplex nails.
Verify the dimensions at the top of the wall forms and the pilaster form.

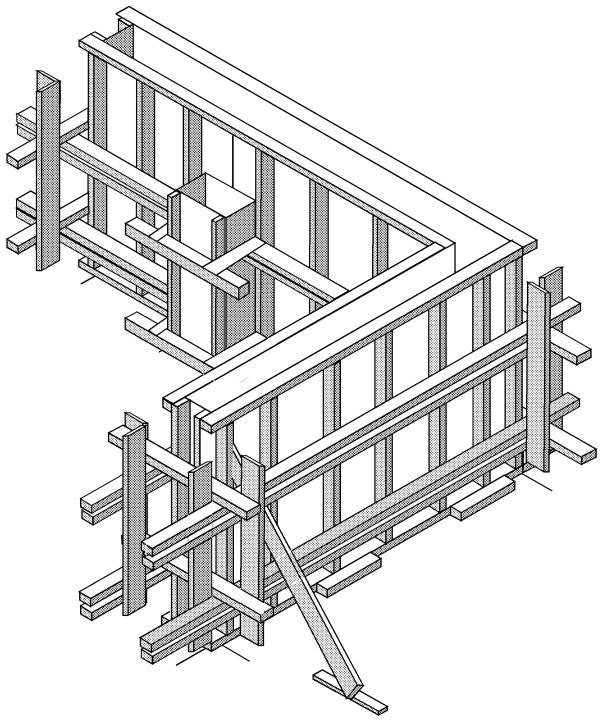


Fig. 3-9

13. Recheck plumb and alignment.

This step to ensure the panels did not move during the erection.
Be sure they are with the tolerances set forth in the specifications.
For this lesson we will use the American Institute of Architects recommendations.
"Variations in the lines and surfaces of concrete columns, piers, and walls may be $^1/_4$ inch in any 10′ of length and a maximum variation of 1 inch along the entire length". Remember this is the maximum variation of the concrete wall.

14. Determine concrete volume required.

Separate the wall into the three rectangular shapes.
Using the formula, V = LxWxH, calculate the volume in cubic feet for each rectangular piece.
Add the volumes together.
Convert the answer into cubic yards by dividing by 27 cubic feet per cubic yard.
Round off the next one half yard.

DO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT

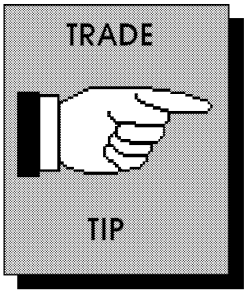
DOUBLE WALER FORMS

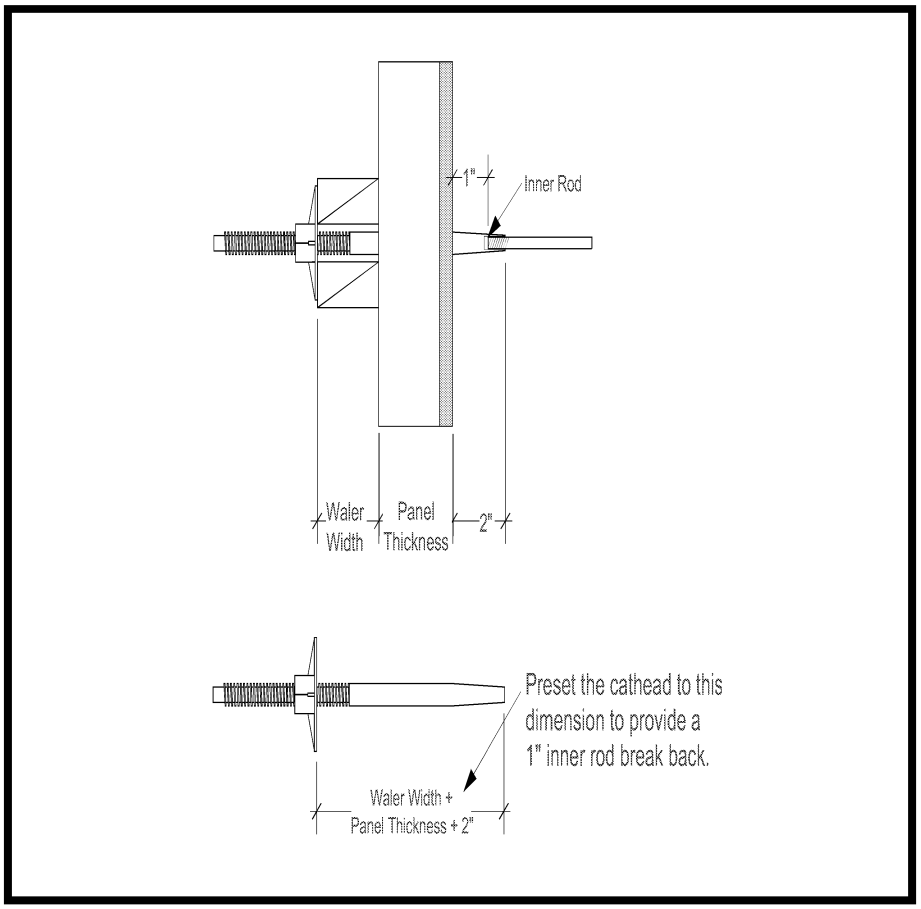
Do's

- Cut plywood with a fence
- Erect outside forms first.
- Install bulk heads, pour strips, block outs, and rustication strips before installing the reinforcing steel.
- Secure hair pins and cat heads with a 6 penny box or 8 penny duplex nail.
- Align adjacent panel faces.

Don'ts

- Do not allow snap tie holes in opposite panels to be offset.
- Do not fasten panel bottom plate to the footing
- Do not over tighten cat heads
- Do not allow gaps at panel joints.





Chapter 4 Form Stripping

THIS CHAPTER IS PLANNED TO PROVIDE ANSWERS TO THE FOLLOWING QUESTIONS:

- **When does planning for safe and efficient form stripping begin on a concrete construction project?**
- **How does the order of erection of forms affect the order of stripping?**
- **How are forms detailed, constructed, and assembled for easy stripping and maximum reuse?**
- **Why is stripping a basic consideration in stair form construction?**
- **How are box molds and waste molds attached to the main form structure.**
- **What hazards are associated with form stripping?**

INTRODUCTION

Safety and efficiency in stripping the forms are not matters that can be left to chance in a concrete construction project. They must be given careful consideration well in advance of the actual stripping operation; first when the job is being estimated, then when the form work details are being drawn up, and again when the forms are being constructed and erected. Well-designed and well-constructed forms are easy to strip, an important consideration not only for safety but also for economy. Easy stripping helps to ensure maximum reuse of the forms and minimum concrete damage during the stripping operation.

PLANNING THE ORDER OF STRIPPING

The order of stripping forms is usually the reverse of the order of erection. If panels are to be reused in subsequent pours, they should, if possible, be scheduled for stripping at a time that will permit them to be removed and reset in one continuous operation. Proper planning will make stripping easier and reduce the number of steps required to reset the forms for the next pour.

ATTACHMENT OF BOXES, MOLDS, AND OTHER APPLIED COMPONENTS TO FORMS

Boxes, molds, rustication strips, wood inserts, and other items applied to the interior faces of the forms for temporary or permanent embedment in the concrete should be lightly fastened to the main form structure. This will permit them to come free of the forms during stripping and remain in the concrete.

Double-head nails, driven from the outside of the form, as shown in Figure 4-1, are recommended fasteners for most of these items; however, long casing nails should be used for attaching rustication strips, as shown in Figure 4-2. The casing nails are pulled through the strip and the sheathing just before the forms are removed, allowing the strip to remain in place until it is dry enough for safe removal.

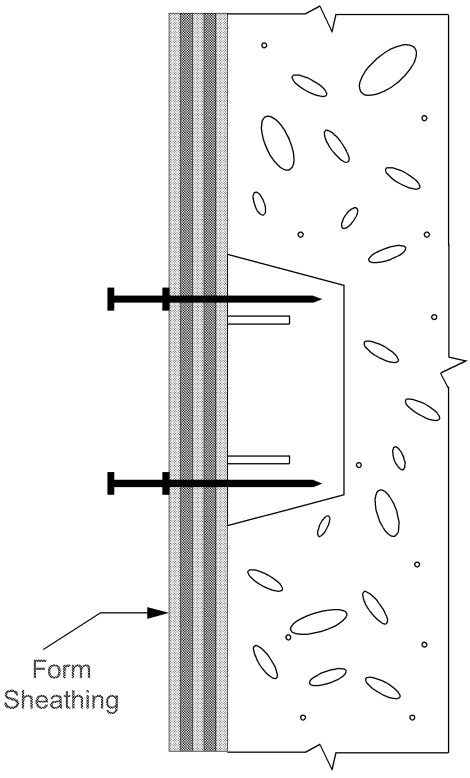


Fig. 4-1

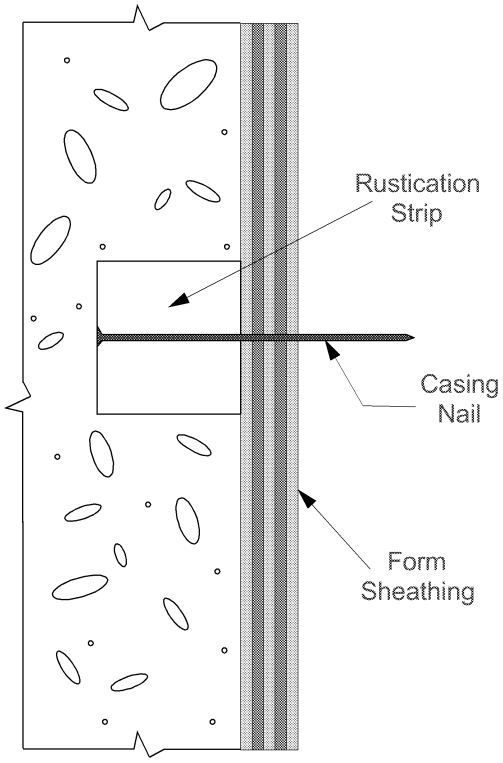


Fig. 4-2

CONSTRUCTION JOINTS

Form panels at construction joints must have no offset and must not leak. If these requirements are not met, an unsightly joint will be revealed when the form panels are stripped. Also, leakage at any point on a form can adversely affect the composition and strength of the concrete in the region of the leak.

Tight forming at a construction joint can be achieved by using she-bolts, located not more than 4 inches below the joint, to hold the forms tightly against the hardened concrete of the previous pour, as shown in Figure 4-3. Wedges are sometimes driven between the walers and the sheathing to help tighten the form at the joint. When the forms above the joint are

stripped, the she-bolts are removed from the concrete.

A row of ties or she-bolts should always be located just above the joint to help the forms resist the pressure of the concrete, as shown in Figure 4-3. Do not depend only on the she-bolts to seal the form against the existing concrete.

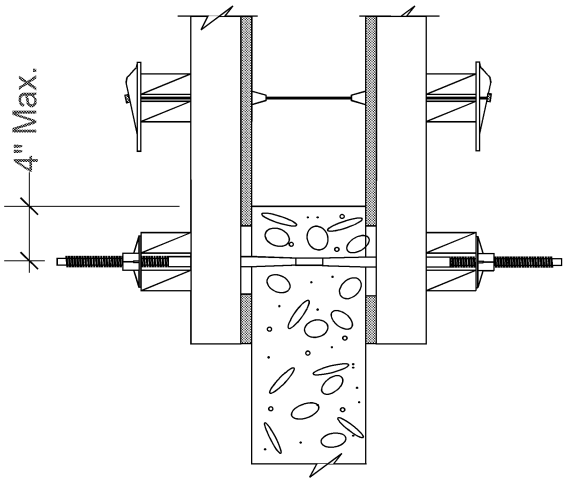


Fig. 4-3

OILING AND WETTING THE FORMS

Twelve hours prior to placing concrete, soak lumber forms with water to tighten the joints, prevent undue absorption of water from the concrete mixture, and make the stripping operation easier. Wood forms should periodically be wet down during the curing period, especially during hot, dry weather.

Plywood forms and forms with a fiberboard liner must be oiled, lacquered, or treated with a release agent before use to prevent the concrete from sticking to the form. Metal forms and molds must be thoroughly cleaned of rust, then coated with light oil or a commercially prepared releasing agent suitable for metal forms. Oil should be used sparingly on forms to avoid staining the concrete. This is of special importance for architectural concrete. Floor form panels must not be oiled until the carpentry work on the form has been completed.

STRIPPING THE FORMS

The form-stripping operation should not be started until the concrete has achieved sufficient strength to support not only its own weight but also any anticipated construction loads (and in some cases, wind loads). Another important reason for keeping the forms in place for the specified time is to protect the concrete from drying too quickly. Leaving the forms in place for a reasonable time is generally the simplest and best method for achieving a satisfactory cure. Forms cannot be stripped before the time period described in the specifications or the building code.

Generally forms are stripped in the reverse order of construction. When stripping walers start at the top of the wall and work down. Careful form construction and placement of concrete can be canceled by the careless use of tools during stripping. Pinch bars, metal wedges, or similar metal tools should not be used directly against the concrete in removing the forms, for this can result in spalling. Wooden wedges should be used if the need arises to apply wedging force between the concrete and the form. Extra care should be taken in removing rustication strips and other embedded form components. Damage to the new concrete can easily occur in these areas as a result of using too much force in stripping.

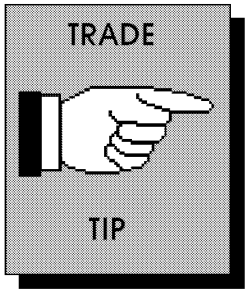
If the forms or the form materials are to be reused, they should be thoroughly cleaned. All

nails no longer required in the stripped forms should be pulled out, not hammered over against the form faces. Any needed patching should be attended to, and any split parts of boards should be replaced with sound lumber. All materials that are to be reused should be neatly stacked in a place where they will be safe from damage and readily available for the next use. Stripped forms and shores must be stored where they will not interfere with construction operations or present a hazard to workmen.

SAFETY IN FORMING AND STRIPPING OPERATIONS

All forming work is hazardous, and every carpenter placing or stripping forms must give utmost attention to safety in every phase of the operation. In this regard, you have a responsibility not only to yourself but also to your fellow workers.

When a carpenter must work from a scaffold in erecting or dismantling forms, you should check the scaffold yourself to determine whether it is safe. Scaffolds must be designed, constructed, and used in accordance with requirements set forth in the CAL/OSHA, State of California Construction Safety Orders.



Leave rustication in place.

Allow it to dry and shrink before removing.

Lesson 4 Form Stripping

INTRODUCTION

In this lesson you will strip a blockout. The blockout must be removed without damaging the concrete surface. The ease of stripping depends upon the planning, construction, and installation of the blockout.

LESSON OBJECTIVES

At the end of the lesson the student will be able to strip a blockout.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. In a logical sequence, strip the blockout from a simulated concrete wall or deck.
2. Choose the correct tools.
3. Strip the blockout without damaging the surrounding concrete.

APPLICATION IN THE FIELD

As with other forms, stripping blockouts is the carpenter's work. This can be a difficult operation if the blockout was not correctly built. The blockout is surrounded by concrete, usually on four or five sides; and the pressure of the concrete has compressed the members. A ease and efficiency of stripping was decided when the blockout was built and installed.

EVALUATION:

A post test will be administered after the lesson is completed. Each student will be evaluated on their ability to strip a blockout and the score on the post test.

EQUIPMENT

To be supplied by the training facility [per 2 students]

1. Wood construction wedges
2. Double jack or Johnson Bar

STUDENT TOOLS

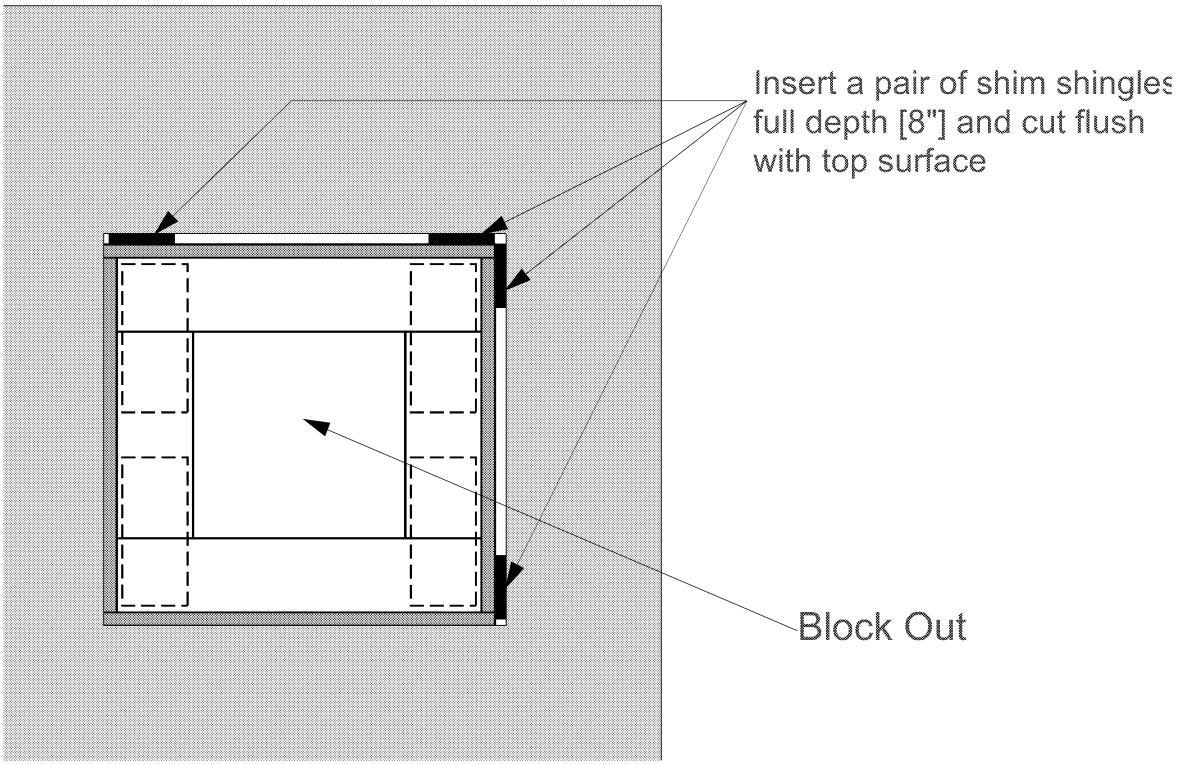
1. One [1] 16 or 20 ounce smooth face hammer
2. One [1] cat's paw
3. One [1] ply bar or offset ripping chisel

PROCEDURES

Use the drawing (Figure 4-1) and the following instructions to strip a blockout.

1. Place the blockout, built in lesson #2, in the opening in the concrete wall mock up as shown in Figure 4-1.
2. Push the blockout tight to one corner of the opening.
3. Use a pair of shim shingles at each of the four points shown in Figure 4-1 to tighten the blockout in the opening.
4. Use a double jack or a Johnson Bar to remove the upper 2x4 frame.
5. Use a cat's paw or offset ripping chisel (flat bar) to pull the duplex nails from the remaining cleats.
6. Remove the cleats and the remaining 2x4s.
7. Use wood wedges to separate the sheathing from the concrete.
8. Remove the sheathing, bend over nails and dispose of material.

Fig. 4-1 Concrete Wall/Deck Mock Up



DO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT	
CONCRETE STAIR FORMS	
Do's	• Use wooden construction wedges to separate forms from concrete. • Strip in reverse order of construction. • Allow concrete to harden sufficiently before removing forms. • Use care in removing rustication strips.
Don'ts	• Use metal wedges or pry bars between the form and the concrete.

Lesson 5 Concrete Stair Forms

INTRODUCTION

In this lesson you will erect the forms for a self supporting concrete stairs. Concrete stairs are used because they are durable, resist the elements, and non combustible.

LESSON OBJECTIVES

Working as partners each student will layout and erect a concrete stair form.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. Correctly identify basic stair components.
2. Correctly layout a simple stair.
3. Assemble the stair form components in the correct sequence.
4. Construct a stair form in a manner that allows efficient stripping.
5. Brace the form components to ensure alignment of the completed concrete stair.

APPLICATION IN THE FIELD

Stairs are one of the most dangerous building components. Great care must be used in layout and construction so the stairs are safe and the dimensions accurate. Concrete stair and wood stair layout use the same principles of rise and run. However, concrete stair forms are built around the shape of the stairs. Stair construction require good visualization and good mechanical skills on the part of the carpenter.

EVALUATION:

A post test will be administered after the lesson is completed. Each student will be evaluated on their participation in the construction, the quality of their work, and the score on the post test.

EQUIPMENT

To be supplied by the training facility [per 2 students]

1. One skill saw
2. One extension cord
3. One pair saw horses

STUDENT TOOLS

1. One [1] 16 or 20 ounce smooth face hammer
2. One [1] pocket tape measure
3. One [1] sharp 8 point cross cut saw
4. One [1] 24" level
5. One [1] combination square or speed square
6. One [1] pencil
7. One [1] chalk box with chalk
8. One [1] framing square

PROCEDURES

Use the plans provided and the following instructions to build a single waler form.

1. Erect Mock Up Panels

   Stand two 4x8 plywood panel at ninety degrees to each other.
   The vertical dimension is four foot.
   Plumb the corner in both directions and nail together with 8 penny duplex nails.
   Plumb and brace the other ends of both panels.
   These panels will represent two concrete walls.

2. Layout Stair

   Determine the unit rise and unit run for the stair.
   Using a level, start at the top of the stair and layout the unit rise and unit run on the concrete side wall.
   Layout the one inch toe in.
   From the structural drawings determine the concrete stair slab thickness.
   Use a framing square and chalk box to layout the soffit line.

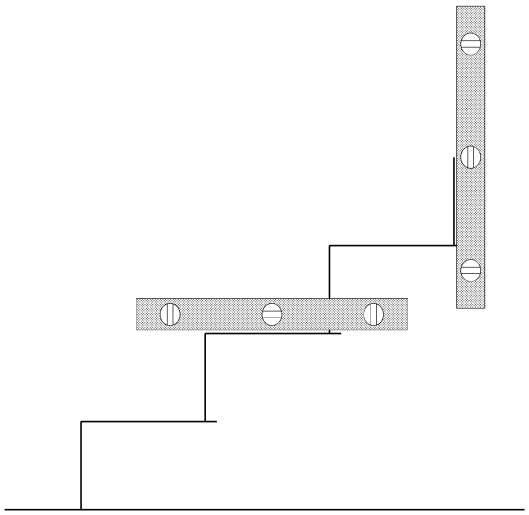


Fig. 5-1

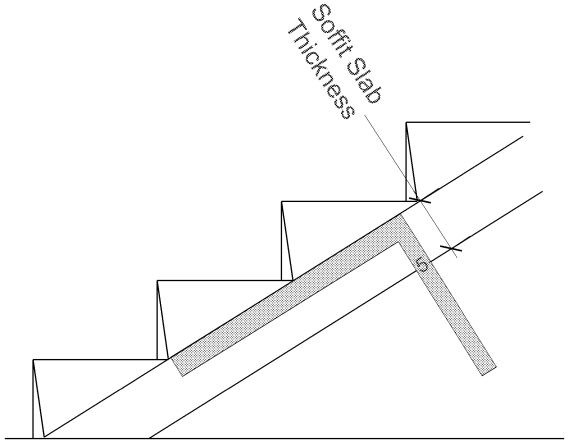


Fig. 5-2

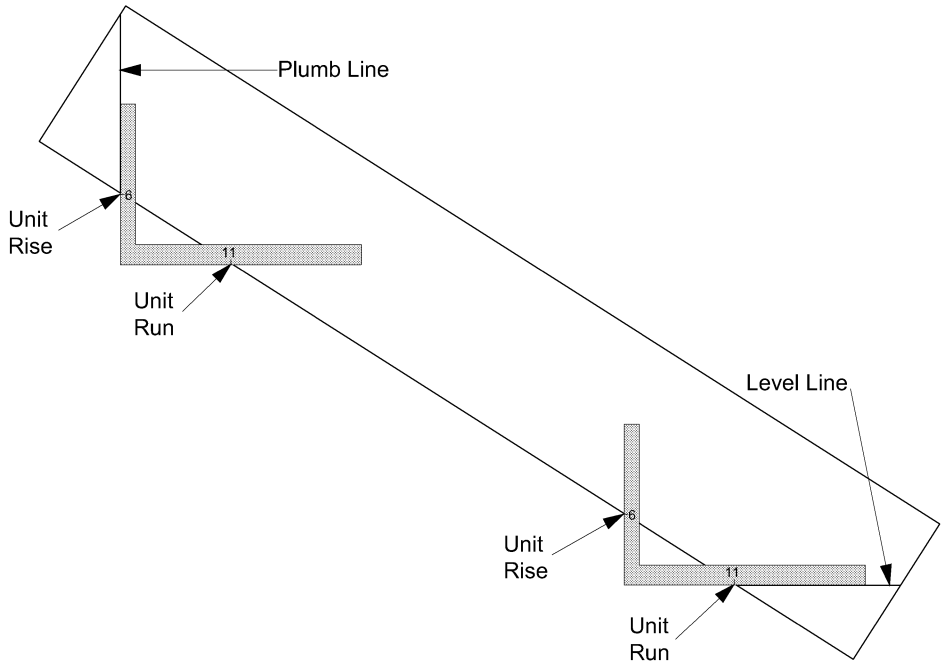
3. Construct Soffit Form.

The soffit forms are made up of sheathing, joist, stringers, and shores.
On the side wall layout the sheathing thickness, joist width, and stringer width.
Use this layout to determine the stringer and shore lengths.
On a 2x4 layout the stringer length.
Then use a framing square to layout the top and bottom cuts.
After the concrete is placed the stringer will be wedged between the wall, soffit, and floor.
To allow stripping, cut the stringer and cleat across the cut with a 3" x 10" piece of plywood.
Nail with duplex nails.
Install the mud sill, cut and place shore under the joist at the splice.
Install the joist.
Fasten the shore to the joist with a plywood cleat. Nail with duplex nails.
To facilitate stripping, install the soffit plywood in two pieces.

4. Construct and Erect Side Panel.

Using the drawing, build the side panel. Use 2x4 for the plate and studs. Sheath with 5/8 inch plywood
On the soffit, layout a parallel line two foot and six inches (2′-6″) from the concrete side wall.
Set the side panel in place and fasten it to the soffit with sixteen penny duplex nails at sixteen inches on center.
Plumb side panel at each end and brace. Install intermediate braces.

Fig. 5-3



5. Transfer Stair Layout to Side Panel

Using a level, start at the top of the stair and layout the unit rise and unit run on the concrete side wall.
Layout the one inch toe in.

6. Install Riser Boards.

Set the skill saw to forty five degrees and rip the riser boards to width.
Measure the width of the stairs and cut the riser boards to length.
Cut two 2x4s about sixteen inches long with a thirty to forty five degree cut across the face.
Nail each end of the riser board to a 2x4 with sixteen penny common.
Start at the top of the stairs. Install each riser in turn by nailing the 2x4 at each end of the riser board to side panel and concrete wall with sixteen penny duplex. (At the concrete wall, under job conditions, use a rotary hammer and a carbide bit and nails to fasten the 2x4 to the wall.)
Check riser boards for level.
On wider stairs reinforce the riser boards with brace and cleats.

7. Determine Concrete Volume

To determine the quantity of concrete calculate the surface area of the side of the stairs and multiply it by the stair width.
Use A = 1/2 B x A for the triangle formed by the unit rise and unit run.
Use A = L x H for the rectangle formed by the slab thickness.
Add them together to calculate the area of the side of the stairs.
Multiply the area by the width of the stairs.
Convert to cubic yards.

DO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT

CONCRETE STAIR FORMS

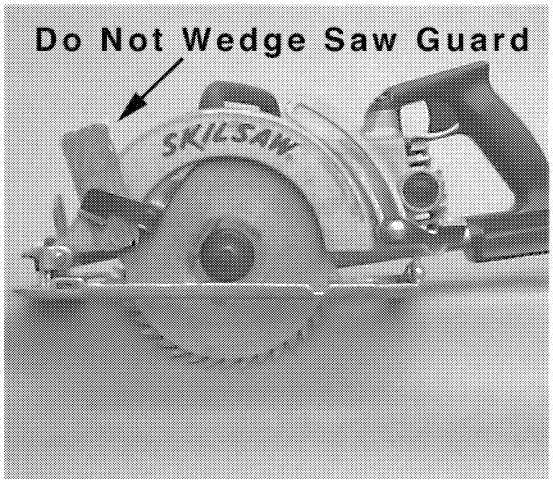
Do's

- Build a tight form
- Use duplex nails whenever possible
- Think of stripping
- Use form release
- Rip the bottom of riser board 45 degree for finishing

Don'ts

- Do not use duplex nails on form surfaces in contract with the concrete.
- Do not nail sheathing to the joist with duplex nails.
- Do not install the soffit plywood in one piece.

Do not wedge the saw guard.



Chapter 6 Form Detailing

THIS CHAPTER IS PLANNED TO PROVIDE ANSWERS TO THE FOLLOWING QUESTIONS:

- **What is meant by form detailing?**
- **What is the purpose of a form detail?**
- **Where does the information for the preparation of the form detail come from?**
- **What are the uses of a form detail?**

INTRODUCTION

Formwork for concrete buildings, bridges, and other complex structures must provide for many shapes, offsets, inserts, and openings. The process of detailing will bring to light the many different problems the carpenter will face in constructing, erecting, and stripping the forms. If the details are carefully drawn, proper thought can be given to preplanning the formwork. This will save time and will reduce the chance that mistakes will be made in the field. It will also permit the estimator to make an accurate list of the form materials needed to complete the job.

REQUIREMENTS FOR FORMWORK

Forms should be styled to meet the architectural requirements of the project, and then designed for load bearing. The following are some general requirements for concrete formwork:

1. The form must be rigid enough so that it will not bulge or twist when filled with a high-density concrete mass. It must be able to resist deflection under any expected load.
2. Joints must be tight enough to prevent mortar leakage.
3. The texture of the form materials and the fit of the parts must not detract from the aesthetic effect desired for the exposed concrete surfaces.
4. Formwork must be designed for easy removal after the concrete has hardened. This is important not only to reduce hazards and prevent loss of time but also to prevent chipping and marring when the forms are being stripped from the concrete.

FORM DETAILS

A form detail is a working drawing that a carpenter can take and use to build a form panel.

The individual preparing the detail takes the information from the plans and specifications and puts it on a single page in a readable form.

PURPOSE

The form detail will have all of the information the carpenters need to build the panel. They will not have to refer to the architectural and structural drawings. It also reduces clutter and

confusion by eliminating non essential information such as unnecessary lines, dimensions, and symbols. The process of detailing the forms will help to plan the project and eliminate errors.

PLANS AND SPECIFICATIONS

Form detailing consists of two steps: (1) visualizing the forms that will be needed to produce the required concrete shapes for a construction project; and (2) transferring this mental picture of the forms to drafting paper. A careful study of the plans and specifications for the project is an important preliminary step in making the detail drawings for the forms. The plans show the concrete shapes that must be produced; the specifications may fix requirements for the concrete finish, including the types of form materials that are to be used for obtaining the desired finish. The journeyman carpenter must have a basic knowledge of the detailing process so that the carpenter can construct the finished forms from the detail drawings.

Methods of form detailing vary, depending on job conditions. However, they all have one thing in common; the detail drawings must be based upon the plans and specifications for the project, and they must in no way be in conflict with them. An error in translating information from the plans and specifications to the formwork details can be very costly, even if the error is discovered and corrected before the concrete is placed. The person detailing the forms must therefore have a thorough knowledge of blueprint reading and construction methods, and must be aware of any special problems that will have to be taken into account in planning, building, and using the forms for the construction project. This is important for safety as well as economy.

DETAILING THE FORMS

The method used in form detailing depends on the size and complexity of the construction project. On a small job, it may be possible to show all the necessary formwork details with a few relatively simple shop drawings. Depicting all the formwork details for a large job, on the other hand, may require several sheets of detail drawings, including plan, elevation, and sectional views. Regardless of the size of the job, however, the detailer must prepare the drawings so that they do not conflict in any way with the architect's working drawings and specifications for the project. All dimensions, grades, elevations, datum locations, and the like must conform exactly to information given in the set of plans for the project.

Form detailing should be done in the same order that the building will be built. The detailer should start in the excavation with the footings, continue with the stem walls to the first-floor level, then go on to the second-floor level, and so on. The detailer must anticipate the needs of the workmen with regard to safe construction, use, and stripping of the forms. Also, in planning the formwork, the detailer must keep in mind the need for using the most economical methods for building, installing, and stripping the forms and placing the concrete.

SAFETY CONSIDERATIONS IN FORMWORK

All forming operations are hazardous. Forms and shores are usually heavy and unwieldy, and the erecting and stripping operations often must be carried on from scaffolds or platforms and in

locations where work space is limited. Safety must therefore be a prime consideration in every phase of the work, starting with the planning and detailing of the forms. Adequate planning includes provision for safety in building the forms; safety in handling the forming and shoring components, including both manual and mechanical handling; and safety for those who will be placing the concrete.

Work platforms and scaffolds must meet the requirements set forth in the California Construction Safety Orders, including requirements for standard safety railings. When safety belts and lifelines must be used, these must be of approved types. In some cases, where other methods of protection against falls are impractical, safety nets under the work area are necessary and required.

NOTES:

Lesson 6 Form Detailing

INTRODUCTION

In this lesson you will determine the panel dimensions and the tie layout for a concrete wall form panel. You will be given a drawing showing a plan and elevation view of a typical concrete wall. You will be provided with a generic panel detail. You will fill in the blanks.

LESSON OBJECTIVES

Each student will determine panel dimensions and snap tie layout.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. Determine panel lap and intersection [configuration]
2. Determine panel height and width.
3. Determine horizontal and vertical snap tie layout.
4. Designate snap tie hole dimensions.

APPLICATION IN THE FIELD

In double waler form construction, carpenters are frequently given the dimensions of simple concrete walls and told to build the forms. The carpenter needs to familiar with the factors that determine the panel size and tie location.

EVALUATION:

Each student will be evaluated on the accuracy of their dimensions.

EQUIPMENT

To be supplied by the training facility

1. None

STUDENT TOOLS

1. One [1] Pencil
2. One [1] Calculator

PANEL DETAIL FORMAT

To ensure the snap tie holes on opposite panels are aligned, the panels are often detailed as pairs.

The way to visualize the panels is to imagine looking at the top of a concrete wall with the panels stripped and laying on the ground. See Fig. 6-1. The bottoms are towards the wall and the tops away from it.

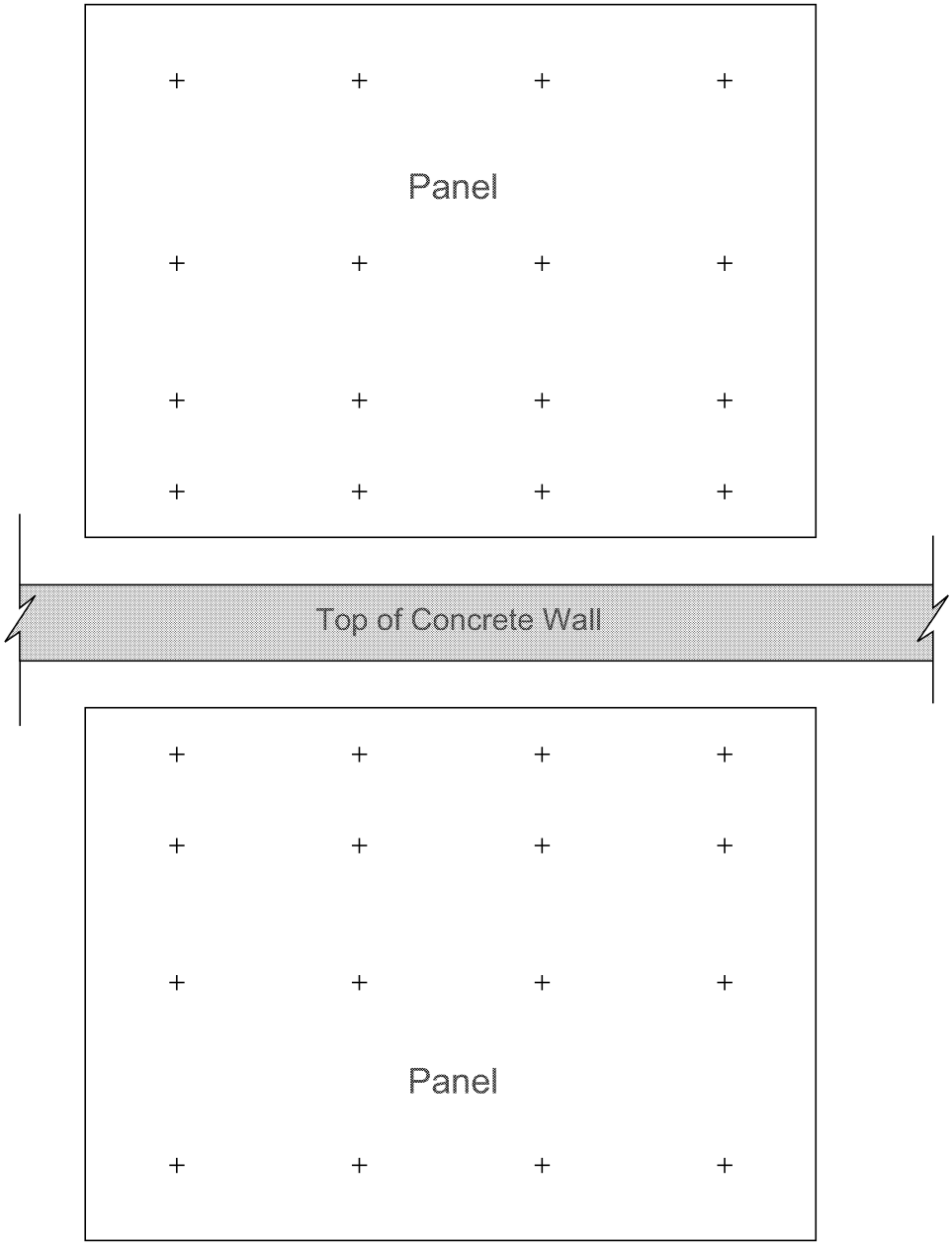


Fig. 6-1

Removing the concrete wall leaves a pair of panels. The horizontal snap tie spacing on one panels will transfer to the opposite panel. Vertical snap tie spacing is measured from the bottom of each panel.

The panel details in lesson #3 follow this format. See lesson #3 manipulative project page 2 of 5 (Double Walers/Panels)

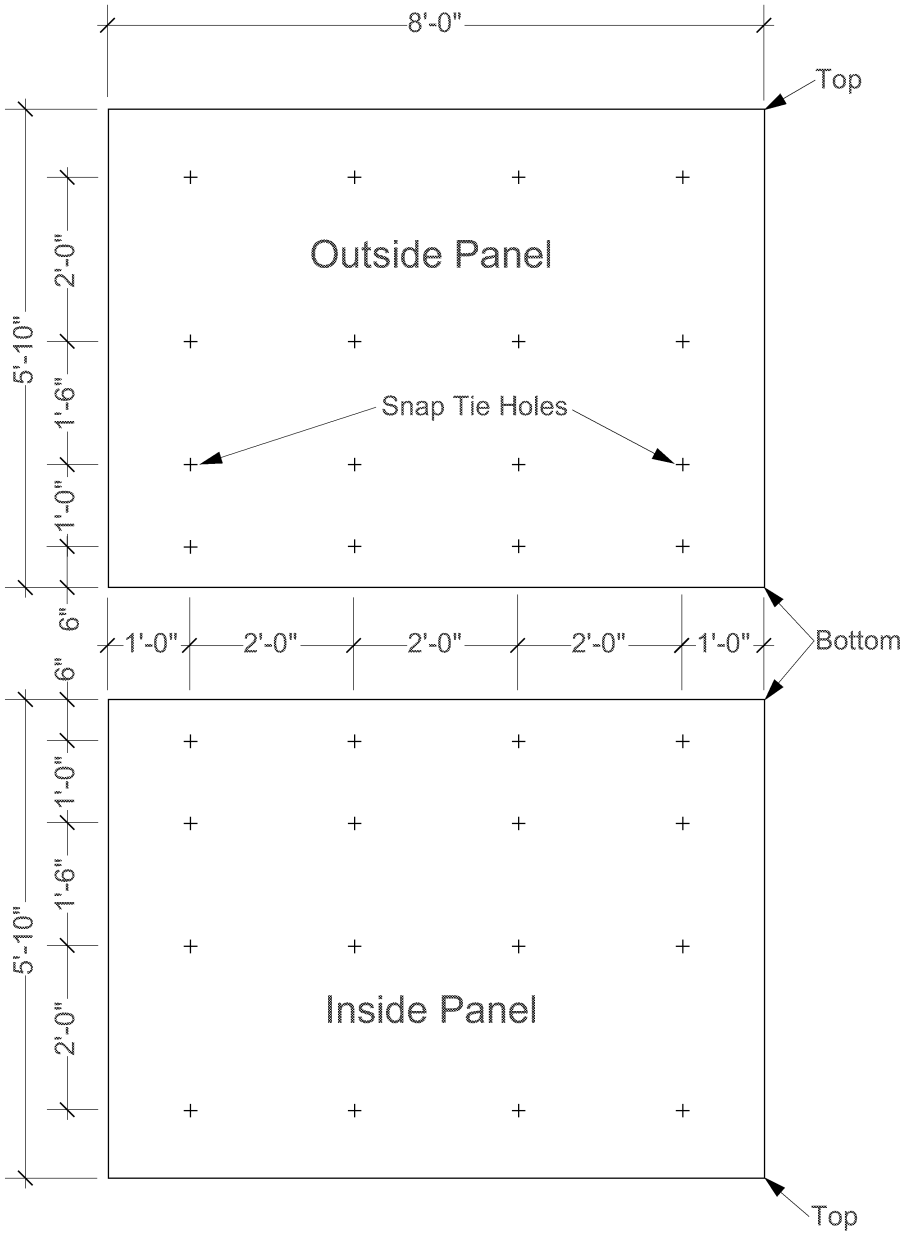


Fig. 6-2

PROCEDURES:

Read the following instruction and complete the exercise on. Then use the plans and details provided and the following directions to determine panel dimensions and snap tie spacing.

1. Determine Outside Panel Length.

   Outside panel sides are either flush with the corner of the concrete wall or extend past it. See Figure 6-3.(Fig. 6-3 on page 63)

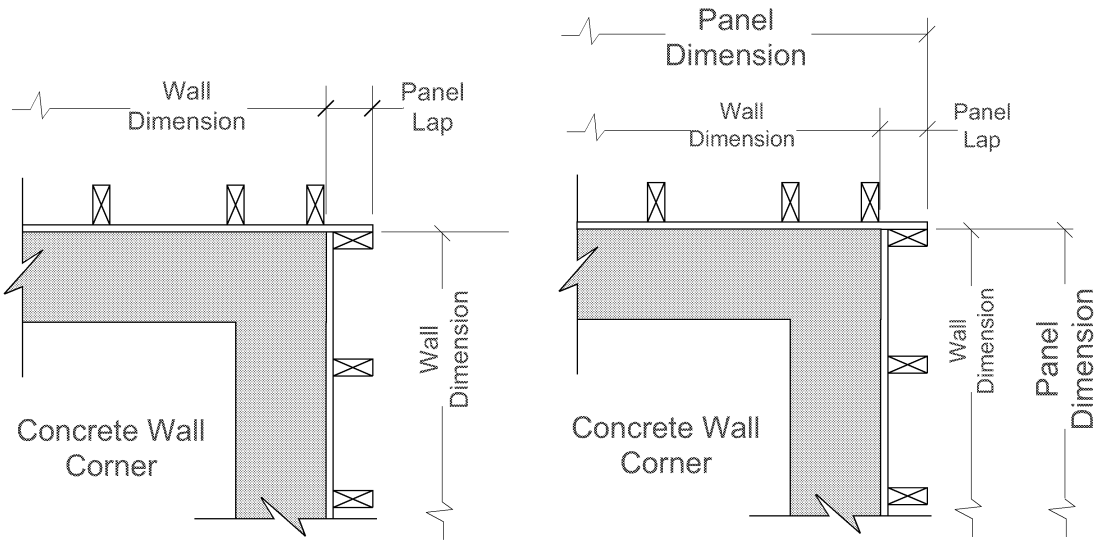


Fig. 6-3

To provide nailing for the bulkhead, outside panel sides extend past the end of the concrete wall . (Fig. 6-4 on page 63)

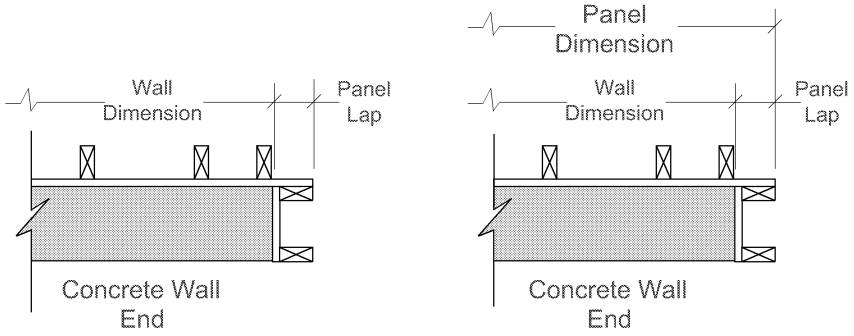


Fig. 6-4

Panel length is determined by adding the concrete wall dimension and the extension at one or both ends.

2. Determine Inside Panel Length

Inside panels at the wall corner either butt into the concrete wall or the back of the adjacent panel. For the latter panel, the detailer will have to deduct for thickness of the first panel. Note the form detailer has made a decision as to how the forms will be assembled.

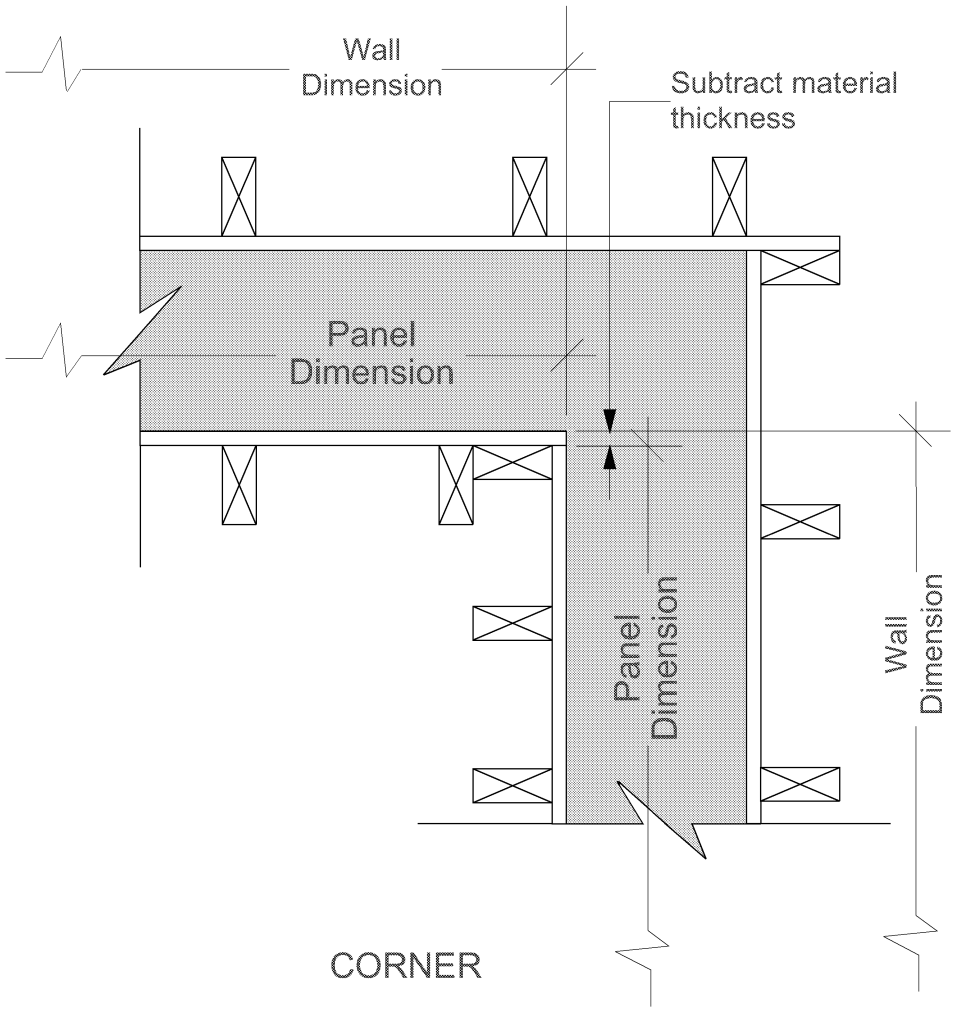


Fig. 6-5

3. Determine Panel Height

Panel height is the distances from the top of the footing to the top of the wall plus [+] one or two inches.
The additional one to two inches will allow the carpenters erecting the panels to compensate for any irregularities in the footing.
The top of concrete is set by the installing a pour strip.

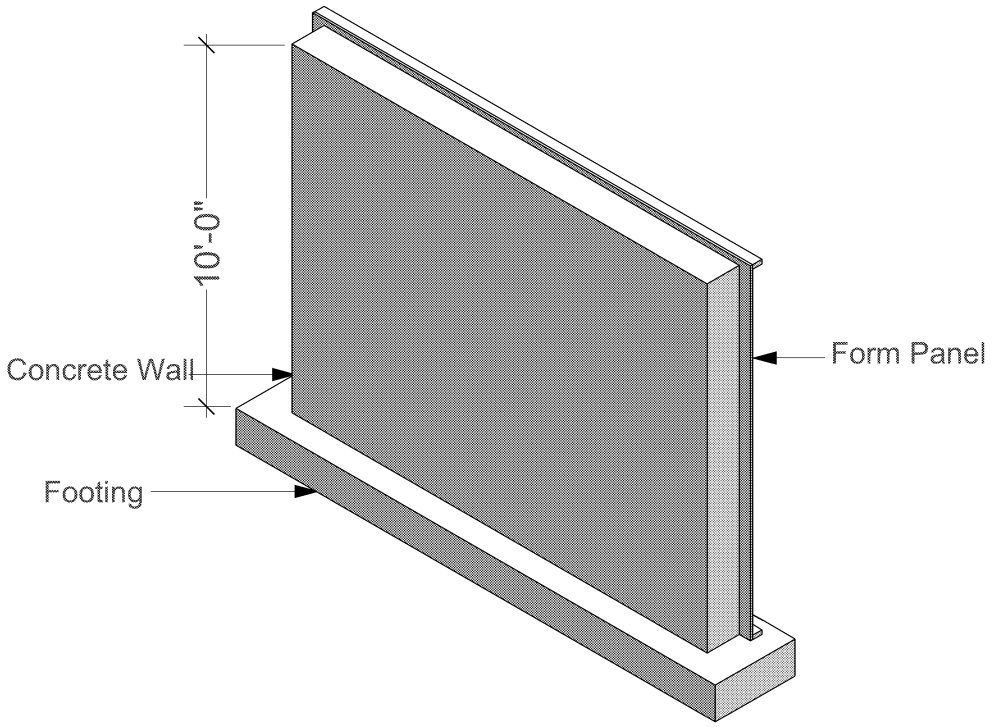


Fig. 6-6

4. Determine Vertical Snap Tie Layout

Vertical snap tie spacing depend upon the pressure the concrete places on the form. Some of the factors that affect concrete pressure are the height of the pour, pour rate, weight of the concrete, temperature, vibration, concrete slump, and chemical additives. See the Appendix for further information.

The carpenter is usually provided with the vertical snap tie spacing. The form section illustrates the vertical snap tie layout. The panel detail shows the layout.

Note: The layout starts at the bottom of each panel.

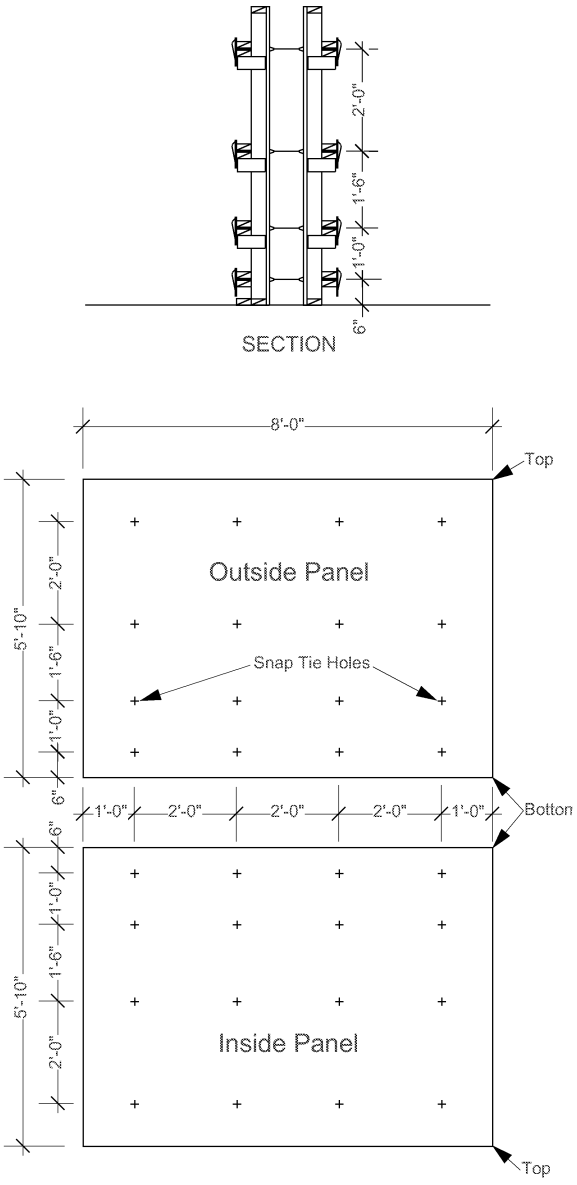


Fig. 6-7

5. Determine horizontal snap tie layout.

   In double waler form construction, the horizontal spacing is usually two feet on center. At corners, intersecting wall, and pilasters this standard spacing may place on end of the snap tie in the concrete wall. The snap tie will have to be move so as avoid the concrete and to miss the form panel and walers on the opposite side of the concrete wall. The snap tie hole is dimensioned from the end of the panel. it is determined by adding the panel thickness [$4^1/_4$″], the 2x4 waler width [$3^1/_2$″], and hair pin width [2″]. The answer is $9^3/_4$ inches. For convenience round off the dimension to 10 inches.

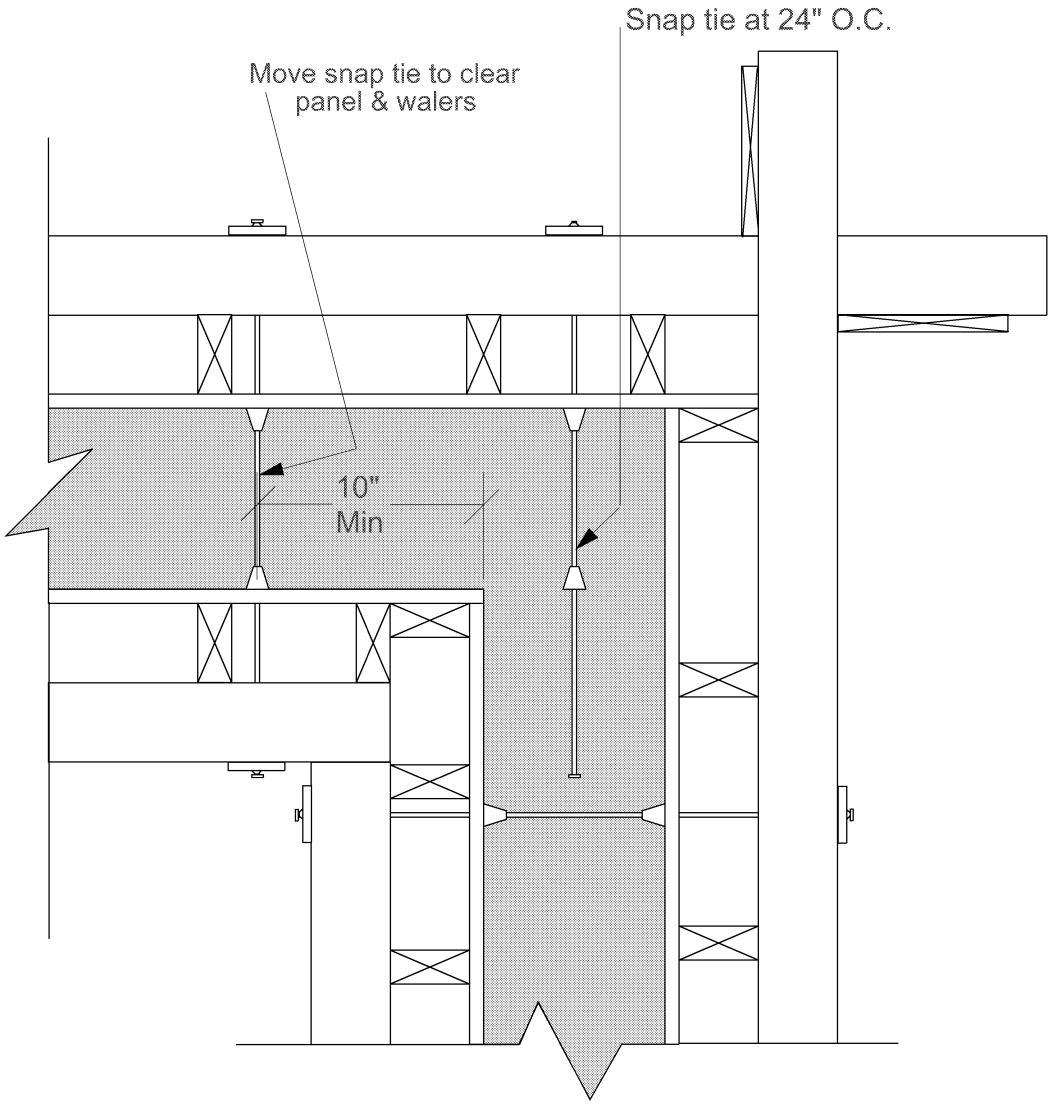
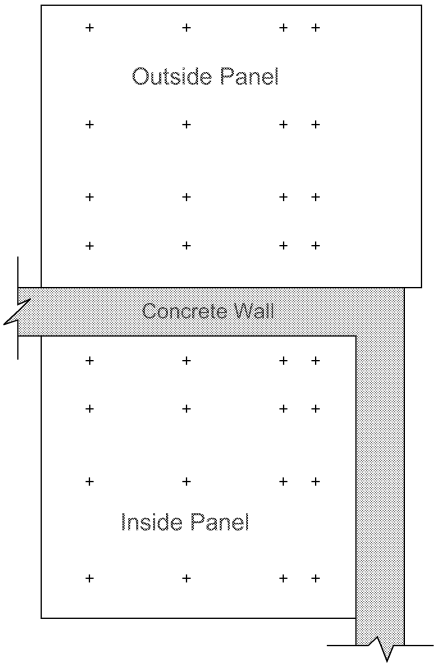


Fig. 6-8 Corner



6. The panel detail will look like (Fig. 6-9 on page 68) . Note the panel edges away from the concrete corner are aligned; and the snap tie holes in the opposite panels are also aligned

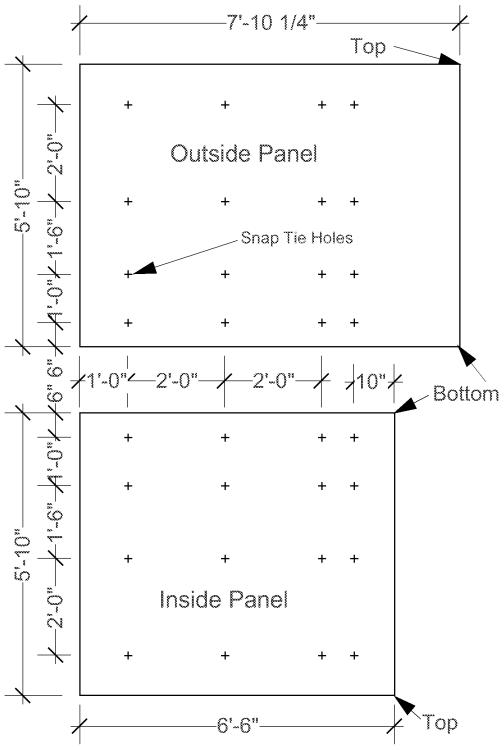


Fig. 6-9

EXERCISE:

The wall illustrated below is 13′-0″ long, 10′-0″, high, and 1′-0' wide. The horizontal snap tie spacing is 24″ O.C., with the first ties 6" from the end of the wall. The vertical snap tie spacing is shown in the section view.

The form panels are constructed with 2x4 studs and plates and $^{5}/_{8}$ inch plywood sheathing.

Determine the panel dimensions and the snap tie layout.

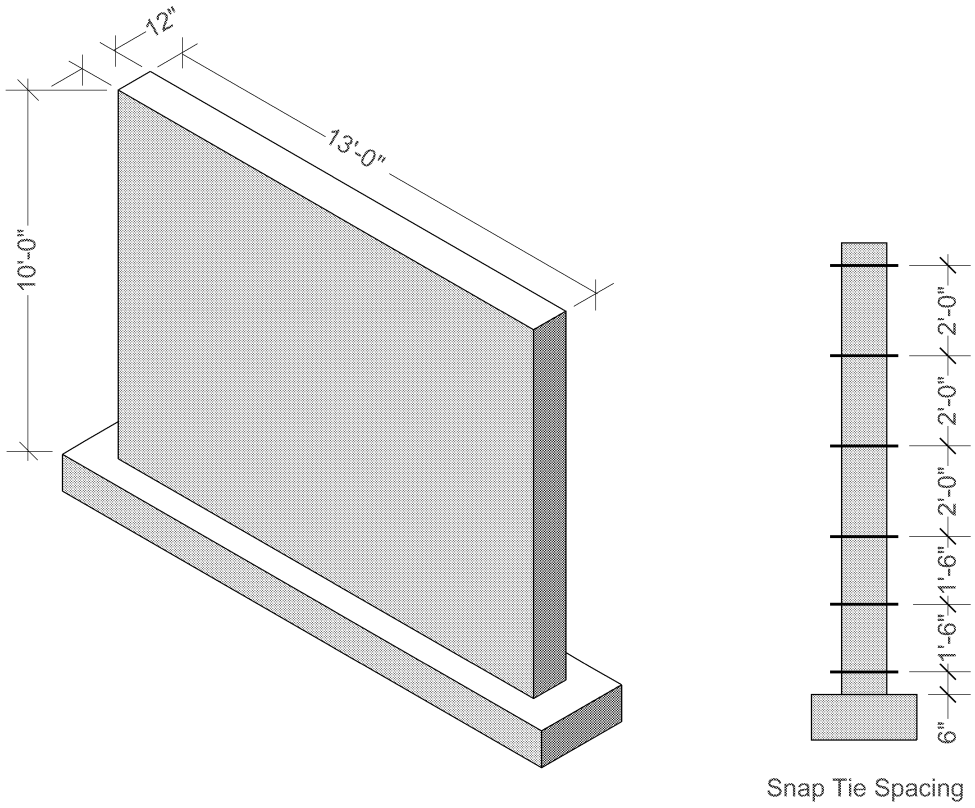


Fig. 6-10

EXERCISE #1

INSTRUCTIONS

Use the information provided in (Fig. 6-10 on page 69) to dimension the panels below

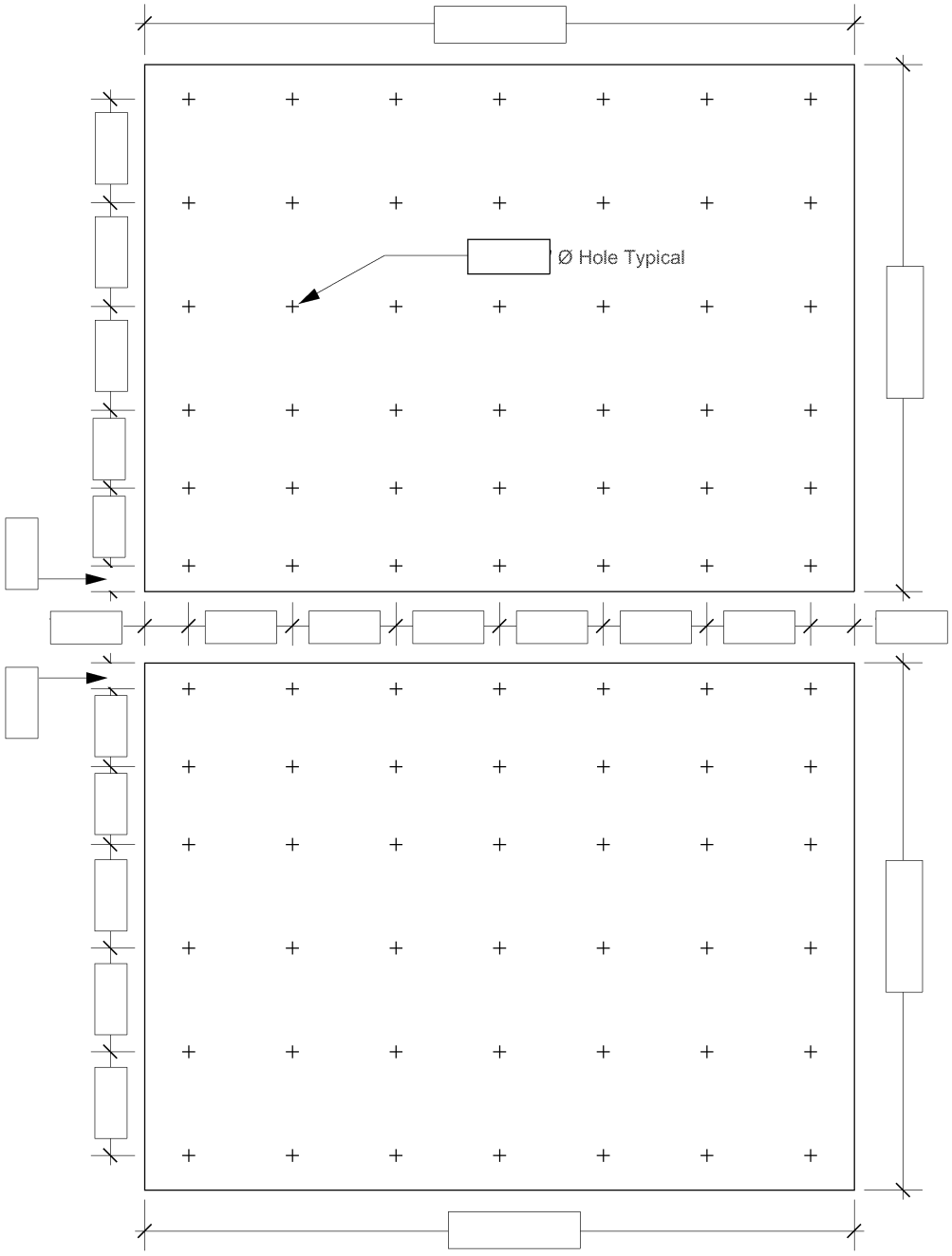


Fig. 6-11

EXERCISE #1 - SOLUTION

The panel width is the length of the concrete wall plus the lap at each end for the bulkhead.
That is 13′-0″ + 4 $^{1}/_{8}$″ + 4$^{1}/_{8}$″ = 13′-8$^{1}/_{4}$″.
The panel height is the height of the wall plus two inches.
That is 10′-0″ + 2″ = 10′-2″.
The first vertical row of snap ties is the distance from the end of the wall to the first tie plus the panel lap.
That is 6″ + 4 $^{1}/_{8}$″ = 10 $^{1}/_{8}$″.
The spacing is then 24″ O.C.
The first horizontal row is 6 inches from the bottom of the panel. The spacing is shown on the section view. Remember the bottoms of the pair panels abut each other and the vertical snap tie spacing is laid out from the bottom of the panels.

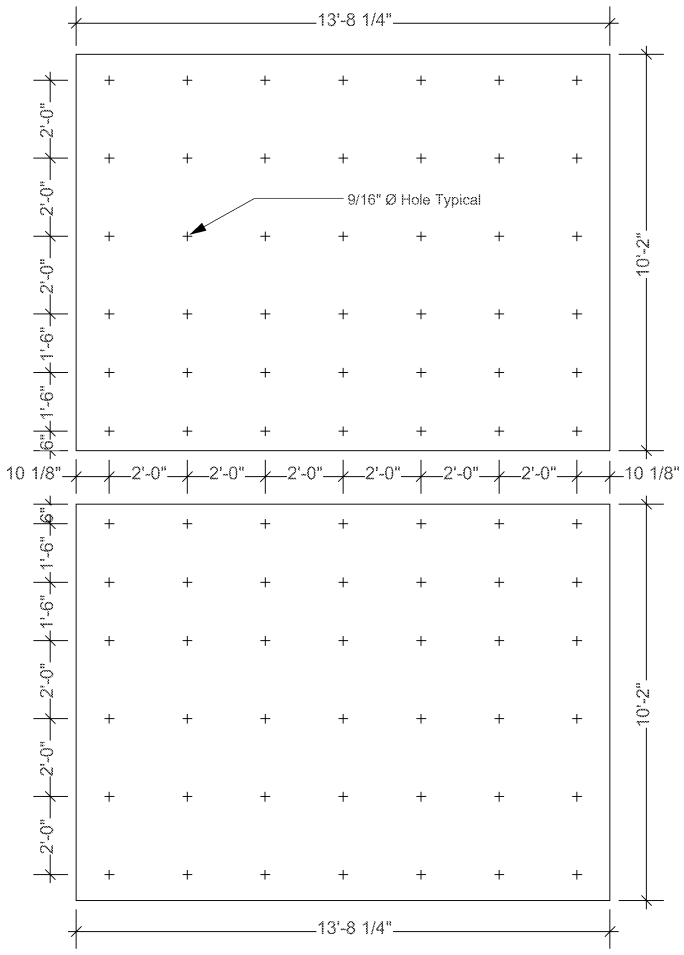


Fig. 6-12

NOTES:

007 UBC CHAPTER 1

FORM TIES

STUDY GUIDE

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. A one piece form tie that extends through both walls of a form is:

   a. An internal disconnecting tie
   b. External tie
   c. A he bolt
   d. A continuous single-member tie

2. Which of these items is not an external holding device?

   a. Snap tie
   b. Coil tie
   c. Taper tie
   d. Pencil rod

3. The groove on a tie's surface that allows the tie to break when twisted is called a:

   a. Breakback
   b. Crimper
   c. Cut-off
   d. Twister

4. To help facilitate removal of a taper tie, the tie should be:

   a. Painted
   b. Heated
   c. Greased
   d. Dry

5. Pencil rods are held in place by:

   a. Bolts
   b. Wedges
   c. Pins
   d. Rod clamps

6. An alternative to metal ties, this tie is rust-proof and can be cut to length on the job site.

   a. Plastic tie
   b. Fiberglass tie
   c. Pencil rod
   d. PVC tie

7. Which of the following would not be used to patch holes left by the removal of ties or their ends?

   a. Non-shrinking, moisture-resistant grout
   b. Dry-pack mortar
   c. Drywall joint compound
   d. Special plastic plug or cap, held in place with epoxy

8. A snap tie is often secured with a device known as a:

   a. Hairpin
   b. Clamp tie
   c. Cathead
   d. Coilnut

9. She bolts are connected through the use of:

   a. Coil assembly
   b. Inner rod
   c. Snap tie
   d. Pencil rod

10. The looped ends of a looped panel tie are usually held in place with:

   a. Tie clamps
   b. Catheads
   c. Hairpins
   d. Wedge bolts

11. What holds a she bolt in place?

   a. Catheads
   b. Tie clamps
   c. Hairpins
   d. Wedge bolts

007 UBC CHAPTER 2 & 3

BRACKETS AND CLAMPS - OTHER FORM HARDWARE

STUDY GUIDE

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. When building forms with snap ties and only one waler, what bracket should be used?

   a. Waler bracket
   b. Cantilever bracket
   c. Single waler bracket
   d. Shear bracket

2. Building and securing column forms can be simplified with the use of:

   a. Pinch clamps
   b. Wood clamps
   c. Pipe clamps
   d. Column clamps

3. Single waler brackets can be installed:

   a. Only after the walers are in place
   b. Either before or after the walers
   c. Only before the walers are in place
   d. Only vertically

4. What type of form tie is secured by a coil nut?

   a. Snap tie
   b. Coil rod
   c. Fiberglass
   d. Spandrel

5. Today, penny size usually represents a nail's _____.

   a. Length
   b. Weight
   c. Diameter
   d. Head size

6. A piece of hardware that can be set in wet concrete and serves a purpose after the concrete has hardened is called:

   a. A hanger
   b. A wet bolt
   c. An embedment
   d. A wing nut

7. An insert is a piece of hardware that is placed in concrete to provide and anchor for something else. Which of the following is a type of insert?

   a. Coil loop insert
   b. Lifting insert
   c. Wedge insert
   d. All of the above

8. This piece of hardware is attached to a 2 x 4 brace and allows for the adjustment of the alignment of the forms.

   a. Turnbuckle
   b. Steel stake
   c. Scaffold bracket
   d. Liner clamp

9. A piece of hardware that suspends one object from another is known as what?

   a. An insert
   b. A hanger
   c. An embed
   d. A steel plate

10. What is the length of a 16d nail?

    a. 3 1/2"
    b. 3 5/8"
    c. 3 1/4"
    d. 3"

007 UBC CHAPTER 4

WALL, PILASTER AND COLUMN FORMS

STUDY GUIDE

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. The force and thrust exerted by plastic concrete against the sides of a form is known as:

   a. Tensile pressure
   b. Vertical pressure
   c. Lateral pressure
   d. Torsion pressure

2. This type of concrete joint is a groove that is formed or cut into a slab or wall to control cracking of the concrete.

   a. Expansion joint
   b. Control joint
   c. Construction joint
   d. Isolation joint

3. What is the most effective angle for a brace?

   a. 30°
   b. 22.5°
   c. 60°
   d. 45°

4. A horizontal member that is attached to the outside of a form wall to strengthen and align the form wall is a:

   a. Stud
   b. Waler
   c. Strongback
   d. Stiffener

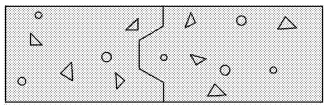
5. The design of concrete formwork will include which of the following considerations?

   a. Difficulty of construction
   b. Strength of the form
   c. Ease of stripping
   d. All of these

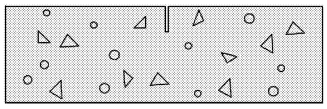
6. Which type of round column form uses a bracing collar?

   a. Steel framed form
   b. Molded fiberglass form
   c. Tubular fiber forms
   d. None of the above

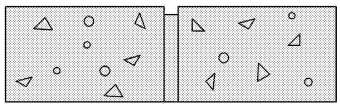
A



B



C



7. What type of concrete joint is shown by drawing A above?

   a. Control joint
   b. Edge joint
   c. Expansion joint
   d. Construction joint

8. What type of concrete joint is shown by drawing B above?

   a. Control joint
   b. Edge joint
   c. Expansion joint
   d. Construction joint

9. What type of concrete joint is shown by drawing C above?

   a. Control joint
   b. Edge joint
   c. Expansion joint
   d. Construction joint

10. A concrete wall that is 6 feet tall will exert how much pressure at the bottom of the form?

    a. 750 lbs./sq.ft
    b. 900 lbs./sq.ft
    c. 600 lbs./sq.ft
    d. 1200 lbs./sq.ft

11. When concrete is first placed and takes the shape of the form, it is known as:

    a. Plastic
    b. Fresh
    c. Flexible
    d. Early

12. Column forms may be constructed of which of the following materials?

    a. Plywood
    b. Fiberglass
    c. Steel
    d. All of these

NOTES:

007 STUDENT LESSON BOOK CHAPTER 4

STUDY GUIDE

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. Forms should be planned, constructed and erected in such a way that stripping can be accomplished:

   a. With minimum breakage of form material
   b. With a three man crew
   c. By a labor gang with minimum supervision
   d. Without use of power equipment

2. Concrete leakage at any point on the form will affect concrete:

   a. Strength
   b. Displacement
   c. Deflection
   d. Cure

3. An ample amount of form oil should be used as a release agent on forms to:

   a. Avoid distorting the forms
   b. Increase the hydration rate
   c. Prevent loosening the snap-tie wedges
   d. Aid form stripping

4. Which of the following is a suitable release agent for use on metal forms?

   a. Light oil
   b. Light grease
   c. Kerosene
   d. Aspahltic paint

5. In general, forms should be stripped:

   a. Three days after the concrete has been placed
   b. In the same order in which they were erected
   c. When test samples show that hydration is complete
   d. In the reverse order of erection

6. If prying force must be applied between a form panel and the concrete surface to strip the panel, what should be used to do the prying?

   a. A small pinch bar
   b. Polished steel wedges
   c. A wide framing chisel
   d. Wooden wedges

7. Rustication strips, wood inserts and similar items that many be required on a form panel should be installed:

   a. With flathead wood screws
   b. After the forms have been doubled up
   c. With casing nails or form nails
   d. After the reinforcing steel is placed

8. Rustication strips should be:

   a. Left in place as long as possible
   b. Removed as soon as the walls are stripped
   c. Thoroughly moistened before being stripped
   d. Pried out at the center

9. The time period between placing the concrete and stripping the forms is determined by:

   a. Owner
   b. Carpenter foreman
   c. Specifications
   d. Plans

10. From panels that are to be reused in subsequent pours should be scheduled for stripping at a time when they can be removed and reset:

    a. With minimum use of power equipment
    b. In one continuous operation
    c. Without disturbing the walers
    d. Without stripping off any trim molds

007 UBC CHAPTER 5

CONCRETE STAIR FORMS

STUDY GUIDE

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. With stairs, the vertical distance from one floor to the next floor is the:

   a. Total run
   b. Total rise
   c. Unit run
   d. Unit rise

2. In the construction of open stairways, rebar extending from the floor level above and below is:

   a. Tied the rebar in the stairway
   b. Used as a decoration
   c. Capped as a safety measure
   d. Tied to the nosing

3. What is the preferred angle for stairs?

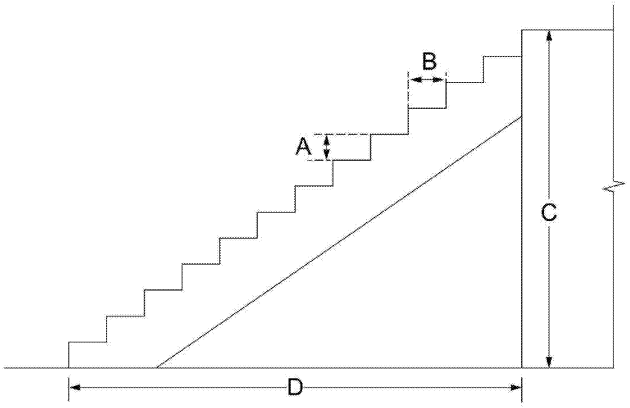
   a. 30° to 45°
   b. 35° to 40°
   c. 25° to 35°
   d. 30° to 35°

4. What is the unit rise of a stair with a total rise of 4'-10" and 8 risers?

   a. 7 1/4"
   b. 6 3/4"
   c. 7 1/8"
   d. 7 3/16"

5. Rip the riser form board to:

   a. 15°
   b. 25°
   c. 45°
   d. 55°



6. In the drawing above, the letter **A** is indicating what part of the stair?

   a. Total rise
   b. Total run
   c. Unit rise
   d. Unit run

7. In the drawing above, the letter **B** is indicating what part of the stair?

   a. Total rise
   b. Total run
   c. Unit rise
   d. Unit run

8. In the drawing above, the letter **C** is indicating what part of the stair?

   a. Total rise
   b. Total run
   c. Unit rise
   d. Unit run

9. In the drawing above, the letter **D** is indicating what part of the stair?

   a. Total rise
   b. Total run
   c. Unit rise
   d. Unit run

10. The soffit is what part of the stair?

a. Top
b. Bottom
c. Center
d. Side

11. Toe in increases the:

a. Tread width
b. Unit run
c. Unit rise
d. Riser thickness

12. What type of stairway is set between two walls?

a. Open
b. Winder
c. Closed
d. Semi-open

13. In general, when are the riser form boards stripped?

a. After the concrete is completely set
b. As the concrete hardens
c. One day later
d. It does not matter

14. What is the unit run of the stair that has a total run of 5'-7 1/2" and 6 treads?

a. 11 1/4"
b. 13 1/2"
c. 11 1/8"
d. 11 5/16"

NOTES:

007 CONSTRUCTION SAFETY ORDERS

STUDY GUIDE

Instructions: Use the California Construction Safety Orders to answer the questions in the blank provided.

1. The top rail of a scaffold guard rail shall be installed how high above the platform?

   _____

2. On a scaffold, where are railings required?

   _____

3. What type of nails shall not be used in the construction of scaffolds, falsework or other temporary installations?

   _____

4. What is the maximum spacing of a bracket scaffold?

   _____

5. How many and what size planks are required for the platform on a bracket scaffold?

   _____

6. The Construction Safety Orders allows three types of access to scaffold platforms. What are they?

   _____

7. Are nailed lifting attachments allowed on concrete form panels?

   _____

8. What is the safety factor for form panels that weigh more than 500 pounds?

   _____

9. Which is allowed, a cap or a protective cover, when employees are working above grades or surfaces that have exposed reinforcing steel?

   _____

10. When is a ramp or ladder required in passageways, entries and exits?

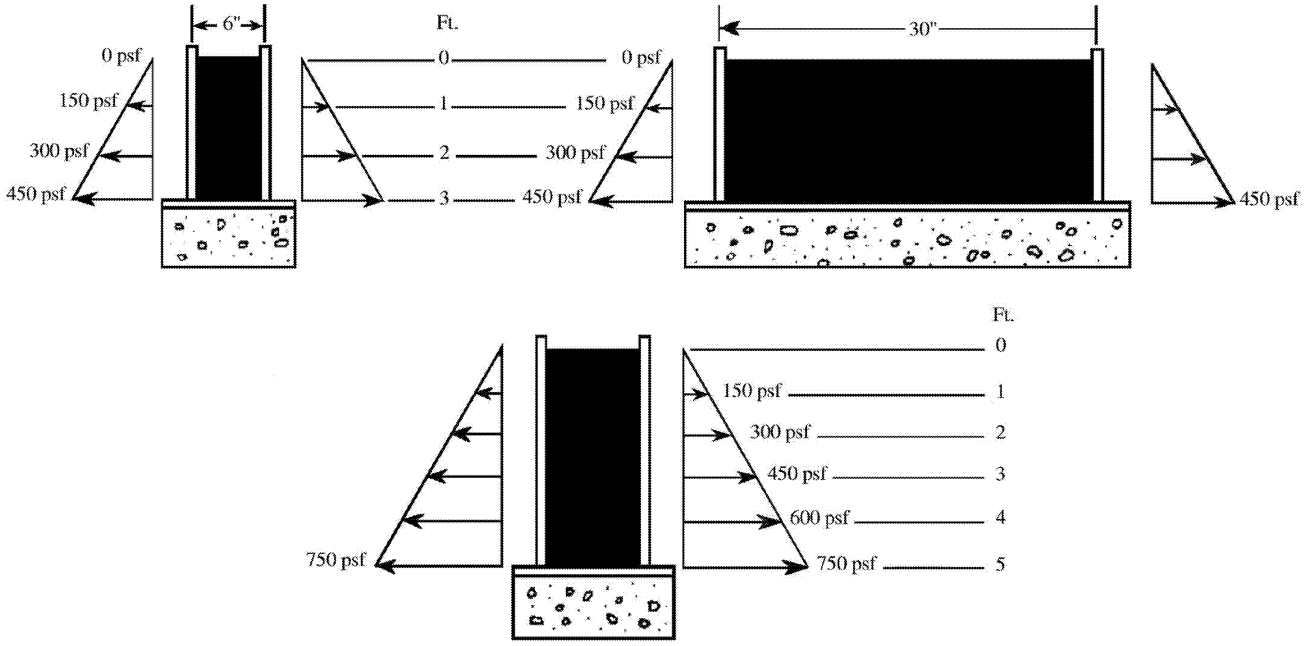
    _____

UNDERSTANDING CONCRETE PRESSURES AND LOADS ON FORMWORK

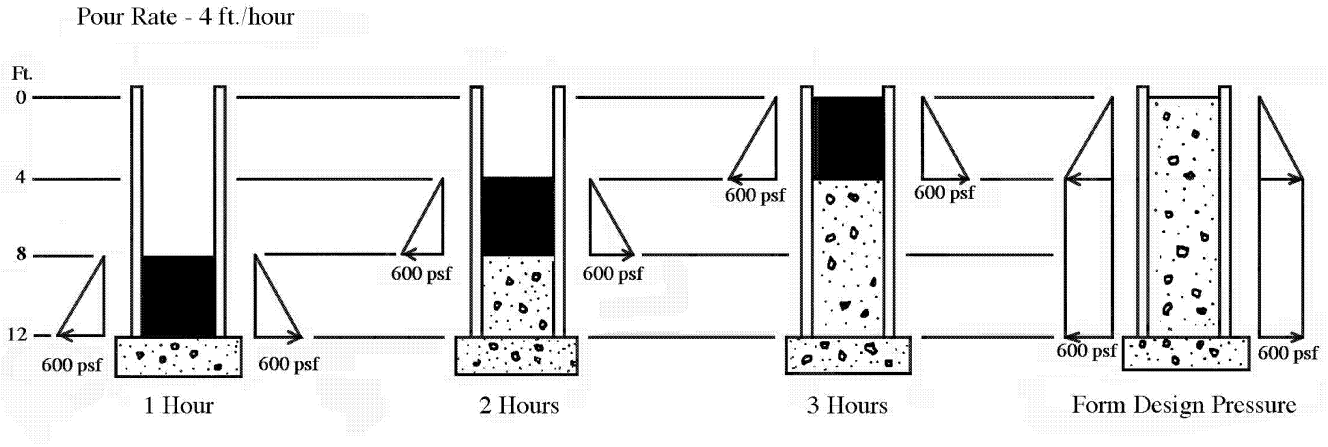
Designing and building formwork effectively requires a basic understanding of how concrete behaves as it exerts pressure on formwork.

Lateral concrete pressure is affected by: 1) height of pour; 2) pour rate; 3) weight of concrete; 4) temperature; 5) type of cement; 6) vibration; 7) concrete slump (water - cement ratio); 8) chemical additives.

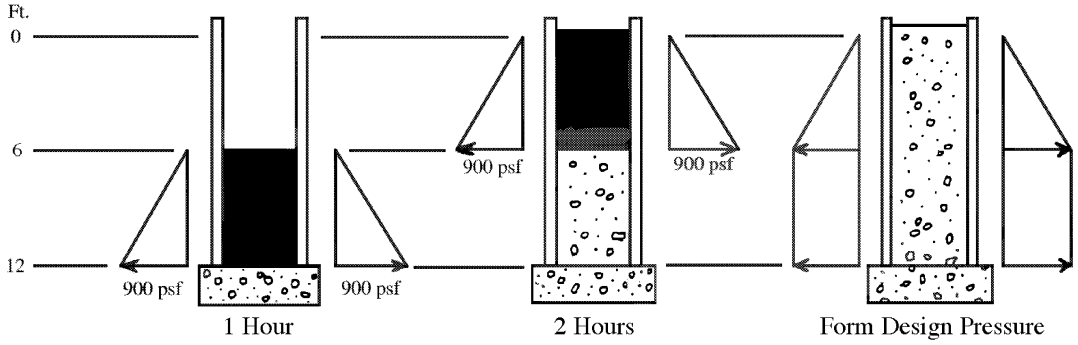
1. **Height of Pour.** Before concrete hardens, it acts like a liquid and pushes against the forms the way water presses against the walls of a storage tank. The amount of pressure at any point on the form is directly determined by the height and weight of concrete above it. **Pressure is not affected by the thickness of the wall.**



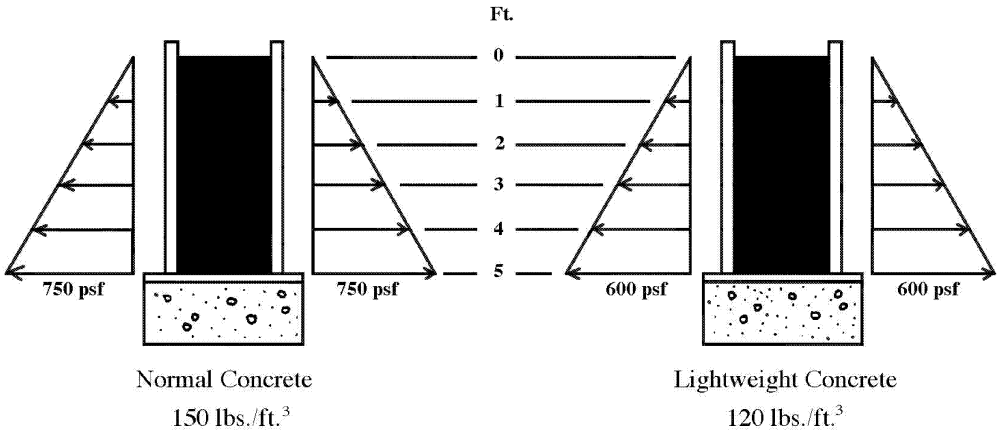
2. **Pour Rate.** Concrete pressure at any point on the form is directly proportional to the height of liquid concrete above it. If concrete begins to harden before the pour is complete, the full liquid head will not develop and the pressure against the forms will be less than if the pour were completed before any of the concrete hardened. Once concrete hardens it cannot exert more pressure on the forms even through liquid concrete continues to be placed above it. The following diagrams for a 12 ft. wall illustrate how form pressure varies when the pour rate is increased from 4 ft. to 6 ft. For ease of explanation, it is assumed that concrete hardens in one hour (typically at 70° F). This will cause the form pressures shown on these diagrams to differ slightly from ACI recommended pressures.



When the pour rate is increased to 6 ft. per hour, the pressure also increases.



3. **Weight of Concrete.** Pressure exerted against the forms is directly proportional to the unit weight of concrete. Light weight concrete will exert less pressure than normal weight concrete.



4. **Temperature.** The time it takes concrete to harden is influenced greatly by its temperature. The higher the temperature of the concrete, the quicker it will harden. Most formwork designs are based on an assumed average air and concrete temperature of 70°F. At low air temperatures, the hardening of the concrete is delayed and you need to decrease your pour rate or heat your concrete to keep the pressure against the formwork from increasing. Ideally, concrete should be poured at temperatures between 60°F and 100°F. Outside this temperature range there is often insufficient moisture available for curing. If adequate water for curing is not available or freezes, the strength of the concrete will suffer.

5. **Type of Cement.** The current type will influence the rate at which concrete hardens. A high early strength concrete will harden faster than normal concrete and will allow a faster pour rate. When using a cement which alters the normal set and hardening time, be sure to adjust the pour rate accordingly.

6. **Vibration.** Internal vibration consolidates concrete and causes it to behave like the pure liquid previously discussed. If concrete is not vibrated, it will exert less pressure on the forms. ACI recommended formulas for form pressures may be reduced 10% if the concrete is spaded rather than internally vibrated. Re-vibration and external vibration result in higher form loads than internal vibration. These types of vibration require specially designed forms.

7. **Concrete Slump.** When concrete has very low slump, it acts less like a liquid and will transmit less pressure. ACI formulas for form pressure are based on a slump of 4"or less. When using concrete with a slump grater than 4", the formwork should be designed to resist full liquid head.
8. **Chemical additives.** Any additives which increase or decrease the setting time will affect the pressure in the same way that the pour rate, the temperature and the concrete slump do.

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