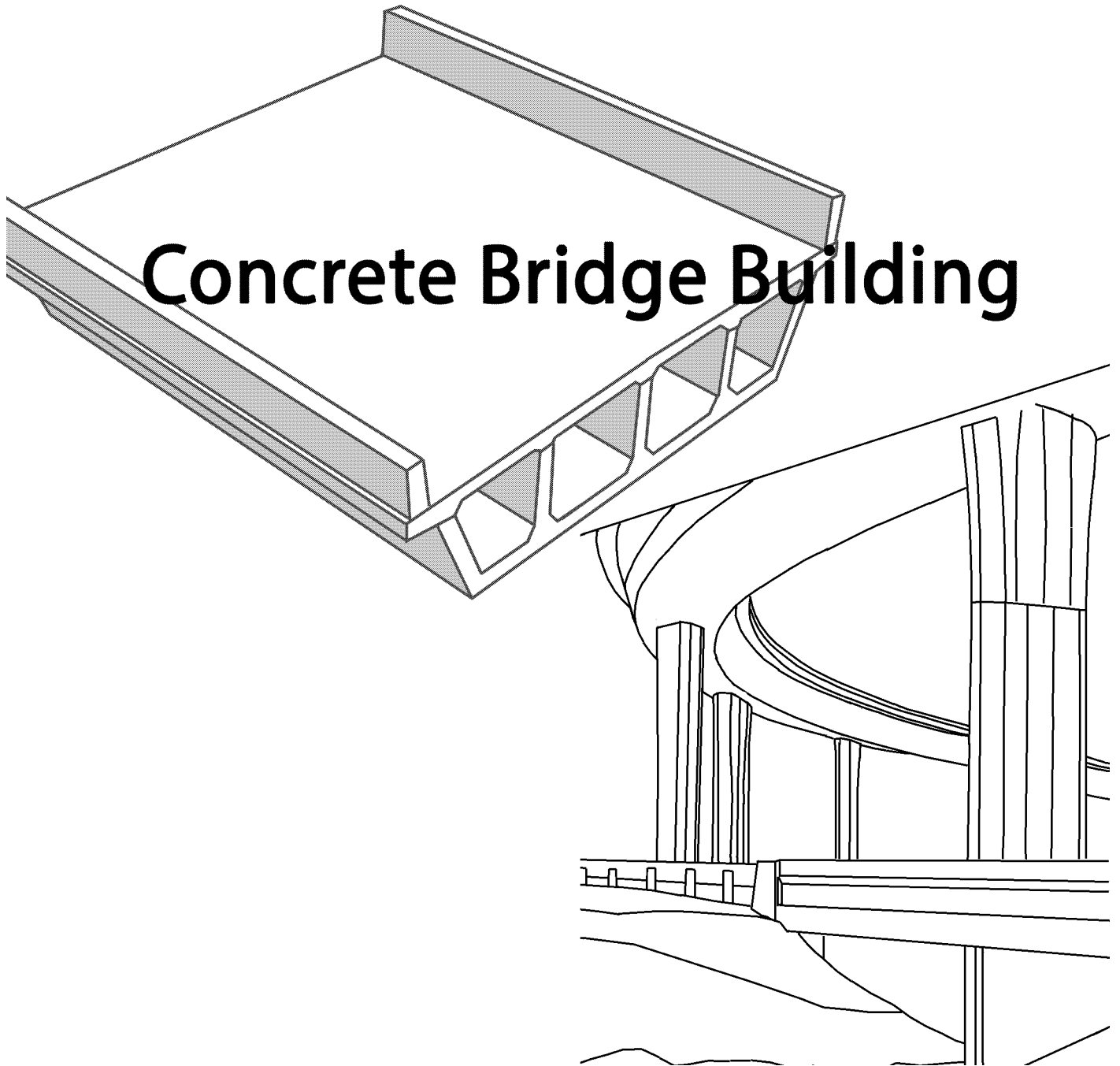


Unit 010



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

CONCRETE
BRIDGE BUILDING

The Carpenters Training Committee
For Northern California

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CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA

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MOS™ 9.2

Opeiu-3-afl-cio-211-sls 01.07.08

Revised 09.10.14 rh

COURSE OBJECTIVES

At the end of this course, the student should begin to develop the necessary work skills and construction procedures to become fluent in the acceptable practices of modern concrete bridge building.

SPECIFIC OBJECTIVES

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

1. Install a concrete bridge soffit over bridge falsework
2. Layout, build, and erect the forms for an exterior bridge girder
3. Position and construct typical bridge overhang formwork
4. Accurately erect interior girder (stem wall) formwork
5. Layout, erect, and brace a bridge diaphragm form
6. Read a basic set of Caltrans bridge blueprints
7. Correctly identify specific sections and details about the box girder bridge in the Caltrans blueprints
8. Read and interpret sections and details from the Caltrans "Standard Plans"

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 Director of Field Services.

Apprentices shall not use lewd and vulgar language while they are on the premises of the Carpenters 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.

Form 154A JB:llr

opeiu-3-afl-cio-211-3/11/99

Revised 1-31-07 sls

CARPENTER APPRENTICE TOOL LIST

Minimum of tools required before 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, $\frac{3}{4}$ " 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, $\frac{1}{2}$ " through $1\frac{1}{2}$ "
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 apprentice to obtain these required 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 on (1) tool a week to spread out the cost. Tools required for specific classes (listed in class notice) are mandatory and must be in your possession.

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 for the Final Exam 20%
3. Manipulative Lessons 40%
4. Final Exam. 30%

Assignment of grades will be as follows:

1. 92 - 100% = **A**
2. 80 - 91% = **B**
3. 70 - 79% = **C**
4. 67 - 69% = **D**
5. Less than 67% = **F**

Criteria for Evaluation

1. Accuracy
2. Completion of assignments
3. Following instructions
4. Interpretation of the blueprints
5. Participation
6. Layout based on plans

010 - CONCRETE BRIDGE BUILDING**PRE-TEST**

Instructions: In the following true/false questions circle the correct answer.

1. T F A major factor determining the compressive strength of concrete is the water-cement ratio.
2. T F Green concrete is concrete that has been placed, but it has not reached its full strength.
3. T F To avoid concrete mix segregation, the free fall distance for concrete placed in high wall forms should 12 feet maximum.
4. T F Wall thickness is the primary contributing factor to the pressure plastic concrete exerts on formwork.
5. T F The design strength of a concrete mix is its strength at 28 days after it is placed.
6. T F A cold joint is the same thing as a construction joint.
7. T F Plywood sheathing is fastened to the studs with the face grain parallel to the studs for maximum strength.
8. T F After adding water to the concrete mix, the concrete should be placed within 90 minutes.
9. T F When employees are working above grades and surfaces that have exposed reinforcing steel, protective covers are required on the exposed ends of the steel.
10. T F Forms for concrete walls should be plumbed, aligned, and braced after the forms are doubled up.
11. T F Concrete bridge girder panels have top and bottom plates.
12. T F A bent is a sharp curve in a concrete bridge.
13. T F The high edge of a bridge deck is referred to as the super-elevation.
14. T F Bridge elevations are usually given in feet and decimal feet.

Pre-Test

15. T F A box girder bridge is very strong, because it a solid piece of concrete.
16. T F Falsework is a structure used to provide shoring or a temporary work platform, and it is dismantled after the job is done.
17. T F Post-tensioning a concrete bridge element subjects it to intense tensional forces.
18. T F To get a complete picture of the bridge, the student needs both the Caltrans Structure Plans and the Caltrans Standard Plans.
19. T F On the plans, a view from above the bridge is known as a sectional view.
20. T F Different types and shapes of concrete piles would be found in the Caltrans Standard Plans.

Lesson 1 Soffit Form Construction

INTRODUCTION

In this lesson you will install soffit joist and plywood sheathing according to CalTrans specifications.

LESSON OBJECTIVES

At the end of the lesson the student will be able to form a concrete bridge soffit.

SPECIFIC OBJECTIVES

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

1. Layout and place soffit joist.
2. Install soffit plywood.

APPLICATION IN THE FIELD

The soffit is the bottom part of the bridge. The soffit form is supported by steel bridge beams and the shoring. The forms for the exterior girders, interior girders, and the deck overhang are built on the soffit form. Accordingly, the soffit form must support the concrete bridge soffit, the bridge girder forms, and provide a work platform.

EVALUATION

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

REFERENCES

1. Student Lesson Book

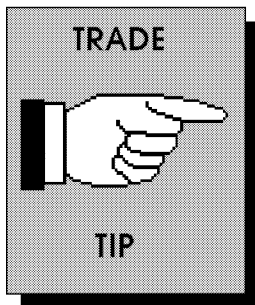
EQUIPMENT

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

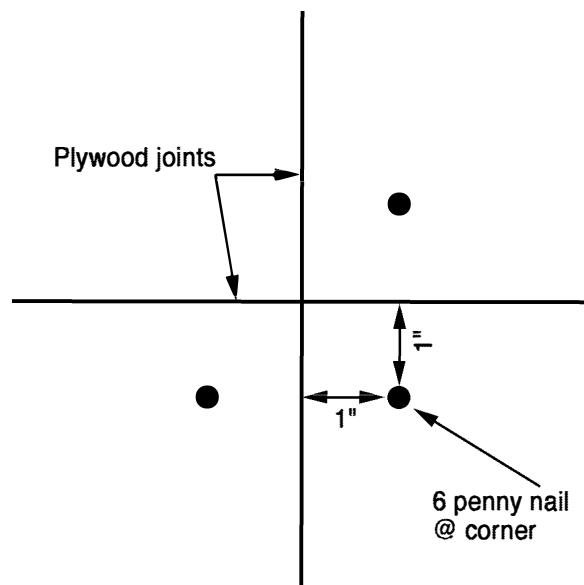
1. One (1) Skill saw
2. One (1) Pair saw horses

STUDENT TOOLS

1. One (1) OSHA approved eye protection
2. One (1) Hammer 16 - 20 oz.
3. One (1) Set nail bags
4. One (1) Measuring tape 1" x 25'
5. One (1) Combination square or speed square
6. One (1) Pencil
7. One (1) Chalk box with chalk
8. One (1) Hand level - 24" minimum
9. One (1) Keil (lumber crayon)



To prevent damage to the plywood during stripping, hold the nails back 1" from the corner.



PROCEDURES

Use the drawings provided and the following directions to erect a bridge soffit.

Falsework

1. Layout and place the continuous 2x6 sleepers.
2. Layout the 4x6 posts.
3. Cut the posts to length, install posts, and 4x6 bridge beams.
4. Install cross braces in each bay as indicated.
5. Install longitudinal braces on every run of 4x6 beams. Nail a diagonal brace at each end.

Soffit Joist

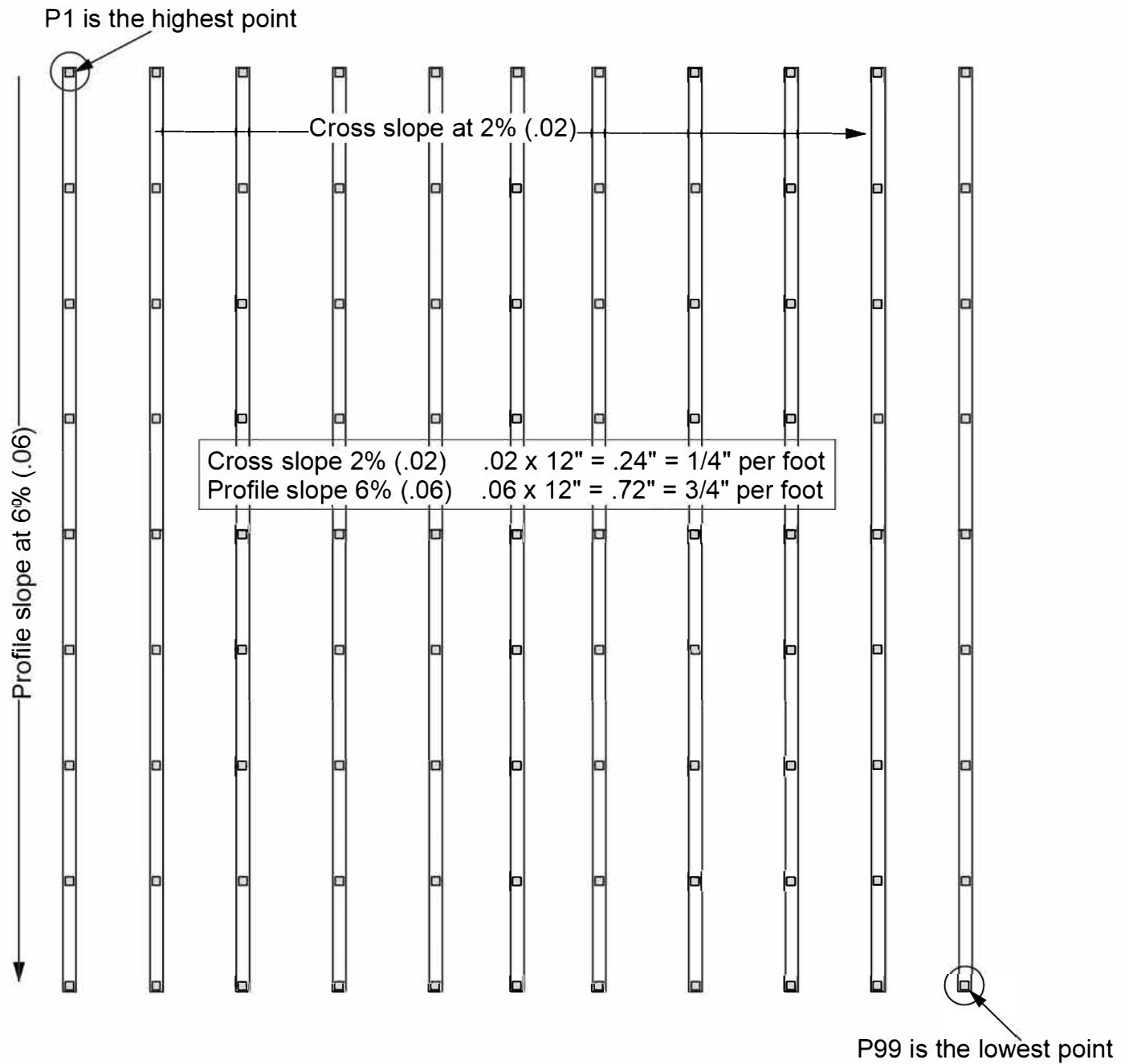
1. Layout and install the first joist at a right angle to the bridge beam. This joist is continuous. Toenail the joist.
2. Working progressively, install the joist at 12" O.C. Do not measure; eyeball the spacing.
3. Lap the joist at the supports. Avoid cutting the 4x4 joist. In order to make stripping easier, **do not toenail these joist.**
4. At the next and subsequent 8' intervals, run the joist continuous.
5. Continue to install the 4x4s.

Soffit Plywood

1. Layout a centerline the length of the soffit.
2. Install the plywood sheathing on each side of the line the length of the soffit. This will provide a work platform.
3. Install the remainder of the sheathing. Work from the center to the edges.
4. The plywood joints must line up in both directions.

Reminder

The concrete bridge soffit is exposed. The plywood seams must line up and the face grain of all of the plywood sheets must run in the same direction.



Procedures for Installing posts:

1. The height of post P1 will be given to you by your instructor.
2. Calculate the heights of the other 3 corner posts.
3. Install the other 3 corner posts.
4. String a line from the top of one corner post to the top of another corner post.
5. Measure, cut and install the remaining posts

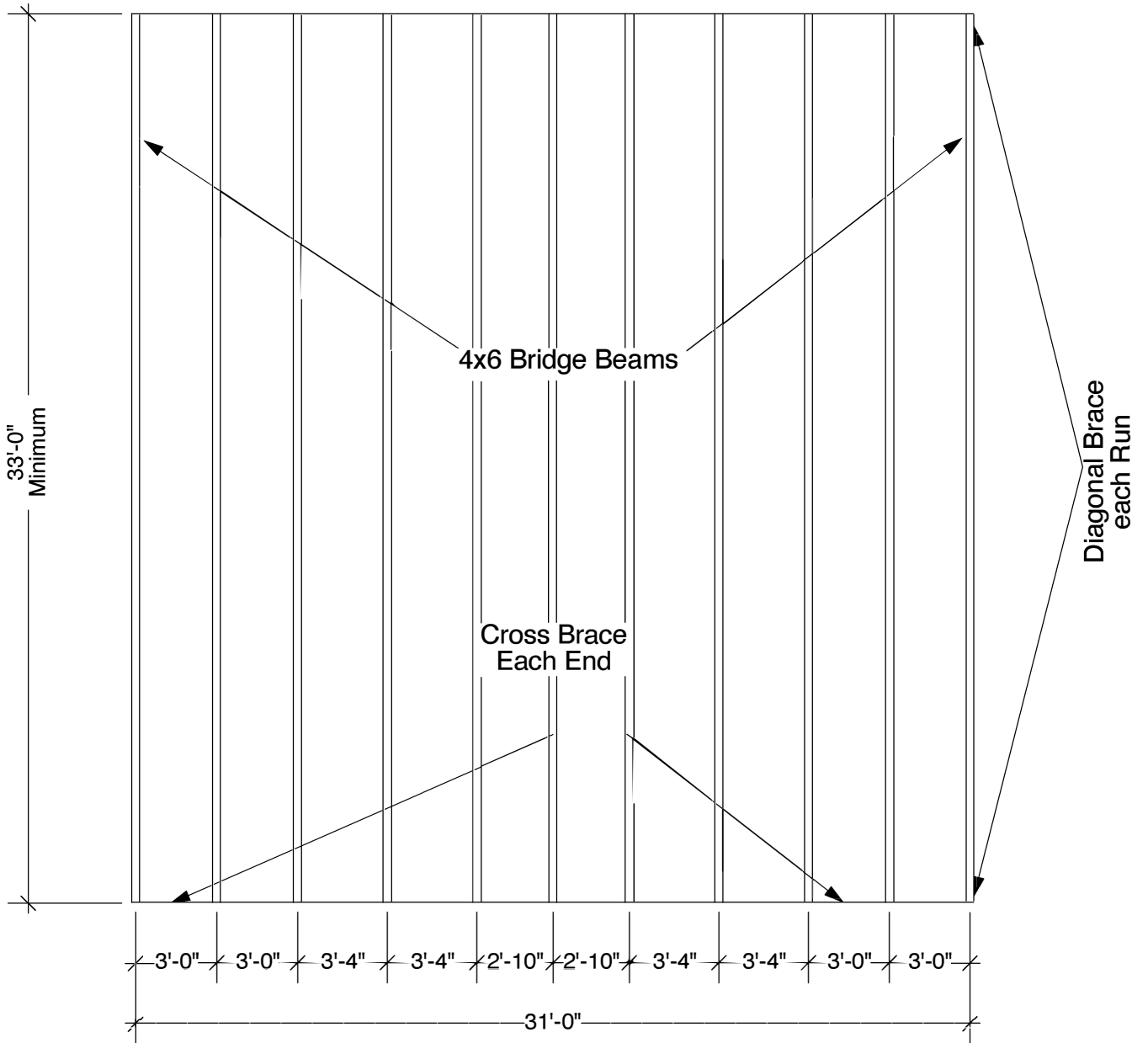



Concrete Bridge
Posts for Bridge Deck

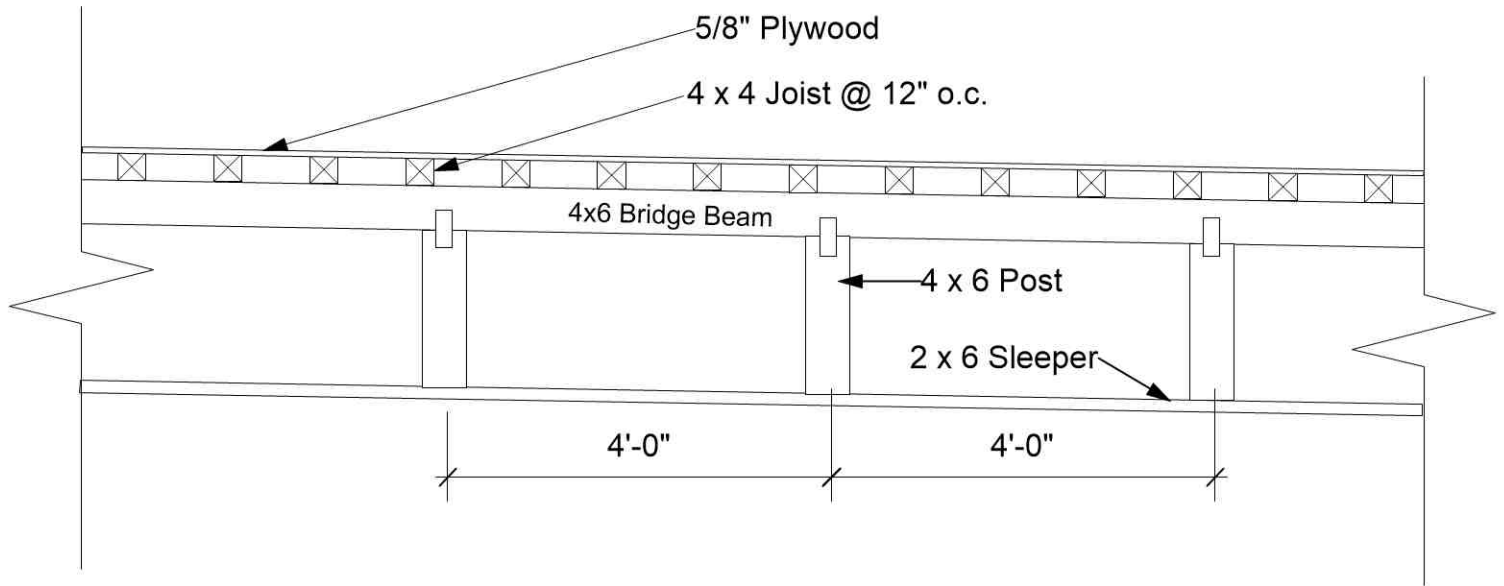
Date: 3/10/20
 Drawn By: .dk

Sheet 1 of 5
 Scale: 3/16= 1'

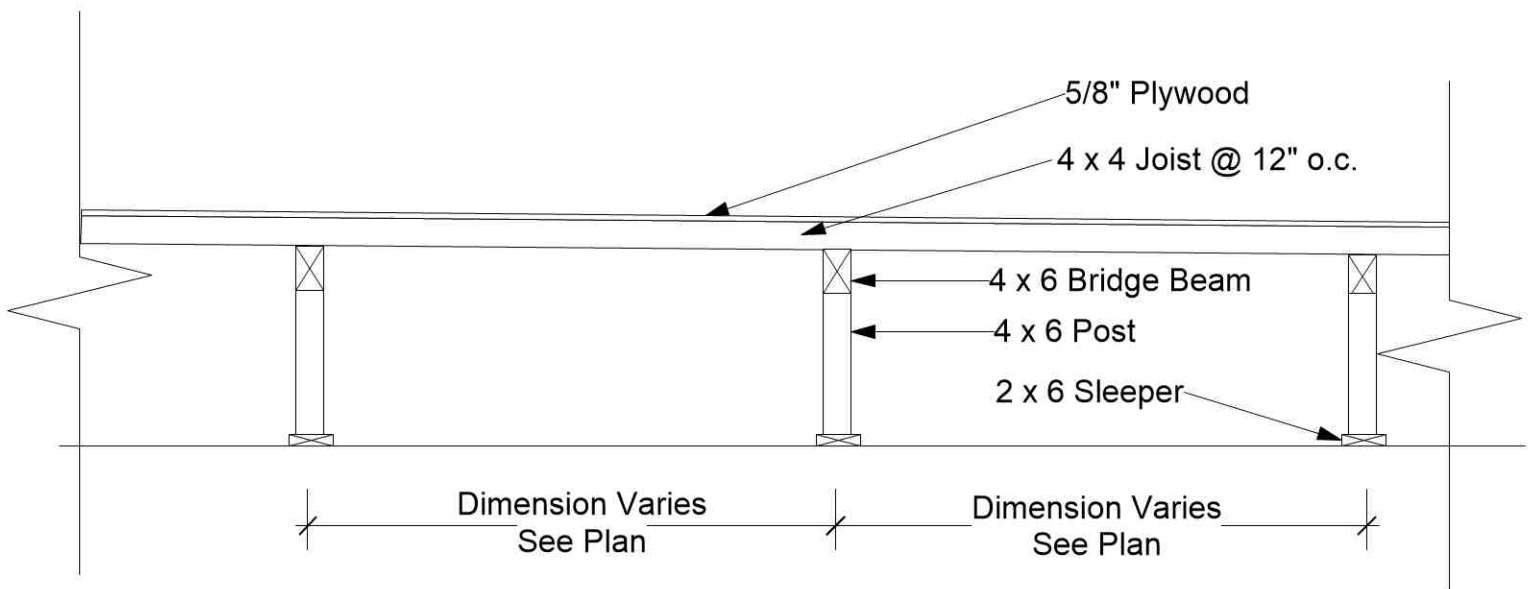
Shop # 1
 010 L1



 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	<p>Concrete Bridge</p>	Date: 04/12/07	Sheet 2 of 3	Shop #2
	<p>Bridge Beam Plan</p>	Drawn By: .dd	Scale: 3/16" = 1'-0"	010 L1



Longitudinal Section



Cross Section



Concrete Bridge

Beam and Soffit Sections

Date: 3/10/20

Drawn By: .dk

Sheet 3 of 3

Scale: 3/16 = 1'

Shop # 3

010 L1

Lesson 2 Exterior Girder Form Construction

INTRODUCTION

In this lesson you will layout, construct, and erect a form for an exterior concrete bridge girder.

LESSON OBJECTIVES

At the end of the lesson the student will be able to layout, build, and erect the forms for an exterior bridge girder.

SPECIFIC OBJECTIVES

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

1. Layout and build an exterior girder form.
2. Erect and brace the form.

APPLICATION IN THE FIELD

There is a difference between bridge forms and regular forms in that bridge forms are built with out a top and bottom plate. The exterior girder often is not plumb but at an angle to the soffit. This is done to give the bridge a wing effect and to add strength to the overhang part of the roadway. We call this angle the slope. In our lesson we will use a 1:2 slope. This slope will change from bridge to bridge, since all bridges are not the same.

EVALUATION

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

REFERENCES

1. Student Lesson Book

EQUIPMENT

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

1. One (1) Skill saw
2. One (1) Pair saw horses
3. One (1) $1/2$ " drill motor w/ $9/16$ " \emptyset drill bit

STUDENT TOOLS

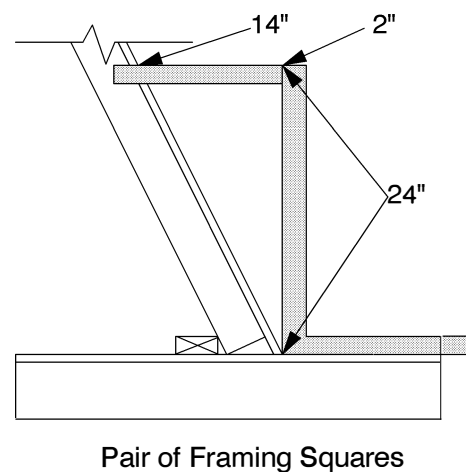
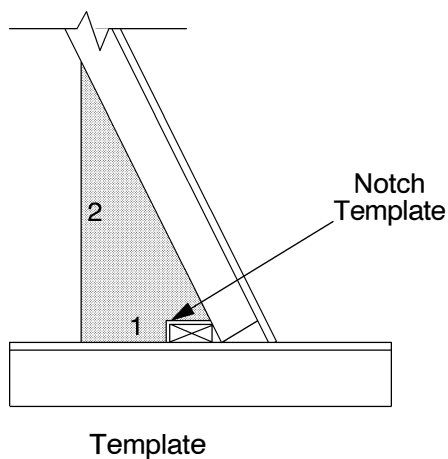
1. One (1) OSHA approved eye protection
2. One (1) Hammer 16 - 20 oz.
3. One (1) Set nail bags
4. One (1) Measuring tape 1" x 25'
5. One (1) Combination square or speed square
6. One (1) Pencil
7. One (1) Chalk box with chalk
8. One (1) Framing square
9. One (1) Keil (lumber crayon)

PROCEDURES

Use the drawings provided and the following directions to layout, build, place, and brace both sides of an exterior girder form.

Outside Form Panels

1. Determine the outside panel component dimensions by making a full-scale layout. Record the dimensions on the drawing provided (Layout Exercise #1).
2. Nail the kicker to the soffit with 16 penny duplex nails. Use the offset dimension determined in step #1.
3. Cut the 2x4 studs to length.
4. Nail a 4x8 sheet of plywood to the studs with 6 penny commons. The top of the plywood will be flush with the top of the studs.
5. Erect the first panel. Toenail it to the kicker and brace at a 1:2 slope. Use a pair of framing squares or a template to establish the slope.



6. Measure and rip the bottom piece of plywood sheathing to a 27 degree angle. (1:2 slope)
7. If everything fits together, build, erect, and brace the rest of the panels.
8. Drill the panel for snap ties with a $\frac{9}{16}$ " \emptyset drill bit. The horizontal spacing is 24" O.C.
9. Check the row of panels for alignment. If necessary, use a string line and the screw jack braces to align the panels.

Inside Form Panels

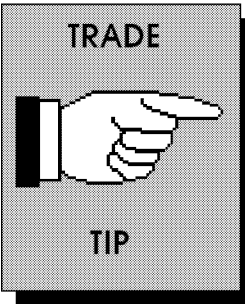
1. Determine the inside panel component dimensions by making a full scale layout. Record the dimensions on the drawing provided (Layout Exercise #2).
2. Cut the 2x4's to length.
3. Nail the plywood sheathing to the studs. Once again, the 4x8 sheet nails flush with the top of the studs and the filler sheet below it.
4. Drill the panel for snap ties with a $\frac{9}{16}$ " \emptyset drill bit. The horizontal spacing is 24" O.C. and the holes align with the holes in the opposite outside form panel.

(**Note:** On the job the snap ties will have to miss the postensioning ducts and the holes will be drilled after the reinforcing steel and the ducts have been installed.)

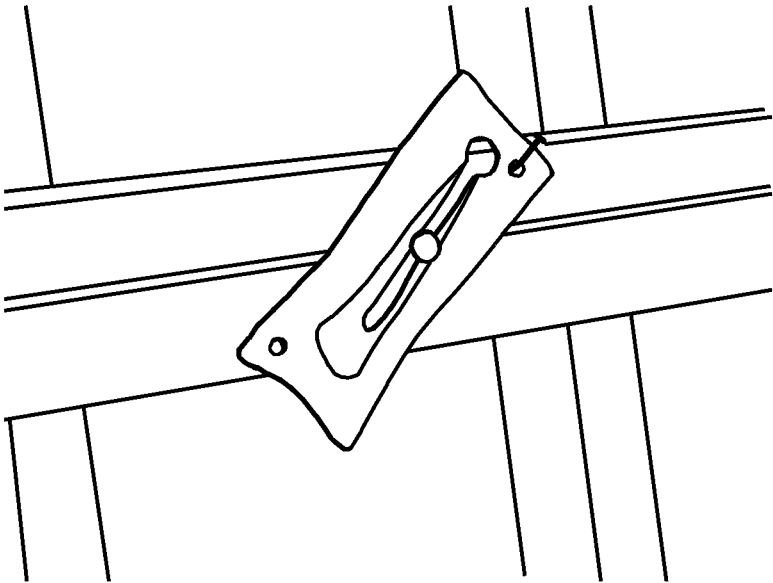
5. Install the snap ties. Place the inside panel on the eight inch (8") dobies and feed the end of the snap ties into the holes.
6. Secure the panel with a short pair of walers and hair pins. Secure the top with a cleat nailed to the panel and the overhang form opposite. Note: On the job the overhang form is installed after the outside exterior girder form has been set. The reinforcing steel and the postensioning ducts are placed; then, the inside form is set.
7. After all of the panels have been set, install the double walers and hair pins. To prevent the hair pins from vibrating loose when the concrete is being consolidated, secure the hair pin with a 6 penny common or duplex nail.

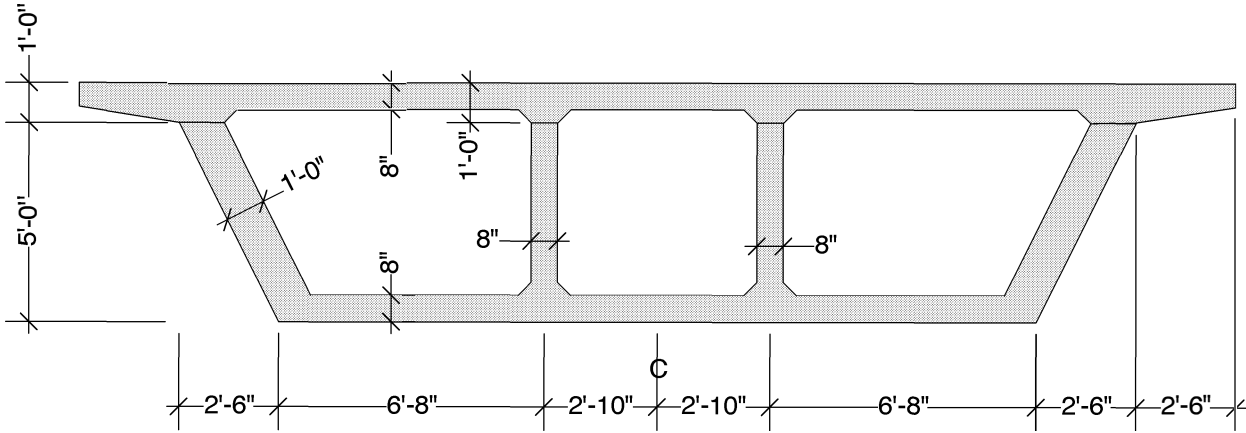
Summary

There are as many ways to install snap ties, walers and hair pins as there are bridge companies. Each will have its own method and they all work equally well.

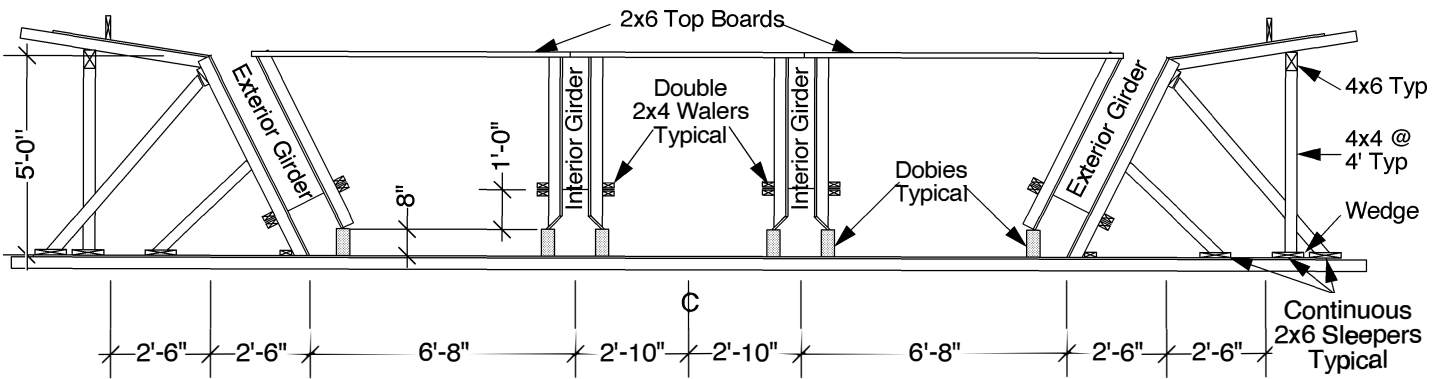


For easy stripping, install hairpin upside down.




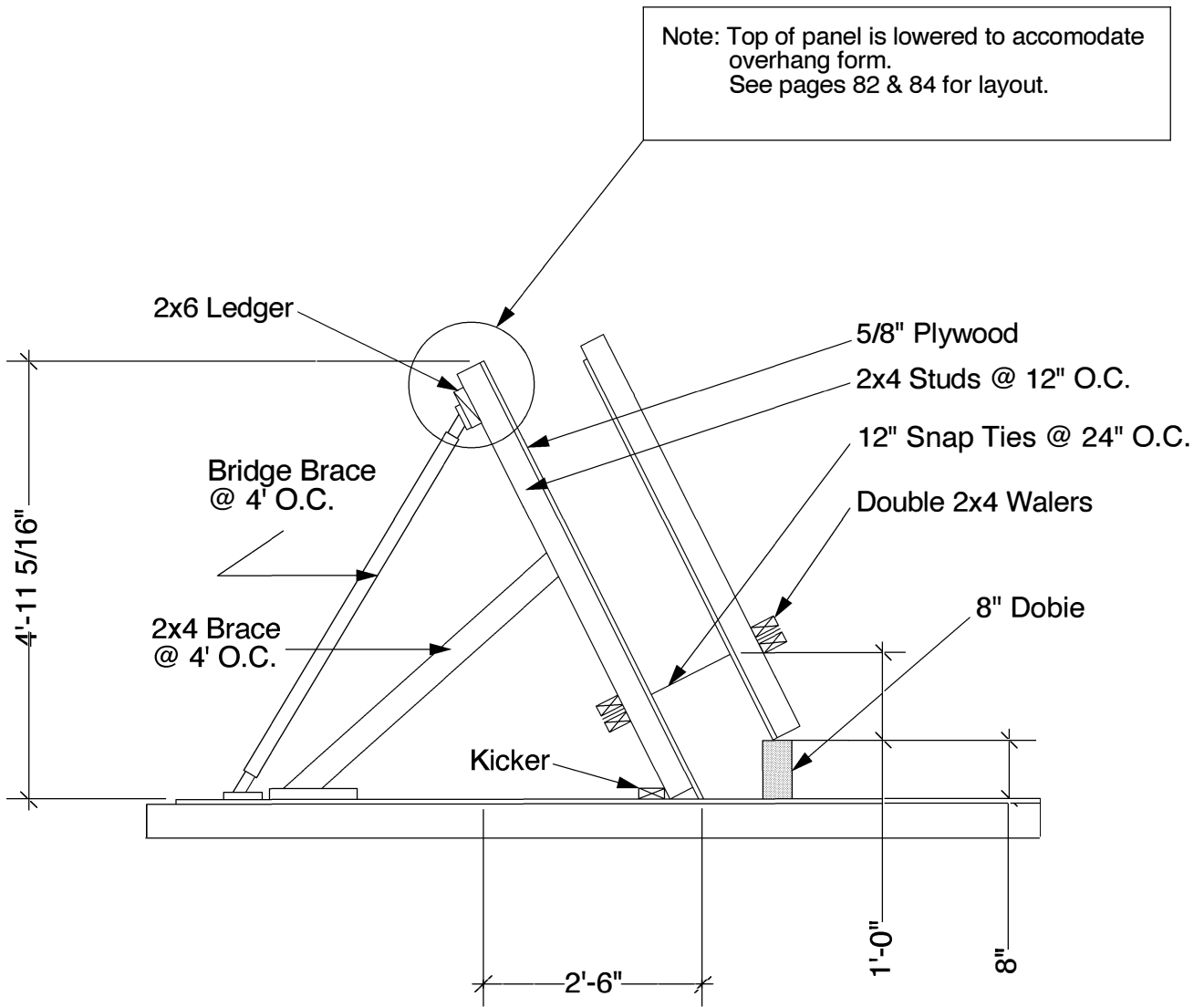



Box Girder Bridge Section

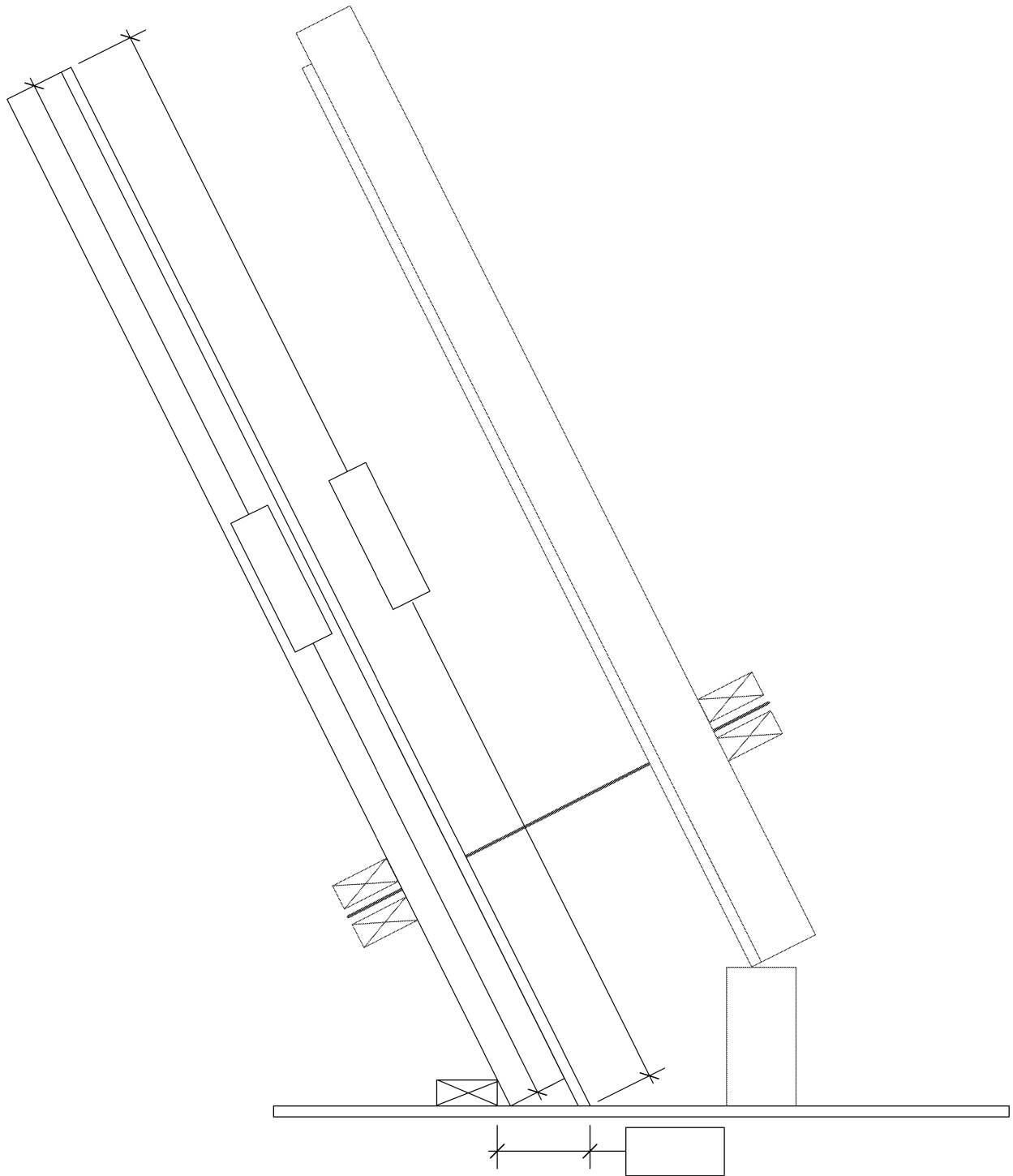



Girder Form Section

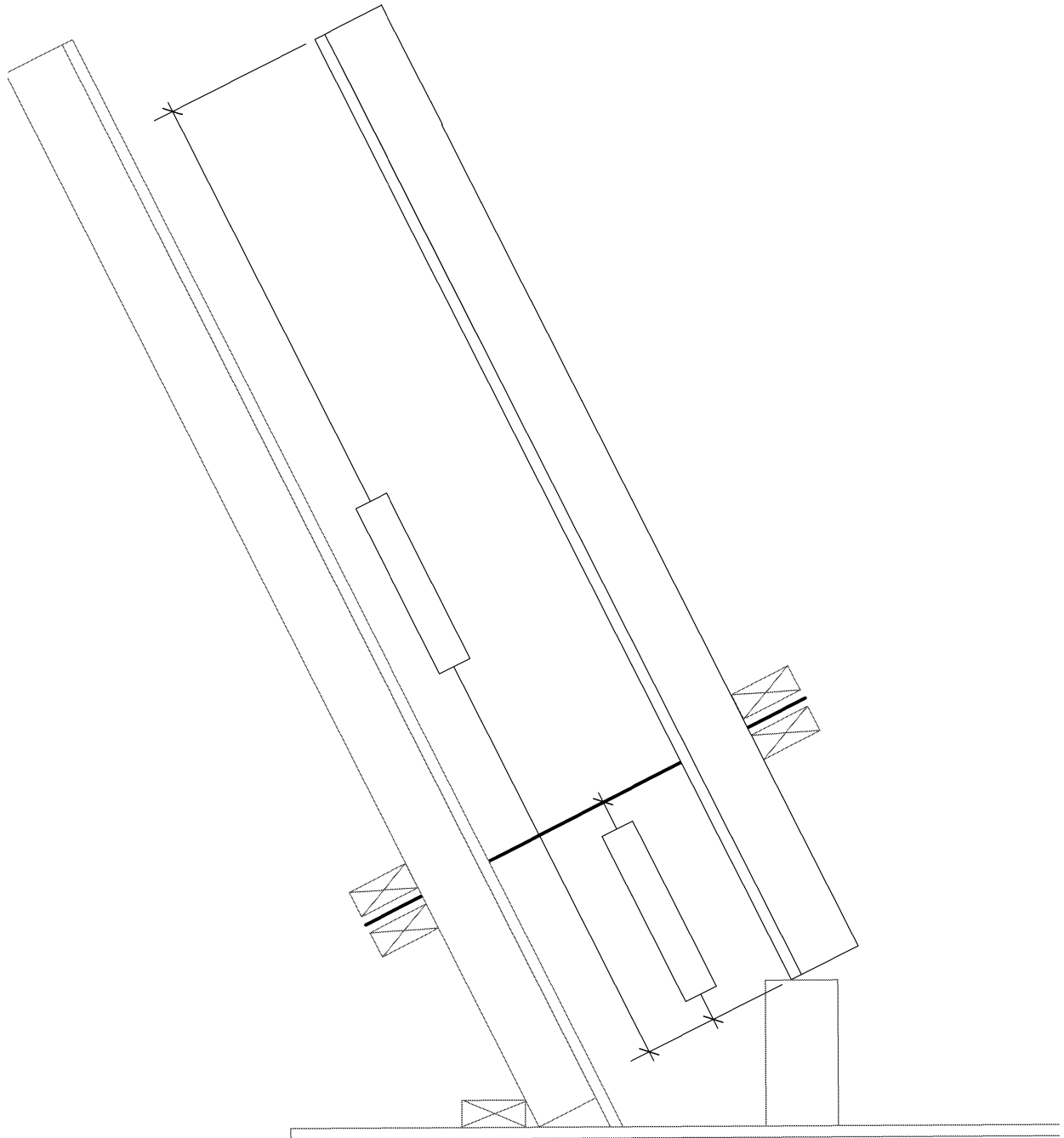
 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	<p>Concrete Bridge</p>	<p>Date: 04/12/07</p>	<p>Sheet 1 of 2</p>	<p>Shop #1</p>
	<p>Girder Form Cross Section</p>	<p>Drawn By: .dd</p>	<p>Scale: N/A</p>	<p>010 L2</p>



 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	<p>Concrete Bridge</p>	<p>Date: 10/08/07</p>	<p>Sheet 2 of 2</p>	<p>Shop #2</p>
	<p>Exterior Girder Form</p>	<p>Drawn By: .dd</p>	<p>Scale: 1/2" = 1'-0"</p>	<p>010 L2</p>



 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	Concrete Bridge	Date: 02/26/07	Sheet 1 of 1	Shop #3
	Layout Exercise #1	Drawn By: .dd	Scale: NA	010 L2



 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	Concrete Bridge	Date: 02/26/07	Sheet 1 of 1	Shop #4
	Layout Exercise #2	Drawn By: .dd	Scale: NA	010 L2

Lesson 3 Overhang Form Construction

INTRODUCTION

A overhang is a structural member that sticks out over the edge of its support. The forms for a overhang member (deck or beam) are supported by shoring. In this lesson you will layout, construct and erect the deck, shoring, and edge form for a overhang deck.

LESSON OBJECTIVES

At the end of the lesson the student will be able to layout, build, and erect the deck, shoring, and edge form for a overhang deck.

SPECIFIC OBJECTIVES

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

1. Layout and erect shoring.
2. Install plywood deck.
3. Install a guard rail according to Cal/OSHA requirements.
4. Build a deck edge form.

APPLICATION IN THE FIELD

The idea of the overhang form work is to build a sloping deck supported by shoring in order to place concrete out and over something, plus supply a work area protected with a guard rail. The deck will support the reinforcing steel, deck edge form, and the concrete. Like all form work, it must provide the shape required by the bridge designers.

EVALUATION

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

REFERENCES

1. Student Lesson Book
2. *California Construction Safety Orders; Article 16, Standard Railings*

EQUIPMENT

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

1. One (1) Skill saw
2. One (1) Pair saw horses

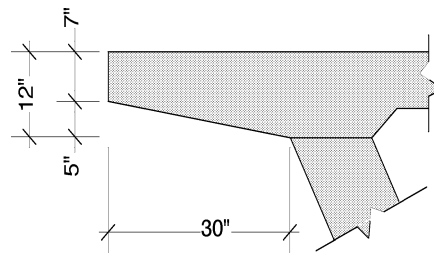
STUDENT TOOLS

1. One (1) OSHA approved eye protection
2. One (1) Hammer 16 - 20 oz.
3. One (1) Set nail bags
4. One (1) Measuring tape 1" x 25'
5. One (1) Combination square or speed square
6. One (1) Pencil
7. One (1) Chalk box with chalk
8. One (1) Framing square
9. One (1) Keil (lumber crayon)

PROCEDURES

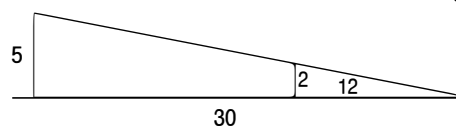
Use the drawings provided and the following directions to layout, build, place, and brace a overhang deck form.

1. Install the ledger against the exterior girder form. Use full size layout to determine the ledger location.
2. From the drawings determine the slope of the bottom of the overhang deck. Convert this slope into a unit rise per foot of horizontal run. The same approach as unit rise and unit run for a roof or stairs. This number will be easier to work with later.



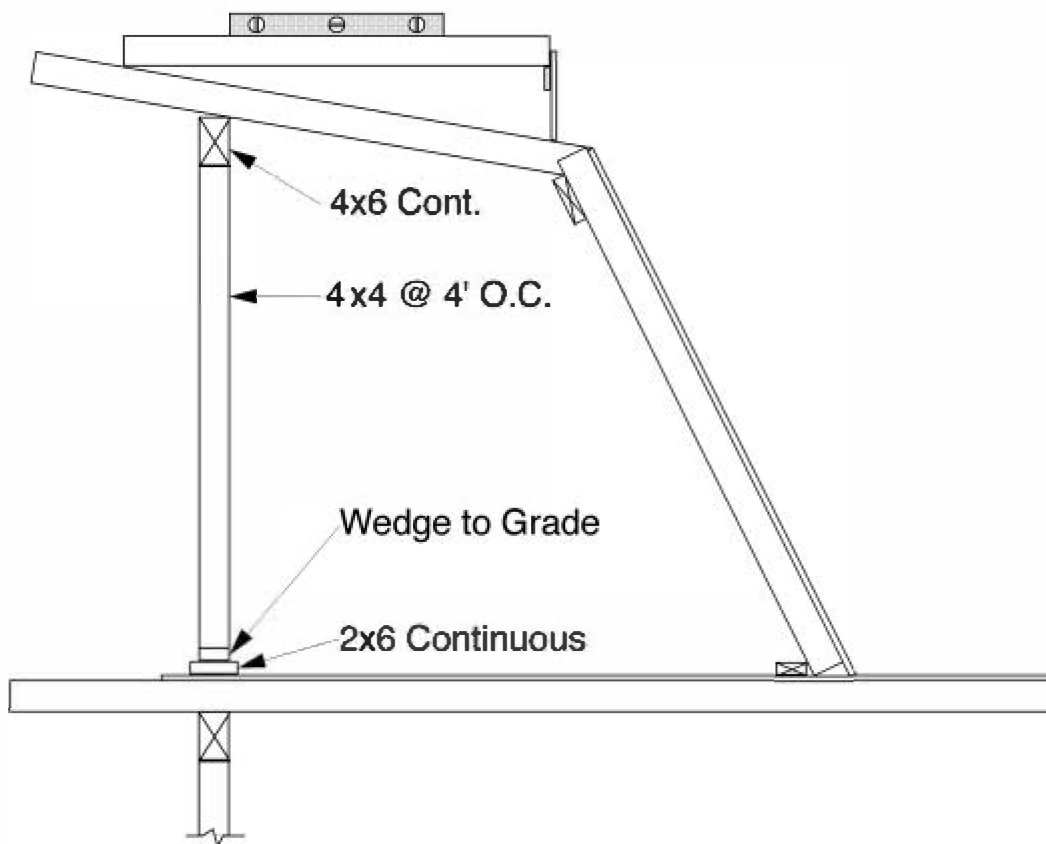
Overhang Section

Scale: 1" = 1'-0"

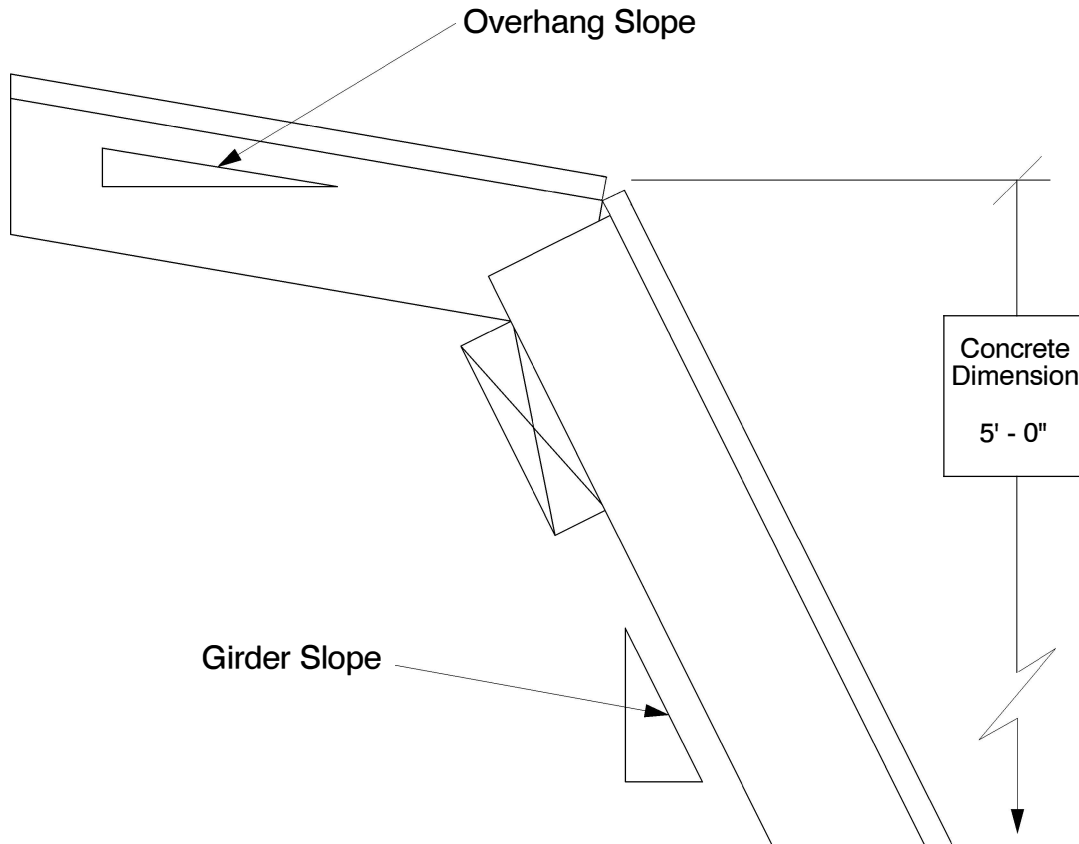


Unit Rise and Unit Run

3. Install and brace the 4x6 beam and 4x4 posts. Determine the distance from the top of the 4x6 to the soffit deck. Determine the length of the 4x4 posts by subtracting $5\frac{1}{2}$ " for the 4x6, 2" for the wedges and $1\frac{1}{2}$ " for the 2x6 continuous sleeper. Set the post on top of a pair of wedges and fasten the 4x6 beam to the post with a cleat, approximately $3\frac{1}{2}$ " x 9", and duplex 8 penny nails. Temporarily brace the shoring.
4. Wedge the 4x4 post until the 4x6 beam is at the correct height. Use a level and a block with a straight edge to establish the correct slope. Brace the shoring in both directions.
5. Install the 2x4 joist on top of the ledge, and 4x6 at 1' O.C. Fasten with 8 penny duplex nails.



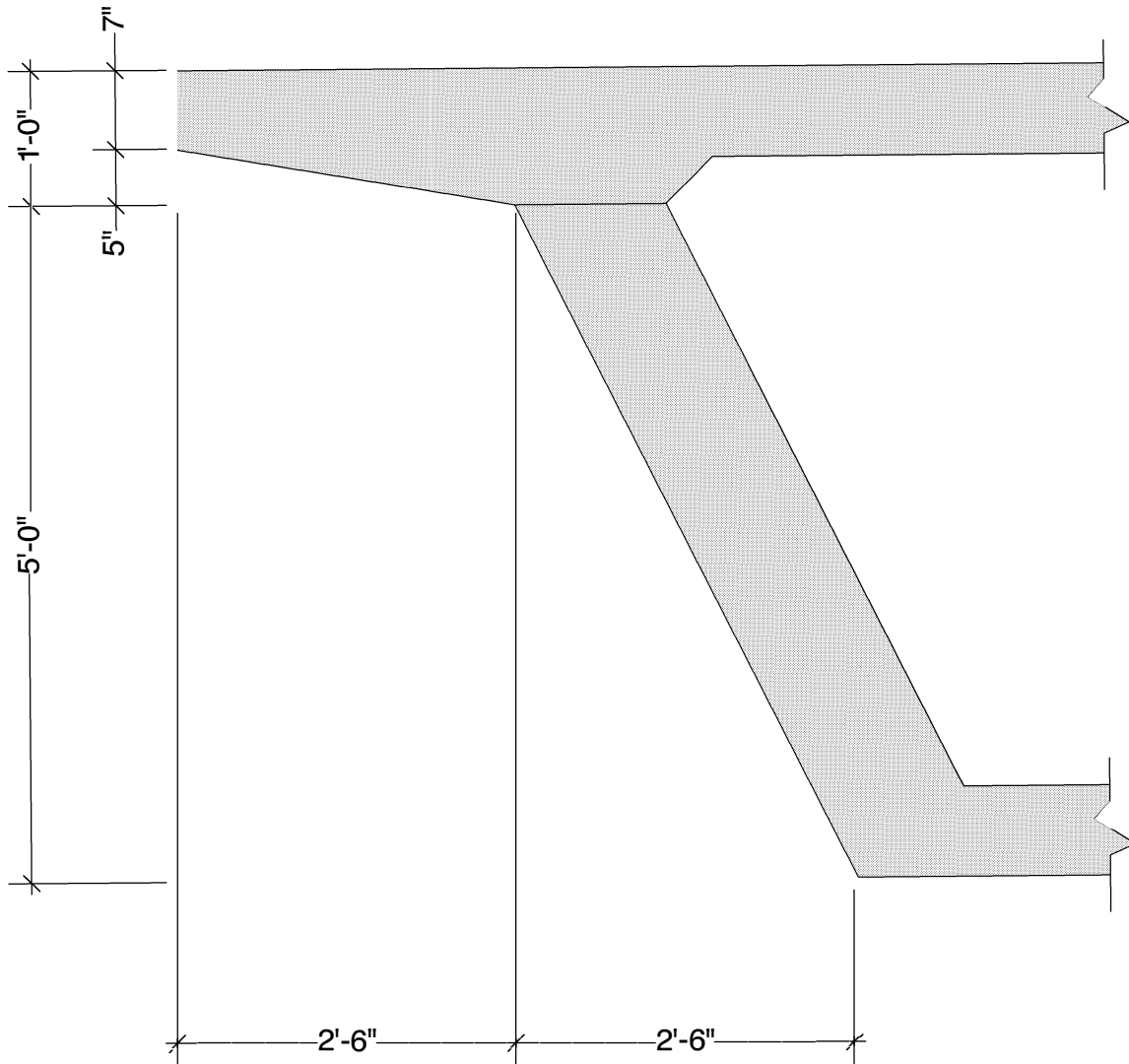
6. Lay the plywood sheathing and fasten with 6 penny common nails. The sheathing edge next to the girder form is left square.




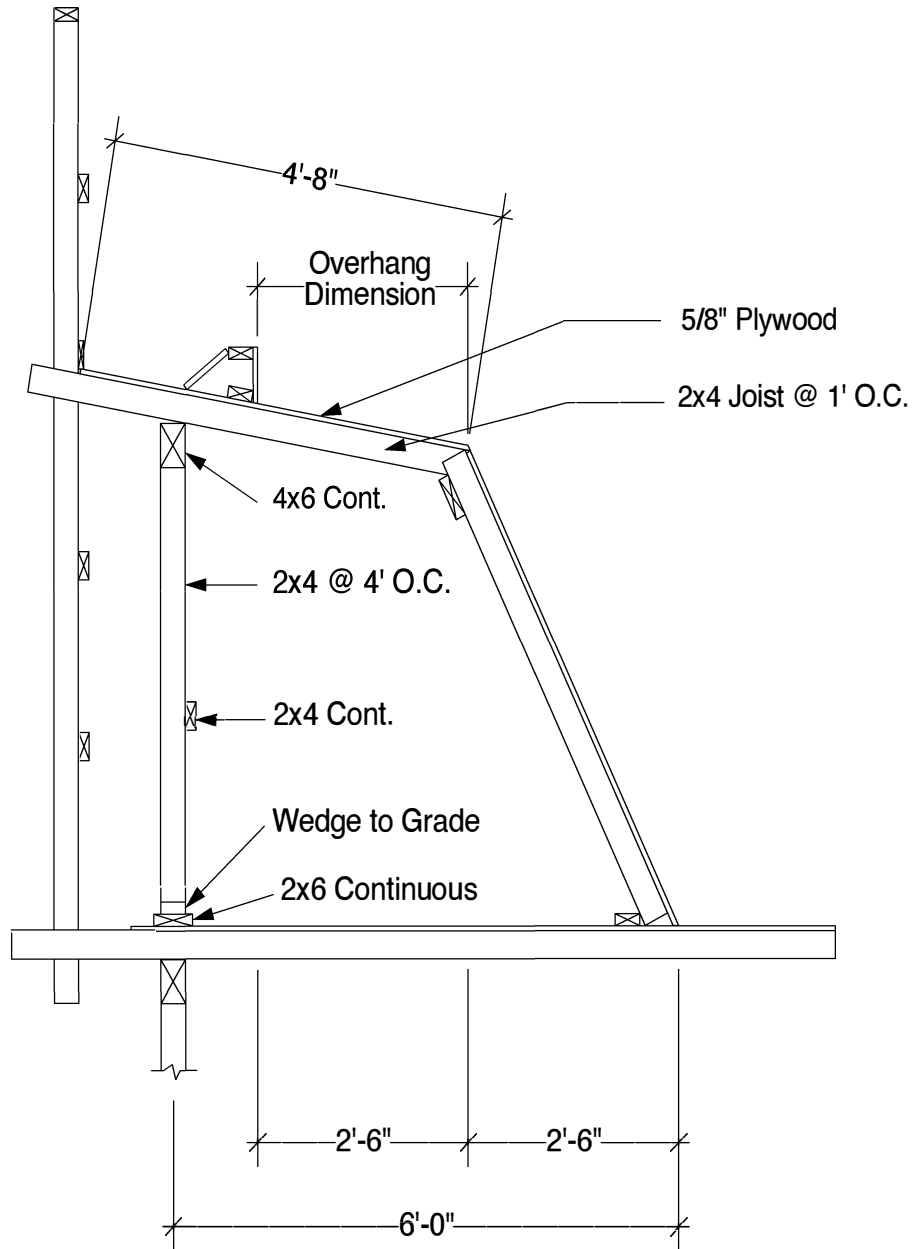
7. Install the guard rail on the outside edge of the deck. Nail 2x4 posts to the joist at 8' O.C. Fasten a 2x4 top rail on top of the 2x4 post with 16 penny common nails. (Do not use duplex nails because they protrude above the surface and can snag clothing.) Install a 2x4 midrail and a toe board if necessary. The Construction Safety Orders require a toe board if there are workers below.
8. Layout the deck edge FOC by plumbing up from the exterior girder FOC on the bridge soffit and measuring over the overhang dimension.
9. Install and brace the edge form.


SUMMARY

The overhang forms are built same as any other deck or soffit forms. They require adequate shoring. This includes post, beams, joist, and braces sufficient to carry the loads imposed on them.



 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	Concrete Bridge	Date: 10/08/07	Sheet 1 of 2	Shop #1
	Overhang Section	Drawn By: .dd	Scale: 3/4" = 1'-0"	010 L3



	<p>Concrete Bridge</p>	<p>Date: 10/08/07</p>	<p>Sheet 2 of 2</p>	<p>Shop #2</p>
	<p>Overhang Form</p>	<p>Drawn By: .dd</p>	<p>Scale: 1/2" = 1'-0"</p>	<p>010 L3</p>

Lesson 4 Interior Girder Form Construction

INTRODUCTION

In this lesson you will layout, construct, and erect a form for an interior concrete bridge girder.

LESSON OBJECTIVES

At the end of the lesson the student will be able to layout, build, and erect the forms for an interior bridge girder.

SPECIFIC OBJECTIVES

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

1. Layout and build an exterior girder form.
2. Erect and brace the form.

APPLICATION IN THE FIELD

As with the exterior girder forms, the interior girder forms are built without a top and bottom plate. However, the interior girders do not have a slope; they may have a fillet (wall thickness is increased) at either the top or bottom. Sometimes both the top and the bottom have fillets. The form height can be determined with simple arithmetic. The interior girders are not exposed, so they do not require as smooth a finish as the exterior girders. However the forms must be built and erected with care so there is no paste leakage at the panel joints. This can lead to honeycombs (voids in the concrete) which must be repaired.

EVALUATION

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

REFERENCES

1. Student Lesson Book

EQUIPMENT

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

1. One (1) Skill saw
2. One (1) Pair saw horses
3. One (1) $\frac{1}{2}$ " drill motor w/ $\frac{9}{16}$ " \varnothing drill bit

STUDENT TOOLS

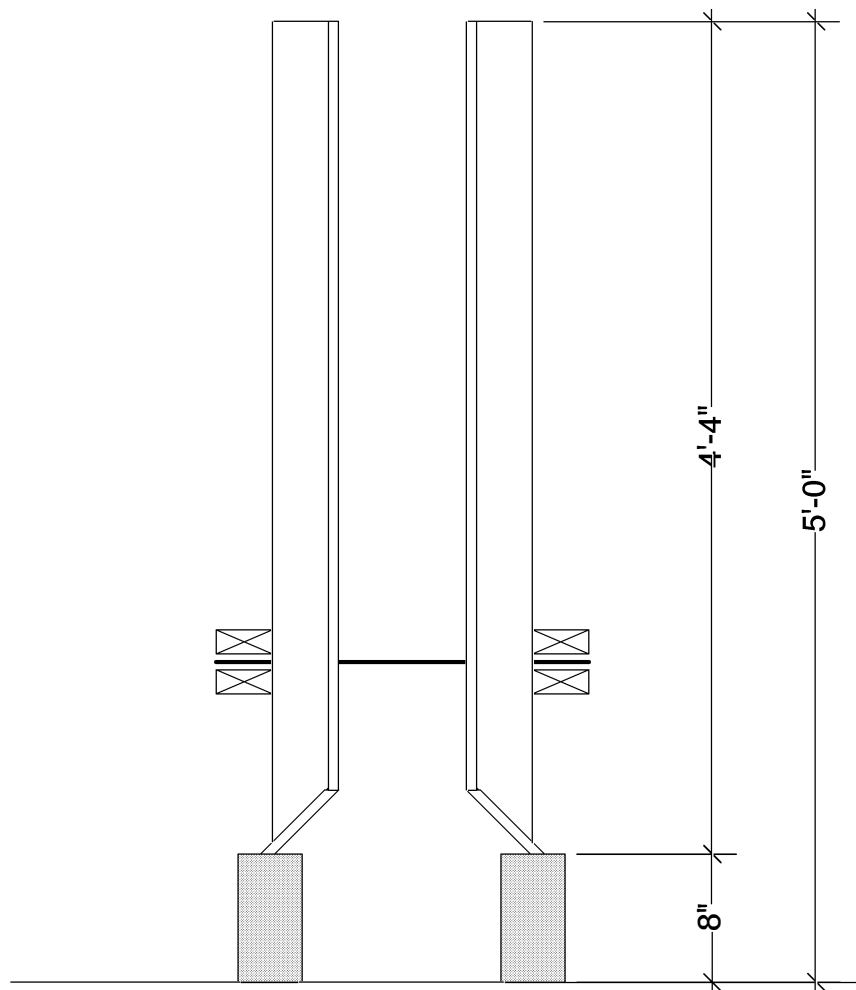
1. One (1) OSHA approved eye protection
2. One (1) Hammer 16 - 20 oz.
3. One (1) Set nail bags
4. One (1) Measuring tape 1" x 25'
5. One (1) Combination square or speed square
6. One (1) Pencil
7. One (1) Chalk box with chalk
8. One (1) Framing square
9. One (1) Keil (lumber crayon)

PROCEDURES

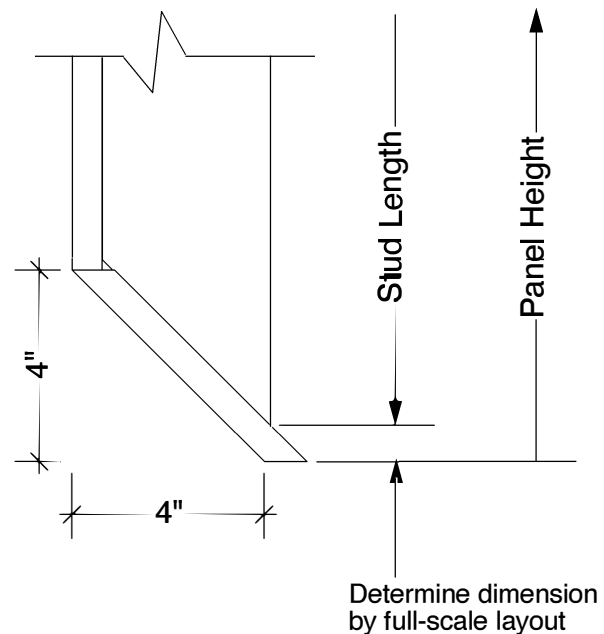
Use the drawings provided and the following directions to layout, build, place, and brace both sides of an interior girder form.

FORM PANELS

1. Determine the panel height by subtracting the soffit thickness from the girder height.



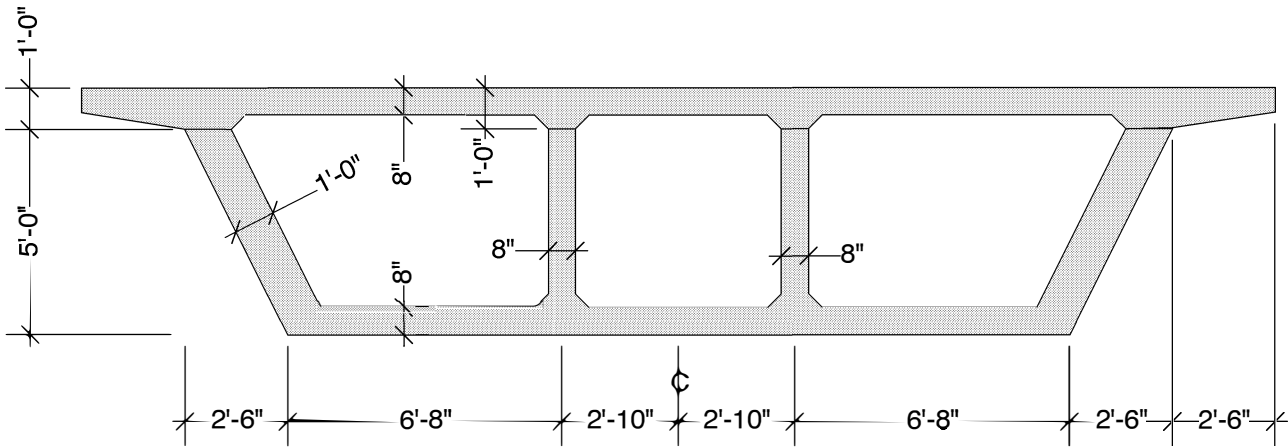
- The stud length is the same as the panel height except when one or two fillets are required. Since the fillets are at a 45 degree angle to the wall, the cut is made at that angle. Shorten the stud to allow for the sheathing. This amount can be determined by a full size layout. Cut the 2x4 studs to length.



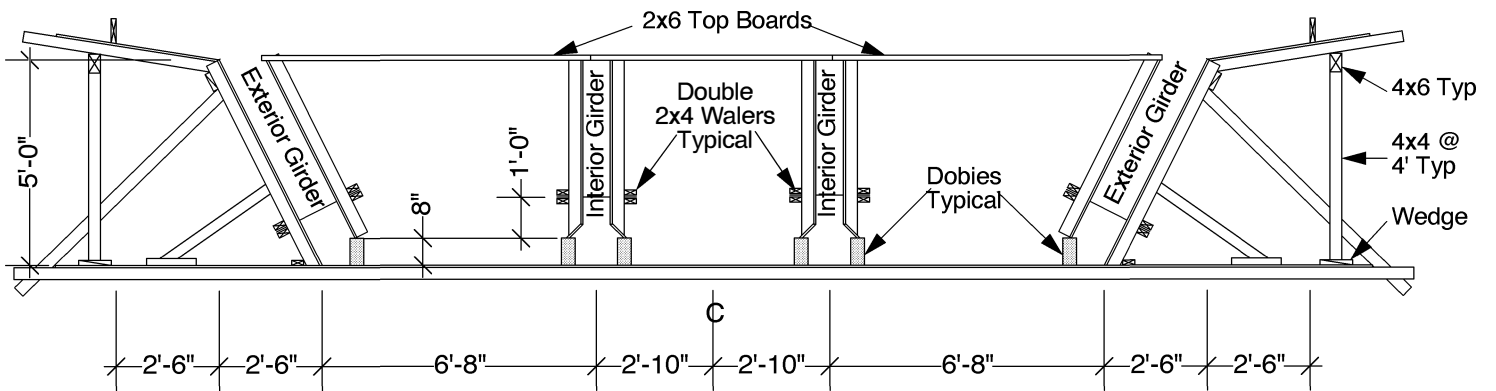
- Nail a 4x8 sheet of plywood to the studs with 6 penny commons. The top of the plywood will be flush with the top of the studs.
- Nail the filler sheet and the fillet sheathing. The width of the fillet sheathing can be measured in step #2 above or calculated as the diagonal of four (4) inches.

Erect Form Panels


- Layout on the deck the face of concrete on either side of the centerline.
- Set the bottom of the panels on the dobies and temporarily brace them.
- Erect all of the panels for one side of the form. Make certain the panel joints are tight. Plumb and brace them.
- Drill the panels for snap ties with a 9/16" Ø drill bit. The horizontal spacing is 32" O.C. Note: On the job the snap ties will have to miss the postensioning ducts and the holes will be drilled with the panels in place.
- Install the snap ties. Place the inside panel on the dobies and feed the end of the snap ties into the holes.
- Secure the panel with a short pair of walers and hair pins. Secure the top with a cleat nailed across the pair of form panels.
- After all of the panels have been set, install the double walers and hair pins. To prevent the hair pins from vibrating loose when the concrete is being consolidated, secure the hair pin with a 6 penny common or duplex nail.



Box Girder Bridge Section



Girder Form Section

 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	<p>Concrete Bridge</p>	<p>Date: 04/12/07</p>	<p>Sheet 1 of 1</p>	<p>Shop #1</p>
	<p>Girder Form Cross Section</p>	<p>Drawn By: .dd</p>	<p>Scale: N/A</p>	<p>010 L4</p>

Lesson 5 Diaphragm Form Construction

INTRODUCTION

A diaphragm is an internal structure that helps support the deck and provides stability to the girders. End diaphragms are used at the bridge abutments and column bents.

OBJECTIVE

At the end of the lesson the student will be able to layout, build, and erect the end diaphragm forms.

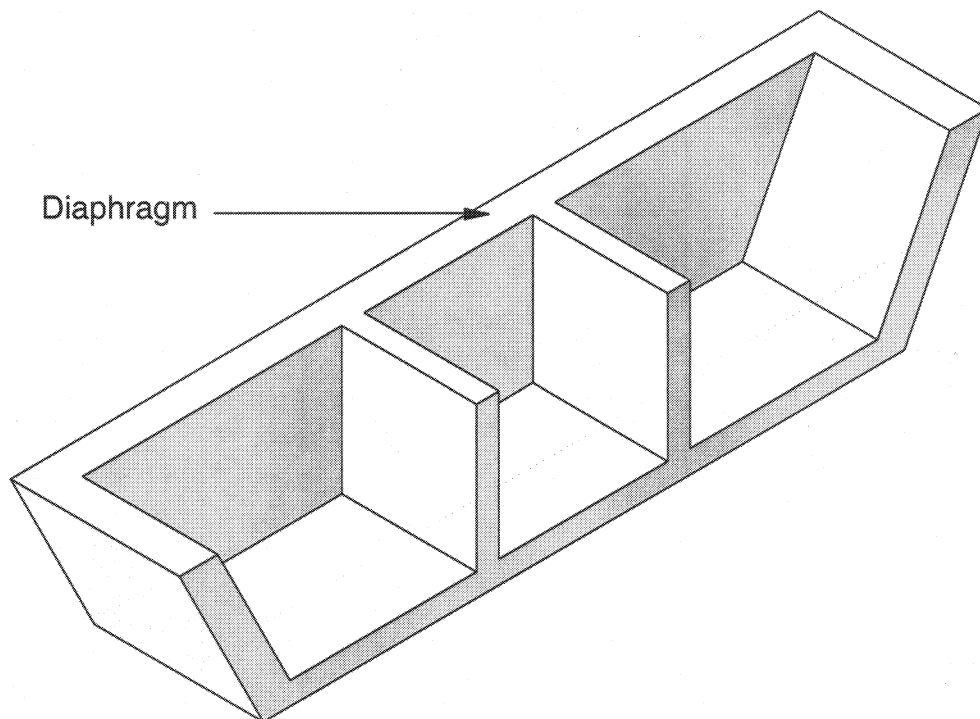
SPECIFIC OBJECTIVES

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

1. Layout and erect diaphragm forms
2. Install strong backs

APPLICATION IN THE FIELD

Diaphragms are structural members that are transverse to the bridge girders. They are formed with bridge soffit and girders and the concrete is placed monolithically. Because forms at intersecting walls can be difficult to stripe, planning and attention must be used in the construction and erection of diaphragm forms.



EVALUATION

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

REFERENCES

1. Student Lesson Book

EQUIPMENT

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

1. One (1) Skill saw
2. One (1) Pair saw horses
3. One (1) $1/2$ " drill motor w/ $9/16$ " \varnothing drill bit

STUDENT TOOLS

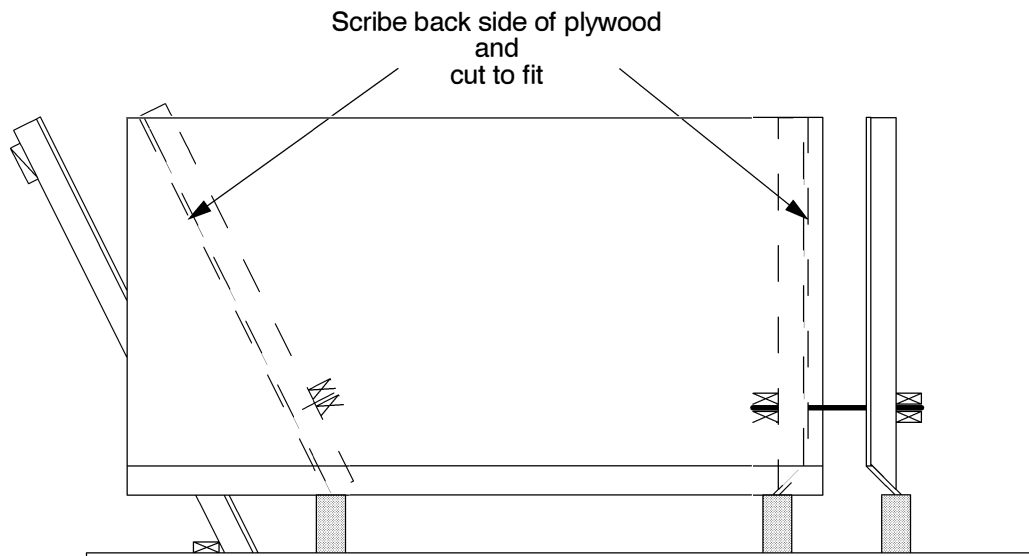
- | | |
|---|---------------------------------|
| 1. One (1) OSHA approved eye protection | 6. One (1) Pencil |
| 2. One (1) Hammer 16 - 20 oz. | 7. One (1) Chalk box with chalk |
| 3. One (1) Set nail bags | 8. One (1) Framing square |
| 4. One (1) Measuring tape 1" x 25' | 9. One (1) Keil (lumber crayon) |
| 5. One (1) Combination square or speed square | |

PROCEDURES

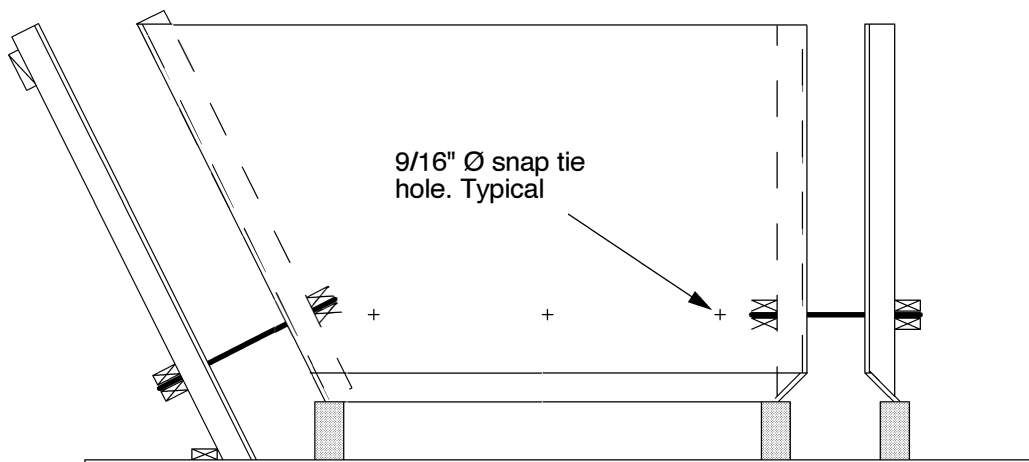
Use the drawings provided and the following directions to layout, build, place, and brace a overhang deck form.

Inside Form (Lay out and build in place)

1. Place the plywood sheathing on a pair of dobies and against the ends of the girder forms. Scribe the sheets to fit.



2. Place the plywood on dobies and nail to the end of the girder forms.



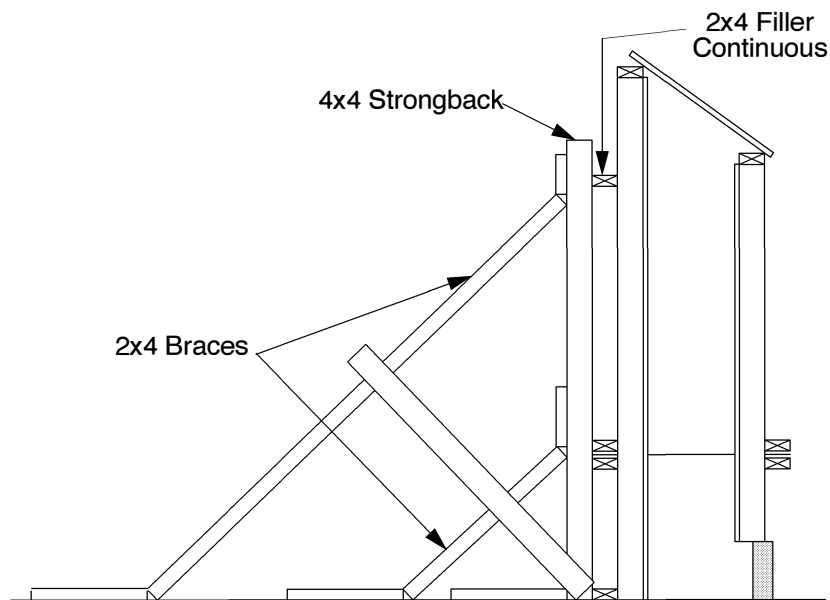
3. Drill the panel for snap ties with a $\frac{9}{16}$ " \varnothing . To provide room for the walers on both the diaphragm and girder forms, layout and drill the end snap tie holes at least 12" from the side of the panel.
4. Cut the studs to length.
5. Nail the sheathing to the studs with 6 penny common nails.
6. Install the snap ties, walers, and hairpins.
7. Repeat for each bay.

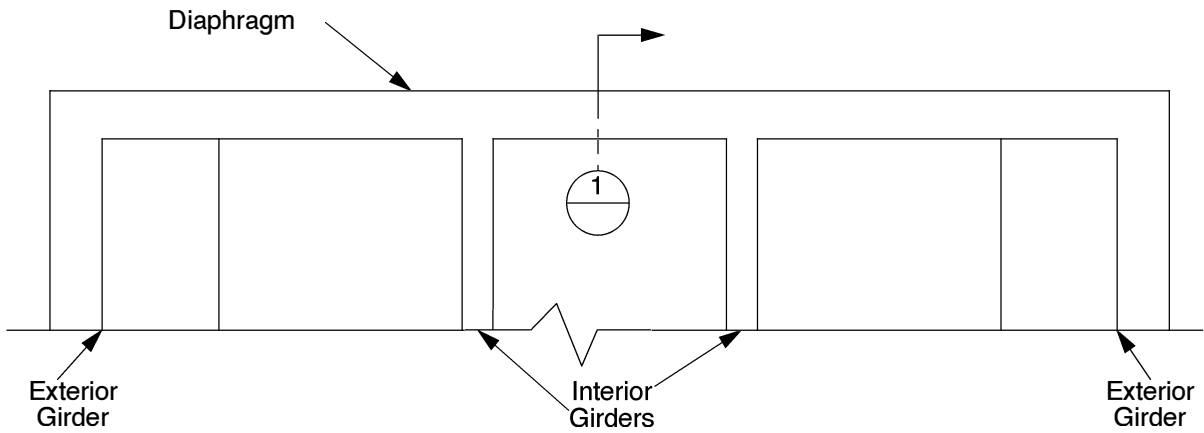
Outside Form

1. Build three panels 8' wide and one filler panel 2' wide. Panel height (stud length) is the overall height of the interior girders. The overall height includes the thickness of the bridge soffit.
2. Drag the panels to their locations. Layout and drill the panels for snap ties.
3. Slip the panels over snap ties and slide the panels into place. Secure the panels with a kicker nailed to the soffit sheathing and cleats across the top of the inside and outside forms.
4. Install the walers and hairpins.

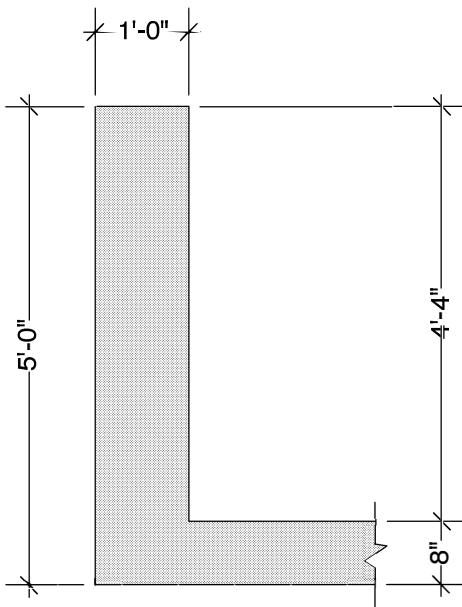
Strongback

1. Install 4x6 strongbacks opposite the girders. (The snap tie spacing is greater at these locations and the ties cannot sustain the concrete pressure without assistance)
2. Install braces. **Note:** Braces are installed with square ends so the corner bites into the strongback as the pressure increases.

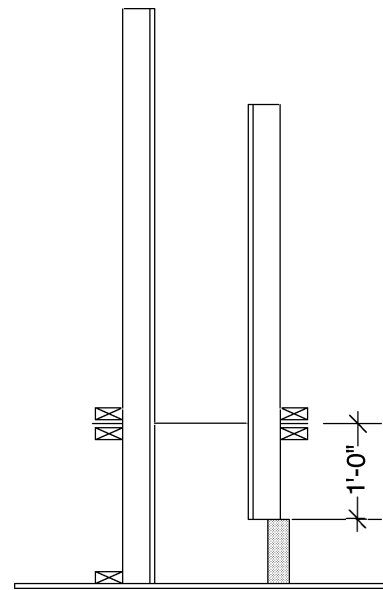





Plan
Scale: 1/4" = 1'-0"



1 Diaphragm Section
Scale: 1/2" = 1'-0"



Form Section
Scale: 1/2" = 1'-0"

 <p>CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA</p>	<p>Concrete Bridge</p>	<p>Date: 04/12/07</p>	<p>Sheet 1 of 1</p>	<p>Shop #1</p>
	<p>Diaphragm Plan & Section</p>	<p>Drawn By: .dd</p>	<p>Scale: 1/4" = 1'-0"</p>	<p>010 L5</p>



Lesson 6 Reading Bridge Plans

INTRODUCTION

In this lesson you will read and interpret typical Caltrans bridge plans.

OBJECTIVE

At the end of the lesson the student will be able to locate and extract specified information from Caltrans project plans and standard plans for a typical Caltrans box girder bridge.

SPECIFIC OBJECTIVES

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

1. Given Caltrans project plans for the Hopyard–Dougherty Road Overcrossing, identify specific symbols and abbreviations.
2. Given Caltrans project plans for the Hopyard–Dougherty Road Overcrossing, locate specified dimensions and other information.
3. Given Caltrans standard plans, locate specified dimensions and other information.

APPLICATION IN THE FIELD

Caltrans is the entity that builds and owns almost all of the bridges in California. They have developed standardized concrete bridge plans so the project plans are similar from bridge to bridge. Bridge carpenters become accustomed to Caltrans plans and specifications, and they quickly and efficiently locate the information they need to build the bridge. This lesson will give you some practice with Caltrans bridge plans and specifications.

EVALUATION

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

REFERENCES

None

EQUIPMENT

To be supplied by the training facility (per student)

1. One (1) set of *Caltrans Hopyard–Dougherty Road Overcrossing* 11x17 plans
2. One (1) set of *Caltrans Standard Plan*

STUDENT TOOLS

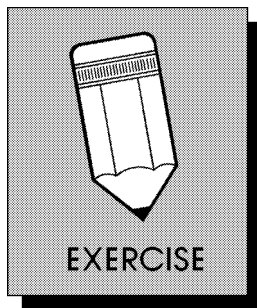
1. One (1) Pencil
2. One (1) 5-function calculator

INTRODUCTION

A set of bridge building plans represents a primary example of pure structural working drawings. Originating from a national standard specification development by AASHTO (American Association of State Highway Transportation Officials) for heavy and highway work, bridge plans for California highway construction are generated from an additional, more rigorous specification developed by Caltrans (California State Department of Transportation).

Caltrans has been the agency in charge of highway and bridge construction in this state for many decades. Consequently, the plans before you represent a codification or standardization of drawing and specification uniformity unparalleled in the nation. Caltrans plans and specs have gone through so many generations of refinement that many of the details and specs have become "typical" or reused in every single bridge built in California. These repetitive items can be found in the Caltrans Standard Plans and the Caltrans Standard Specifications.

These plans, a freeway overpass structure on Highway 580 @ Hopyard Road in Pleasanton, California, represent many of the methods Caltrans has employed to streamline highway construction. Considering the complexity of a bridge structure, these drawings have a "look" of good graphic organization and readability. Because of these qualities, there is a deceptive volume of information contained on each sheet. You must, therefore, pay attention to every detail.



INSTRUCTIONS FOR EXERCISE 1

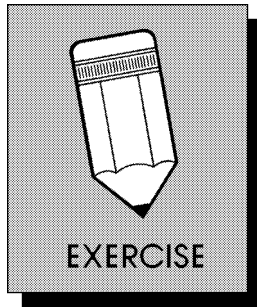
Read the question and refer to the *Hopyard-Dougherty Road Overcrossing* plans for the correct answer. (Location number is listed.)

In the space provided, please fill in the correct answer.

LOCATIONS & VIEWS

1. What is the height clearance between the top of the road surface and the bottom of the bridge?
_____ (Sheet 31)
2. How long is the total bridge? _____ (31)
3. Is abutment #1 on the north or south side of the bridge? _____ (31)
4. What is the reference datum elevation for this project? _____ (31)
5. What is the specified tip elevation of typical Class 45C pile? _____ (31)
6. What is the scale of the plan view on the "General Plan" sheet? _____ (31)
7. What is the total width of the bridge (out-to-out)? _____ (31)
8. What is the depth of the box girder section from the bottom of the soffit to the top of the roadway? _____ (31)
9. What is the total number of girders in the bridge? _____ (32)
10. What is the Caltrans reference number of the existing bridge? _____ (33)
11. What is the lowest point (bottom of footing elevation) on the abutments? _____
(33)
12. What is the typical slope of the batter pile on this job? _____ (34)
13. What is the width of the footing under main Abutment #1? _____ (34)
14. The interior of the lower wall section of Abutment #1 is battered at what slope? _____ (34)
15. How many rows of batter piles are there under a typical abutment? _____ (34)

16. What is the typical thickness of the upper section of each abutment (back wall)?
_____ (34)
17. What is the typical thickness of the spread footing under the abutments? _____
(34)
18. What is the typical pile penetration into the bottom of the spread footing of the
abutments? _____ (34)
19. How many batter piles are there in Abutment #3? _____ (35)
20. What are the typical bottom elevations of the retaining walls? _____ (36)
21. What is the length of the left retaining wall at Abutment #1? _____ (36)
22. How many piles are there in a typical column footing? _____ (37)
23. What is the long dimension at the top of a typical column? _____ (37)
24. What is the total width of the bridge from the outside of each concrete barrier on the wear
surface of the road? _____ (38)
25. What is the width of the pedestrian R/W on the bridge? _____ (38)
26. On which side of the bridge (N, S, E, W) does the pedestrian R/W occur? _____
(38)
27. The five interior concrete girders or stem walls occur on what typical centers or
O.C.? _____ (38)
28. What is the width of the column cap @ Bent 2? _____ (37)
29. What is the average depth of the box girder voids? _____ (38)
30. What is the length of the flare for the interior sides of the two exterior
girders? _____ (39)



INSTRUCTIONS FOR EXERCISE 2

Read the question and refer to the *Hopyard-Dougherty Road Overcrossing* plans for the correct answer. (Location number is listed.)

In the space provided, please fill in the correct answer.

IDENTIFICATION

1. What do the following abbreviations mean? (23)

E.B. _____

O.G. _____

B.B. _____

V.C. _____

B.V.C. _____

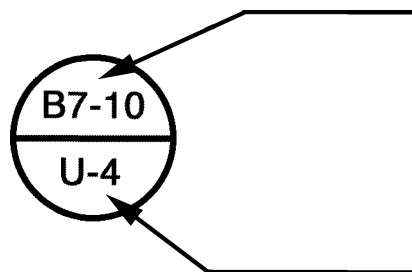
L.O.L. _____

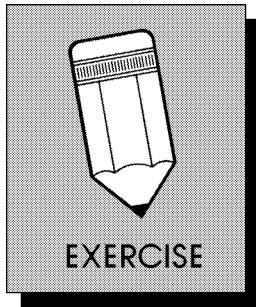
2. Who was the Principal Engineer on this project? _____ (1)

3. What strength (in P.S.I.) is the concrete in the bridge designed to meet in 28 days? _____ (32)

4. What are the 10' grid grades at Bent #2? _____ (32)

5. What would the following symbol represent? _____ (31)





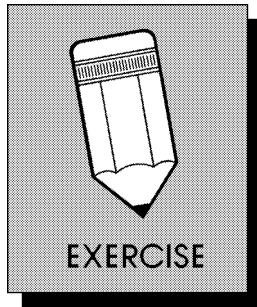
INSTRUCTIONS FOR EXERCISE 3

Read the question and refer to the *Hopyard-Dougherty Road Overcrossing* plans for the correct answer. (Location number is listed.)

In the space provided, please fill in the correct answer.

CALCULATIONS

1. What is the total amount of linear feet of K-rating on the job? _____ (19)
2. What is the difference in elevation at the beginning of the bridge (south end), opposed to that of the north end? (In feet and inches) _____ (31)
3. In bent number 2, what is the difference between specified tip elevation and probable tip elevation for the concrete piles in that bent? _____ (31)
4. What is the difference in elevation between the bottom of the retaining wall and the reference point "H8" sta. 62+33.35? _____ (36)
5. How many cubic yards of concrete are needed for each column footing (assume thickness = 5'-3")? _____ (37)



INSTRUCTIONS FOR EXERCISE 4

Read the question and refer to the *Caltrans Standard Plans* for the correct answer. (Plan number is listed.)

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

1. If L is 18 feet, what size rebar is needed, and what is the spacing? (Plan BO-1)

a. #6 @ 9"	c. #8 @ 9"
b. #7 @ 9"	d. #9 @ 9"

2. What is the slope of the weep hole? (BO-3)

a. $\frac{1}{8}$ inch to 1 foot	c. -2%
b. $\frac{1}{4}$ inch to 1 foot	d. +2%

3. How big is the construction joint if the bridge deck thickness is less than or equal to 10 inches? (BO-5)

a. $\frac{3}{4}$ "	c. $1\frac{1}{2}$ "
b. 1"	d. 2"

4. What protects the horizontal and vertical polystyrene? (BO-13)

a. Waterstop	c. Steel plate
b. $\frac{1}{8}$ " minimum hardboard	d. Polyethylene sheets

5. What is the typical distance that the pile is embedded in the footing? (B2-8)

a. 3"	c. 8"
b. 6"	d. 12"

6. What is the vertical curve at the top of the wall slope? (B3-8)

a. None	c. 10'
b. $1\frac{1}{2}$ inches to 1 foot	d. 20'

7. If the Movement Rating (MR) is 1 inch, what is the dimension in the winter, for cast iron pipe (cip/ps)? (B6-21)
- a. $\frac{1}{4}$ "
 - b. $\frac{1}{2}$ "
 - c. $\frac{3}{4}$ "
 - d. $1\frac{1}{2}$ "
8. What is the size of the fillets at the top of the girder stem walls? (B7-1)
- a. 4 " minimum
 - b. 4 " maximum
 - c. In proportion to height
 - d. Shown in the specifications
9. How many vents are required per span? (B7-1)
- a. None
 - b. Minimum of one
 - c. Minimum of two
 - d. Minimum of three
10. How many layers of building paper must the utilities be wrapped with? (B7-10)
- a. None
 - b. 1
 - c. 2
 - d. 3
11. What is the minimum typical concrete thickness of the exterior girders? (B8-5)
- a. 6 "
 - b. 12 "
 - c. 18 "
 - d. 24 "
12. What is the outside dimensions of the post pocket? (B11-51)
- a. 4 x 5 " x 0'-9 "
 - b. 5 " x 5 "
 - c. 2x 2.1875 "
 - d. 3 x 2.1875 "
13. How high is the top of the type 26 concrete barrier from the top of a type H curb? (B11-52)
- a. 8 " minimum
 - b. 1 '- 2 " minimum
 - c. 2 '- 3 " minimum
 - d. 2 '- 4 " minimum

14. On the type 25A barrier, what is the reinforcing specification? (B11-53)
- a. 2.61 lbs. per lineal foot
 - b. #8 @ 15
 - c. 2.61 cu. ft. per lineal foot
 - d. 25.5 lbs. per lineal foot
15. What size is the pipe sleeve for the anchor bolts on the detail (small) plan view? (B11-54)
- a. $1\frac{1}{2}$ " \varnothing x 6"
 - b. $1\frac{1}{4}$ " x 8"
 - c. $1\frac{1}{4}$ " x 10"
 - d. $1\frac{1}{4}$ " \varnothing x 12"

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010
CONCRETE
BRIDGE BUILDING

UNIT 010 – CONCRETE BRIDGE BUILDING

KOEL UNIT 37

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

1. Concrete is a mixture of portland cement, fine aggregate, coarse aggregate and:
 - a. Water
 - b. Admixtures
 - c. Rebar
 - d. Fibers

2. Sand is what kind of aggregate?
 - a. Coarse
 - b. Lightweight
 - c. Heavy
 - d. Fine

3. A deformed steel bar with ridges on the surface is known as:
 - a. An embed
 - b. Rebar
 - c. Slip dowel
 - d. Welded wire

4. How is concrete placed in hard to reach places?
 - a. Wheelbarrow
 - b. Shovel
 - c. Concrete pump
 - d. Tailgate

5. What is the term used to describe the chemical reaction between water and cement that causes concrete to harden?
 - a. Oxidation
 - b. Hydration
 - c. Single displacement
 - d. Synthesis

6. When placing concrete, it should be:
- a. Placed and moved from one end of the form
 - b. Allowed to free fall 10 to 12 feet in the form
 - c. Compacted as little as possible
 - d. Placed as close as possible to its final location in the form
7. Concrete in wall forms are placed in level lifts ranging from:
- a. 6 inches to 12 inches
 - b. 8 inches to 16 inches
 - c. 12 inches to 20 inches
 - d. 20 inches to 30 inches
8. The process of keeping concrete moist to allow proper hydration to occur is:
- a. Retarding
 - b. Curing
 - c. Wetting
 - d. Sprinkling
9. What is used to discharge concrete from a ready-mix truck directly in the forms?
- a. Chute
 - b. Bucket
 - c. Buggy
 - d. Pump
10. How long does it take concrete to reach its full strength (design strength)?
- a. 7 days
 - b. 14 days
 - c. 28 days
 - d. 56 days

11. A primary factor in the strength and quality of the concrete is the amount of:
- a. Aggregate
 - b. Water
 - c. Chemicals
 - d. Additives
12. What is the most effective method to cure a concrete slab?
- a. Leave the edge forms in place
 - b. Place a layer of sand over the slab
 - c. Cover the slab with boards
 - d. Spread water-soaked burlap or plastic sheets over the slab
13. What is the most critical time during the curing and hydration process of concrete?
- a. The first 3 days
 - b. The first 28 days
 - c. After the first 3 days
 - d. After the first 7 days
14. Concrete attains approximately what percent of its design strength at 14 days?
- a. 55%
 - b. 70%
 - c. 85%
 - d. 100%
15. A concrete wall that is 9 inches thick, 4'-6" high and 22' long will contain how many cubic yards of concrete?
- a. 74 cubic yards
 - b. 2.75 cubic yards
 - c. 27.5 cubic yards
 - d. 33 cubic yards

16. Adding water to a concrete mix changes the water-cement ratio. What is the effect of adding extra water to a concrete mix on the strength of the hardened concrete?
- a. Increased strength
 - b. Decreased strength
 - c. No effect on strength
 - d. Initially lower strength, then strength returns to normal

UNIT 010 – CONCRETE BRIDGE BUILDING

KOEL UNIT 69

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

1. A grooved joint in a concrete slab that creates a weakened plane is called:
 - a. A control joint
 - b. A cold joint
 - c. An expansion joint
 - d. A construction joint

2. To deposit concrete into deep walls or tall columns, a/an _____ should be attached to the lower end of a drop chute.
 - a. Elephant trunk
 - b. Hopper
 - c. Hose
 - d. None of the above

3. An admixture that produces small air bubbles that improve workability and resist freezing and thawing is called:
 - a. An accelerator
 - b. A retarder
 - c. Air-entraining
 - d. Pozzolans

4. What kind of joint separates adjoining sections of concrete and allows for expansion and contraction of the concrete?
 - a. A control joint
 - b. A cold joint
 - c. An expansion joint
 - d. A construction joint

5. A vibrator should be inserted into the concrete for a period of:
 - a. 5 seconds to 15 seconds
 - b. 20 seconds to 30 seconds
 - c. 3 seconds
 - d. 1 minute

6. A concrete bucket is:
- a. A long arch-shaped tube
 - b. Lifted by a crane and carried to the placement area
 - c. Moved by motorized buggies
 - d. Only used on small concrete projects
7. When placing concrete in walls, how do you avoid segregation?
- a. Limit the free fall to 4 to 6 feet
 - b. Moving the concrete horizontally with a vibrator
 - c. Allowing the concrete to strike the rebar
 - d. Adding water to the mix
8. What is used to consolidate concrete in heavy construction work?
- a. Spade
 - b. Rod
 - c. Immersion vibrator
 - d. Consolidator
9. What is the water-cement ratio of a cubic yard of concrete that contains 11.5 pounds of water and 21 pounds of cement?
- a. 0.33
 - b. 0.54
 - c. 1.8
 - d. 0.45
10. What is the name of the test used to measure the consistency of the concrete?
- a. Proportion test
 - b. Consistency test
 - c. Slump test
 - d. Trowel test

11. How is the strength of concrete measured?

- a. Tension test
- b. Compression test
- c. Combination tension-compression test
- d. Shear test

12. A PVC, rubber or stainless steel barrier used to prevent liquid or gas from passing through a concrete joint in a slab or a wall is called a:

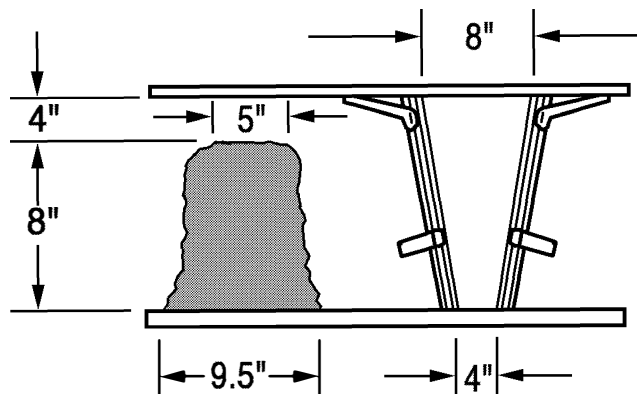
- a. Dam
- b. Corker
- c. Watertight
- d. Waterstop

13. A concrete slab that is 51'-6" long, 32' wide and 6" thick will require how many cubic yards of concrete?

- a. 31 cubic yards
- b. 30 cubic yards
- c. 824 cubic yards
- d. 28 cubic yards

14. In the slump test shown below, what is the slump of the concrete mixture?

- a. 4"
- b. 8"
- c. 9.5"
- d. 5"



15. When placing concrete in even lifts, vibration should:
- a. Not penetrate the newest lift
 - b. Penetrate several inches into the previous pour
 - c. Penetrate completely through all the lifts
 - d. Not be used
16. Which of the following is not an admixture?
- a. Water
 - b. Retarder
 - c. Accelerator
 - d. Air-entraining
17. At what point are the test cylinders of concrete compression tested?
- a. 3 days
 - b. 7 days
 - c. 28 days
 - d. 14 days
18. During the initial curing stage of concrete, the concrete should be kept moist for:
- a. 3 days
 - b. 4 days
 - c. 5 days
 - d. 14 days

