Construction Blueprint Reading Unit # 108

Unit #108

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Chapter 1

Construction Documentation

Objectives:

Upon completion of this chapter, students will be able to:

1). Understand the importance of communication through documentation.
2). Properly complete field construction documents.
3). Recognize the impact of the proper documentation to a project's profitability.

Introduction

The construction project will change the very moment you step on the jobsite. The owner can request additional work or deletion of work. The architect did not clearly state his or her intentions and a part of the drawings require clarification before proceeding. The general contractor could accelerate the construction schedule or schedule work out of sequence. As a drywall/lathing foreman, you will document any changes, handle day-to-day jobsite activities for your company and obtain answers to questions you have.

In this chapter, we will discuss the various documents commonly used on the jobsite when communicating with the architect and the general contractor. Any paperwork requiring a change to the contract, must be accurate and complete so there cannot be any questions about what was done, when the work was performed and who authorized the work. In addition, all changes require documentation as to how much material is used, how many labor hours were necessary and any other miscellaneous costs. These costs will need to be tracked and expensed to the general contractor. As we previously mentioned, there is a fine line between a profitable job and one, which is not.

RFI (Request For Information)

Construction drawings and specifications are not 100% complete and without errors as you know. For example, a reflected ceiling plan could

clearly show a gypsum board ceiling for a particular room, but the finish schedule lists a t-bar ceiling for the same room, or a soffit detail shows a two-track slip system for the top track, how would you proceed? The architect's intentions will need to be clarified by the use of a RFI originated by the drywall/lathing foreman.

A RFI is a document used to clarify the contract documents, once a question arises. When a subcontractor issues an RFI, it goes to the general contractor first, who in turn sends the RFI to the architect for clarification. It is important to follow this procedure, because of the paper trail it produces. In the example above, if the architects' intentions were to have a gypsum board ceiling, then a change to the drawings may have occurred and a price adjustment to the contract is justified. The change to the drawing should be issued in the form of an addendum, which we will discuss later in this chapter. Not every RFI will result in an addendum, but your question should answered in a timely manner and in writing as how to proceed.

Be sure to thoroughly research the drawings to find the answer before you issue an RFI, it is possible the architect has placed the information somewhere in the drawings. The project superintendent may have previously discussed the problem with the architect and have the answer, so check with the superintendent or your company's estimator may have discovered the answer when bidding the project. When writing a RFI, clearly and precisely state the question along with references to plan details, elevations, sheet numbers and callouts. This will ensure the architect does not have any questions about what is being asked. Your writing should be legible, in ink and do not use a carpenters pencil to fill out any paperwork.

The following is a blank example of a typical RFI. It should contain your company's letterhead, an address along with the job number of your company and the general contractor, who is the general contractor, date of the plans you are using, the start work date of the project, the issue date of the RFI, an area for you to state the description of the question and any possible cost or schedule impact to the project, including how many pages the RFI contains, along with an area for you to sign. The latter example shows a properly completed RFI. If your company's RFI form does not come in duplicate or triplicate form, then make a copy of the RFI for your records and forward a copy to your project manager.

A Request For Information Form

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Request For Information

Job Name:
RFI #
AAA Job #
GC Job #

Page ____ of _____

General Contractor:
Contact Name:

Date:
Date of Plans:
Start Work Date:

Description:

Cost Impact? _____ Schedule Impact? _____

Submitted By: for AAA Drywall & Lathing, Inc.

Thank You for your assistance!

A Properly Completed Request For Information Form

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Request For Information

Job Name: Holiday Hotel
RFI # 1
AAA Job # 01123
GC Job # 2245A

Page __1__ of ___1__

General Contractor: Daylight Construction, Inc.
Contact Name: Joe Smith

Date: 1/1/04
Date of Plans: 10/15/03
Start Work Date: 12/1/03

Description:

1). Room 2001 as shown on the Reflected Ceiling Plan sheet A/3 calls for a gypsum board ceiling. Room 2001 as listed on the Room Finish Schedule sheet A/8 specifies a t-bar ceiling, please clarify.

2). Soffit detail 7, sheet A/9 references a two track slip system, please detail the track to track connection supporting the soffit.

Cost Impact? ___X___ Schedule Impact? ___X___

Submitted By: for AAA Drywall & Lathing, Inc.

Joe Foreman

Thank You for your assistance!

Change Orders

Change orders are used to record changes to the construction contract. A change order is a document issued to the contractor or subcontractor formally identifying changes to the original plans, specifications, or other contract documents. Upon successful negotiation of the change in project's scope, cost and schedule, the change order with the proper signatures, becomes a legal amendment to the construction contract.

Change orders may be required for a variety of reasons, but most often result from changed site conditions; design modifications; or changes in the scope; materials, cost or schedule. These changes may be requested from the owner, architect, general contractor or subcontractors. Change orders can result in an addition or subtraction to the original contract price.

Changes to the project will affect a variety of negative factors, which the drywall/lathing foreman should recognize and understand. Try to avoid the following situations if at all possible.

- **Redirection of the Workforce-** A change is disruptive to the flow of work at the site. Workers may need to be redirected and new workers brought in. This can lead to inefficient crew sizes and retraining.
- **Fatigue-** Overtime may be required to complete the base contract work. Overtime lowers work output and efficiency through physical fatigue.
- **Purchasing/Material Handling**- A change is disruptive to purchasing, delivery, storage and stocking of material on the jobsite.
- **Stacking of Trades-** A change can transform a sequenced work area into many trades working at the same time creating inefficiencies.
- **Dilution of Supervision**- Your time as a drywall/lathing foreman supervising a change may direct you away from the base contract work.
- **Worker Moral**- If partitions, soffits, ceilings, etc. have to be removed and reinstalled, it has an adverse effect on the workers morale. Most workers take pride in their work.

Normally the estimator or project manager estimates change orders in the office prior to the start of the work, however, changes may need to be

implemented immediately. Immediate changes will become the drywall/lathing foreman's responsibility to manage and document with an "Extra Work Order".

EWO- Extra Work Order

Extra work orders (EWO) are documents for time and material changes, which the project manager submits to the general contractor for the purpose of a formal change order. The drywall/lather foreman's responsibility is to track **all** labor, material and equipment associated with the field change on a daily basis. Any additional labor including stocking, clean up and supervision should be record also. You should instruct the taping foreman, so he or she can properly document the change and any dump fees should be added to the extra work order.

It is important to obtain a signed authorization to proceed from the general contractor's project manager or superintendent prior to starting "extra" work and on a daily basis once the work is started! Doing any additional work without a signed work authorization is a risky proposition; it is possible your company will **not** be paid for the work. Your project manager or estimator should be made aware of any additional work before the work starts.

The following is an example of an "Extra Work Order" along with a numbering system explaining how to complete the paperwork. Most EWO's have a triplicate form and your company will instruct you as to what copy goes to the GC, your office and your files.

An example of an "Extra Work Order"

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Extra Work Order

AAA Job # 6

Date: 7

Customer Information		Job Information
Customer Name 1		Work Location 8
Customer's Project Manager 2		Street Address 9
Customer's Job# or PO# 3		City, State, Zip 10
Date of Plans 4	Start Work Date 5	Reference # 11

12 Reason for Extra Work: ☐ Architect ☐ Owner ☐ Backcharge ☐ GC Revision # ☐ Other

Work Performed

13

Labor, Material and Other

Labor:	Material and Other:
14	18
	19
Total Labor	$
Total Material	
Total Other	
Total Extra Work Order	$

Customer's Approval	Approval for ABC Drywall & Lathing, Inc
AAA Drywall & Lathing is authorized to complete the work per this agreement. We will issue AAA Drywall & Lathing a Change Order or Purchase Order for this work.	AAA Drywall guarantees all materials and workmanship as specified or to industry standards. We are not responsible for delays beyond our control. Payment for this work is due 30 days from the date of our invoice.
Signature 15	Signature 20
Printed Name and Title 16	Printed Name and Title 21
Date Signed 17	Date Signed 22

Below is an explanation on how to properly fill out the "Extra Work Order". The explanations are numbered on the example form 1 thru 22.

1). **Customer Name:** The General Contractor
2). **Customers Project Manager:** The manager for the General Contractor, ask the project superintendent for this information.
3). **Customer's Job # or PO #:** Ask the project superintendent.
4). **Date of Plans:** The date of the plans you are working with.
5). **Start Work Date:** The date the additional work started, not the start of the job or when the tag was written or signed.
6). **Company Job Number:** Your company's job number.
7). **Date:** The date when the tag is filled out.
8). **Work Location:** Name of the project.
9). **Street Address:** Address of the project.
10). **City, State Zip:** Of the project.
11). **Reference #:** Any paperwork issued by the General Contractor, architect or engineer relating to the additional work. Attach a copy to the EWO if possible.
12). **Reason for Extra Work:** Check one of the reasons.
13). **Work Performed:** Be precise and detailed about the work being performed. List what was changed, deleted in a particular room or area. If it is an area, refer to the area using column line identification. It is important to list who directed or requested the work.
14). **Labor:** All labor hours for regular and overtime work. Should include labor hours for framing, hanging, taping, stocking, clean up and supervision.
15). **Signature:** Signature of the project superintendent.
16). **Printed Name and Title:** Have superintendent print name and title.
17). **Date Signed:** Date customer signed EWO.
18). **Material and Other:** All material, dump fees, truck time and any equipment needed to accomplish the additional work, i.e. scissor lifts, boom lift etc.
19). **Total Labor, Total Material, Total Other, Total Extra Work Order:** Leave blank for the office or project manager to complete.
20). **Signature:** Signature of the drywall/lathing foreman.
21). **Printed Name and Title:** Printed name of the foreman.
22). **Date Signed:** Date the EWO is signed.

A Completed Extra Work Order

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Extra Work Order

AAA Job # 01123

Date: 1/5/04

Customer Information		Job Information	
Customer Name	Daylight Construction, Inc.	Work Location	Holiday Hotel
Customer's Project Manager	John Smith	Street Address	222 Ridge road
Customer's Job# or PO#	2245A	City, State, Zip	Anywhere, CA 22222
Date of Plans 10/15/03	Start Work Date 1/5/04	Reference #	AAA RFI #1

Reason for Extra Work: [X] Architect ☐ Owner ☐ Backcharge ☐ GC Revision # ☐ Other

Work Performed

Installation of gypsum board ceiling in Room 2001 per John Smith on 1/5/04 in reference to AAA RFI #1 dated 1/1/04. Architect claraification dated 1/4/04.

Labor, Material and Other

Labor: 1/5/04		Material and Other:	
Joe Hanger	8 hours	24 pcs- 4 x 12 5/8" wallboard	
Steve Rocker	8 hours	40 pcs - 3 5/8" x 12'-0" stud 20 gauge	
Jose Framer	8 hours	15 pcs - 3 5/8" x 10'-0" track 20 gauge	
Joe Scrapper	5 hours	Dump Fee	
		Taping Materials	
1/8/04		Total Labor	$
Bill Taper	8 hours	Total Material	
Pedro Bead	8 hours	Total Other	
		Total Extra Work Order	$

Customer's Approval	Approval for AAA Drywall & Lathing, Inc
AAA Drywall & Lathing is authorized to complete the work per this agreement. We will issue AAA Drywall & Lathing a Change Order or Purchase Order for this work.	AAA Drywall guarantees all materials and workmanship as specified or to industry standards. We are not responsible for delays beyond our control. Payment for this work is due 30 days from the date of our invoice.
Signature	Signature
Printed Name and Title Joe Smith/Super	Printed Name and Title Joe Foreman
Date Signed 1/5/04	Date Signed 1/8/04

Submittals

Submittals are communications to the architect illustrating the contractor's or subcontractor's intent for complying with specific items of the contract documents, typically involving the materials supplied to the jobsite. Procedures for the submittal process will be found in the specifications under each trade's section or division and the general requirements. The subsequent example for a submittal procedure is as follows: items

1.03 SUBMITTALS

A. Product Data: Submit Manufacturer's Specifications, design data and installation instructions.
B. Shop Drawings: Submit Drawings showing layout, dimensions and construction details.
C. Certificates: 1. Submit Mill Certification with shipment to verify chemical composition, yield strength, tensile strength, elongation and coating thickness. Include listing of applicable ASTM standards specified in this section and comparison of ASTM requirements to actual materials provided to jobsite. 2. Submit Manufacturer's certification that products furnished meet or exceed the specified design requirements.

The submittal instructions above come directly from a metal framing specification. The architect is requiring product data, which can found in the manufacturers literature or brochures. Shop drawings are not common to the drywall/lathing trade unless your company has engineered portions of the work in efforts to obtain the work or to save the owner money. Certificates for material verify the architect's design criteria for the work. ASTM references will be found in the manufacturers literature.

Submittals are the responsibility of your company's project manager. The project manager will supply the general contractor with 3 to 5 copies of the documentation required by the specifications. The general contractor approves all of the subcontractor submittal packages and submits them to the architect for approval. Identifying, processing and obtaining approvals of submittals is a very important and time-consuming process. Once the submittals have been stamped approved by the architect, they are returned to the general contractor, who then returns the submittals to the appropriate subcontractor. Technically, all materials and prefabricated items are not to be ordered or built until approval of the submittal package is complete and

returned as approved to the subcontractor. However due to the fast paced nature of most construction projects today, approval can lack behind the ordering and delivery of materials. It is important to understand any materials delivered to the jobsite must meet or exceed the submittal requirements. Once the project is complete, the general contractor will give the owner copies of the approved submittals for their records.

Addendum

An addendum (plural- addenda) is a written or graphic document issued after the original document issue date, which modifies the original document to the extent indicated. In other words, it is a change to the original drawings, specifications or contract by additions, deletions, clarifications or corrections. In terms of construction blueprints, the architect will issue a new drawing or multiple drawings depending upon the amount of changes.

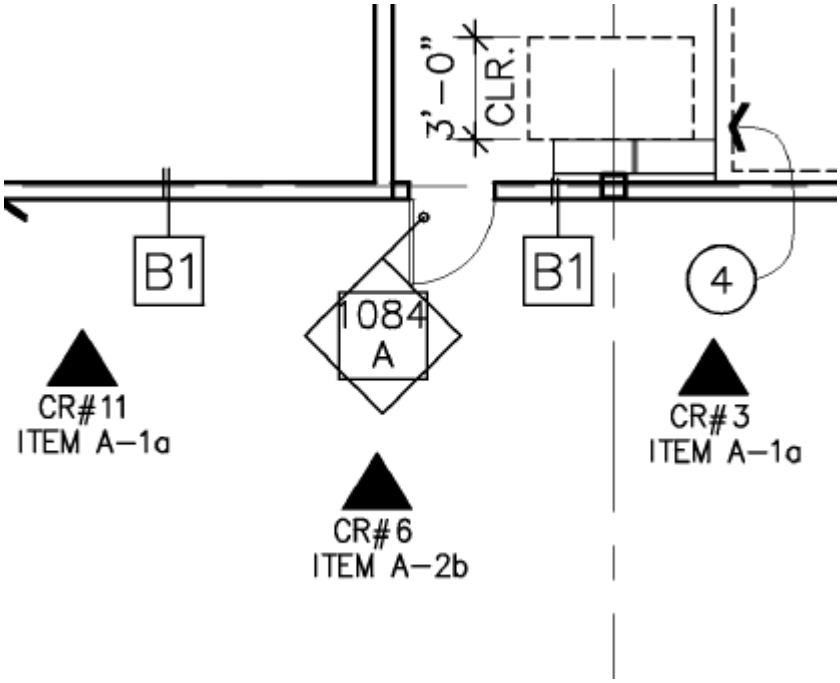
A clouded area will usually highlight the change on the new drawing, along with a delta symbol (Δ) attached, including an addendum number or some type of identification number. Sometimes the architect will only attach the delta symbol and number to the change, instead of clouding the entire area, in an effort to keep the drawings legible. The addenda changes, along with the dates of the addenda, will also be listed in the addendum block located on the edge of the drawings.

An Addendum Block Recapping all Addenda

REV.	BY	DESCRIPTION	DATE
	JC	ISSUED FOR PLAN CHECK	4–10–98
	JC	ISSUED FOR BID	4–17–98
	JC	ISSUED FOR CONSTRUCTION	5–13–98
▲	SM	CHANGE REQUEST #3	6/29/98
▲	SM	CHANGE REQUEST #6	7/10/98
▲	SM	CHANGE REQUEST #11	8/11/98
▲	SM	CHANGE REQUEST #16	9/16/98
▲	SM	CHANGE REQUEST 18	9/23/98

You should compare the new drawing with the old drawing to identify any addendum changes. Keep in mind, not all changes will affect the drywall/lathing trade, so there may be drawings having a date later than yours even though it does not affect the drywall/lathing scope of work. The following example taken from a set of prints shows the use of delta symbols, in lieu of clouding the affected areas. Many times the architect will recap the changes on an 8 1/2 x 11 sheet of paper, issued with the revised drawings, as he has probably done in the example below. (i.e. Item A-1a, Item A-2b). In this case, you will need to read the accompanying documentation to fully understand the changes to the drawing.

Addenda as shown in a set of Blueprints



Chapter 1

Study Guide

Construction Documentation

Directions:

Answer the following questions using the bubble answer sheet.

1). When a subcontractor issues an RFI, it goes directly to the architect.

A). True

B). False

2). RFI's are used to record changes to the construction contract.

A). True

B). False

3). It is important to obtain a signed authorization to proceed from the general contractor's project manager or superintendent prior to starting "extra" work!

A). True

B). False

4). The general contractor approves all of the subcontractor submittal packages and submits them to the architect for approval.

A). True

B). False

5). An addendum (plural- addenda) is a written or graphic document issued after the original document issue date, which modifies the original document to the extent indicated.

A). True

B). False

6). It is important to understand any materials delivered to the jobsite must meet or exceed the submittal requirements.

A). True

B). False

7). You should compare the new drawing with the old drawing to identify any addendum changes.
A). True
B). False

8). Addenda are communications to the architect illustrating the contractor's or subcontractor's intent for complying with specific items of the contract documents.
A). True
B). False

9). All materials and prefabricated items are not to be ordered or built until approval of the change order package is complete and returned as approved to the subcontractor.
A). True
B). False

10). Every RFI will result in an addendum.
A). True
B). False

11). Change orders can result in an addition or subtraction to the original contract price.
A). True
B). False

12). A change order is a document issued to the contractor or subcontractor formally identifying changes to the original plans, specifications, or other contract documents.
A). True
B). False

Chapter 1

RFI Exercise

Directions:

Write an RFI identifying the following *hypothetical* problems found on the "Coulter Pharmaceutical" drawings. The information is given on the drawings; act as if you need clarification with an RFI. Issue a separate RFI for each clarification and use the drawings to obtain the necessary information.

Job Information:
General Contractor: High Rise Development, Inc.
Superintendent: Joe Jones
GC Job #: 2234
AAA Job #: 778
Start Work Date: 1/9/04

RFI #1
1). The serpentine wall in Room 1015, found on sheet A2.1, does not have radii dimensions.

RFI #2
1). Backing height is needed for the counter top shown on elevation 12/A5.2

RFI #3
1). Door 1079B is not identified on sheet A2.1.

RFI Exercise

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Request For Information

Job Name:
RFI #
AAA Job #
GC Job #

Page ____ of _____

General Contractor:
Contact Name:

Date:
Date of Plans:
Start Work Date:

Description:

Cost Impact? _____ Schedule Impact? _____

Submitted By: for AAA Drywall & Lathing, Inc.

Thank You for your assistance!

RFI Exercise

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Request For Information

Job Name:
RFI #
AAA Job #
GC Job #

Page ____ of _____

General Contractor:
Contact Name:

Date:
Date of Plans:
Start Work Date:

Description:

Cost Impact? _____ Schedule Impact? _____

Submitted By: for AAA Drywall & Lathing, Inc.

Thank You for your assistance!

RFI Exercise

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Request For Information

Job Name:
RFI #
AAA Job #
GC Job #

Page ____ of _____

General Contractor:
Contact Name:

Date:
Date of Plans:
Start Work Date:

Description:

Cost Impact? _____ Schedule Impact? _____

Submitted By: for AAA Drywall & Lathing, Inc.

Thank You for your assistance!

EWO Exercise #1

Directions:

Fill out an "Extra Work Order" with the information given in each situation found below. You will need to estimate the materials required to accomplish the work. Try approximating the labor hours needed to accomplish this work based on your experiences. Use the blank EWO's found on the following pages to complete this assignment.

EWO #1

1). Jim Perez, the superintendent for general contractor, Builder, Inc. has requested AAA Drywall & Lathing, Inc to construct 112 lineal feet of full height partition, 24'-0" high, with 5/8" fire taped gypsum board each side full height, framing is to be 6" 20 gauge stud, 24" O.C. with regular top and bottom track. Builder, Inc issued Sam Smith, foreman for AAA Drywall & Lathing a PO # 1876 (GC Revision #1) for the work. The job, Office City, 234 Strobe Street, Uptown, Ca. 23498 has original plans dated 11/24/03. The additional work was started on 1/7/04. AAA, Inc. job number is #4454.

EWO #2

2). Henry White, the superintendent for general contractor, Constructor, Inc. has requested AAA Drywall & Lathing, Inc to construct 236 lineal feet of 12'-0" high partition, with 5/8" fire taped gypsum board each side to 12'-0" and with R-11 insulation, framing is to be 3 5/8" 20 gauge stud, 16" O.C. with regular top and bottom track. Constructor, Inc issued Enrique Cota, foreman for AAA Drywall & Lathing a PO # 8876 (Owner Request) for the work. The job, Village Office Building, 3887 State Street, Village, Ca. 23009 has original plans dated 2/9/04. AAA, Inc. job number is #0998. The additional work was started on 6/20/04.

EWO#3

3). John Rodriguez, the superintendent for general contractor, Best, Inc. has requested AAA Drywall & Lathing, Inc to construct 170 lineal feet of 18'-0" high partition, with 5/8" fire taped gypsum board each side to 18'-0". Framing is to be 3 5/8" 20 gauge stud at 24" O.C. with regular top and bottom track. Best, Inc. has issued Frank Means, foreman for AAA Drywall and Lathing, a PO # 0923 (Architect Reference #23) for the work. The job, Town Hall, 56 Main Street, Compton, CA 23232 has original plans dated 12/7/03. Additional work started 4/15/04. AAA, Inc. job number is #6567.

EWO Exercise #1

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Extra Work Order

AAA Job #

Date:

Customer Information		Job Information
Customer Name		Work Location
Customer's Project Manager		Street Address
Customer's Job# or PO#		City, State, Zip
Date of Plans	Start Work Date	Reference #

Reason for Extra Work: ☐ Architect ☐ Owner ☐ Backcharge ☐ GC Revision # ☐ Other

Work Performed

Labor, Material and Other

Labor:	Material and Other:	
	Total Labor	$
	Total Material	
	Total Other	
	Total Extra Work Order	$

Customer's Approval	Approval for AAA Drywall & Lathing, Inc
AAA Drywall & Lathing is authorized to complete the work per this agreement. We will issue AAA Drywall & Lathing a Change Order or Purchase Order for this work.	AAA Drywall guarantees all materials and workmanship as specified or to industry standards. We are not responsible for delays beyond our control. Payment for this work is due 30 days from the date of our invoice.
Signature	Signature
Printed Name and Title	Printed Name and Title
Date Signed	Date Signed

EWO Exercise #1

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Extra Work Order

AAA Job #

Date:

Customer Information		Job Information
Customer Name		Work Location
Customer's Project Manager		Street Address
Customer's Job# or PO#		City, State, Zip
Date of Plans	Start Work Date	Reference #

Reason for Extra Work: ☐ Architect ☐ Owner ☐ Backcharge ☐ GC Revision # ☐ Other

Work Performed

Labor, Material and Other

Labor:	Material and Other:	
	Total Labor	$
	Total Material	
	Total Other	
	Total Extra Work Order	$

Customer's Approval	Approval for AAA Drywall & Lathing, Inc
AAA Drywall & Lathing is authorized to complete the work per this agreement. We will issue AAA Drywall & Lathing a Change Order or Purchase Order for this work.	AAA Drywall guarantees all materials and workmanship as specified or to industry standards. We are not responsible for delays beyond our control. Payment for this work is due 30 days from the date of our invoice.
Signature	Signature
Printed Name and Title	Printed Name and Title
Date Signed	Date Signed

EWO Exercise #1

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Extra Work Order

AAA Job #

Date:

Customer Information		Job Information
Customer Name		Work Location
Customer's Project Manager		Street Address
Customer's Job# or PO#		City, State, Zip
Date of Plans	Start Work Date	Reference #

Reason for Extra Work: ☐ Architect ☐ Owner ☐ Backcharge ☐ GC Revision # ☐ Other

Work Performed

Labor, Material and Other

Labor:	Material and Other:	
	Total Labor	$
	Total Material	
	Total Other	
	Total Extra Work Order	$

Customer's Approval	Approval for AAA Drywall & Lathing, Inc
AAA Drywall & Lathing is authorized to complete the work per this agreement. We will issue AAA Drywall & Lathing a Change Order or Purchase Order for this work.	AAA Drywall guarantees all materials and workmanship as specified or to industry standards. We are not responsible for delays beyond our control. Payment for this work is due 30 days from the date of our invoice.
Signature	Signature
Printed Name and Title	Printed Name and Title
Date Signed	Date Signed

Chapter 1

EWO Exercise #2

Directions:

Fill out an "Extra Work Order" with the information given below. The "Coulter Pharmaceutical" drawings will be required for this exercise. List the approximate lineal footage of partition types needed, along with the quantities of materials for the additional work. Try approximating the labor hours needed to accomplish this work based on your experiences, (you will not be graded on the labor hours). Use the blank EWO found on the following page to complete this assignment.

1). Henry Cotto, the superintendent for general contractor, Code Plus, Inc. has requested AAA Drywall & Lathing, Inc. to construct Offices 2030 through 2038, as shown on the Coulter Pharmaceutical drawings. The additional work includes framing, drywall, insulation and taping. The framing is 16" O.C., 20- gauge material, braced at 8' o.c. All other construction information will be found in the drawings. Code Plus, Inc. issued Pat Perez, foreman for AAA Drywall & Lathing, Inc., a PO #1111 for the additional work as requested by the owner. The additional work is to start on 12-1-04. AAA, Inc. job number is #5557.

EWO Exercise #2

Name: _____

AAA Drywall & Lathing, Inc
1234 Elm Street
Anywhere, CA 22222
License #11111A
Phone: 408-555-1234
Fax: 408-555-1234

Extra Work Order

AAA Job #

Date:

Customer Information		Job Information
Customer Name		Work Location
Customer's Project Manager		Street Address
Customer's Job# or PO#		City, State, Zip
Date of Plans	Start Work Date	Reference #

Reason for Extra Work: ☐ Architect ☐ Owner ☐ Backcharge ☐ GC Revision # ☐ Other

Work Performed

Labor, Material and Other

Labor:	Material and Other:	
	Total Labor	$
	Total Material	
	Total Other	
	Total Extra Work Order	$

Customer's Approval	Approval for AAA Drywall & Lathing, Inc
AAA Drywall & Lathing is authorized to complete the work per this agreement. We will issue AAA Drywall & Lathing a Change Order or Purchase Order for this work.	AAA Drywall guarantees all materials and workmanship as specified or to industry standards. We are not responsible for delays beyond our control. Payment for this work is due 30 days from the date of our invoice.
Signature	Signature
Printed Name and Title	Printed Name and Title
Date Signed	Date Signed

Chapter 2

Job Schedules

Objectives:

Upon completion of this chapter, students will be able to:

1). Realize the importance of a construction schedule.
2). Comprehend two basic types of schedules used on commercial projects.
3). Organize manpower in conjunction with a construction schedule.
4). Understand the importance of a daily job log.
5). Calculate the progress of a project in terms of completion.
6). Estimate the labor hours needed to complete various types of work.

Introduction

The general contractor or construction manager is responsible for the project's construction schedule. The construction schedule is used as a tool for management of the job and for communication with the subcontractors. The construction schedule also serves two important factors, it makes binding performance agreements with the subcontractors, but it also gives the owner a roadmap for completion and how the sequence of work will be scheduled. Comprehensive construction schedules will include the dates for; land acquisition, meetings with design consultants and architects, producing design documents, obtaining building permits and construction of the building.

Job Scheduling

For larger projects, communication between the general contractor and the subcontractors concerning the schedule is usually done weekly with jobsite progress meetings and prior to the start of the job. The general contractor should request activity durations for items such as framing, gypsum board installation and taping from your office when preparing the initial construction schedule.

The drywall/lathing foreman is concerned with the time and dates given to certain activities such as material delivery, layout, framing, inspections, gypsum board installation, lathing, etc. and any changes to the schedule will

impact the manpower required to complete each phase of the job. There is a difference to having a job schedule on paper and seeing the job in the field. Many times a job is behind schedule, not from the fault of any subcontractor, but from the general contractor failing to properly coordinate the project. Do not schedule men for the job just for the sake of having men on the job. Many times, the GC's superintendent could care less if you are wasting manpower, just so they can fill out their daily log showing drywall/lathers on the job. Schedule manpower when you are ready for the labor by having material properly stocked, enough equipment and the areas you are going to work in have been properly coordinated with other trades. This is a fine line to walk, because on one hand, the GC is screaming for more manpower and on the other hand, you know more manpower will be unproductive. It is recommended you talk to your field foreman or shop, explain the jobsite situation and let your office communicate with the general contractor. Time is of essence in every construction project, but not if you are wasting manpower.

It is important to note, construction schedules are the basis for delay claims. As an example, suppose the schedule for framing the interior partitions was met, but the electrician did not complete the electrical work as scheduled. This would impact any trades following the electrician, including the gypsum board installation, taping and so forth. This could require you and your men to work overtime to complete the project within the allotted time. You should note any delays in your daily log and how many days you were delayed in performing the scheduled work and the reason for the delay. This should also be noted at the weekly progress meeting. The additional money required for the overtime portion should be the electrician's responsibility and could result in a back charge claim by your company's project manager.

Types of Construction Schedules

The type of schedule used for a project normally depends on the cost and complexity of the project. A bar chart is usually used for smaller projects and for larger projects a critical path method (CPM) schedule is established.

A bar chart simply indicates when specific activities will start, the duration of the activity and the finish date of the activity. Since each activity on a bar chart is depicted as a straight line on the schedule, a bar chart is easy to

understand. A bar chart does not indicate the interrelationship between different activities, nor does it indicate that the commencement of one activity is dependent on the completion of the successor activity.

The bar chart found on page 35 represents a 60-day project. The activities are given on the left side of the graph, along with the duration of the activities in days along the bottom of the graph. The drywall framing would start on the 37th day of the project and have duration of 5 days. The hanging of the gypsum board would start on the 38th day of the project and have duration of 5 days. Taping of the drywall would start on the 41st day of the project and have duration of 6 days.

As a drywall/lathing foreman, you would need to consider how many days the work is scheduled for and how much framing or hanging there is to accomplish when determining how many workers are required to meet the job schedule. The project estimator has calculated how many man-hours are needed to complete the job. For example, if the total numbers of man-hours to frame the job totals 165 hours, 5 hours were for layout, then you would divide the remaining 160 hours by 5 days equaling 32 hours per day. Divide 32 hours per day by 8 hours per man, equaling 4 workers per day to complete the framing portion. The same process is used to determine how many workers are needed to complete the hanging portion of the job. If 210 hours are estimated to hang the gypsum board, divide 210 hours by 5 days, equaling 42 hours per day. Again divide 42 hours by 8 hours per worker, equaling 5.25 workers per day to hang the gypsum board. In this case you could consider 6 workers per day and hang the job in 4.37 days.

What is important to note the partition framing and the hanging of the gypsum board are overlapping in the schedule. In other words, some of the actions are occurring on the same days. Note how the hanging of the gypsum board starts 1 day after the farming starts. You would need to average 4 workers framing and 6 workers hanging per day to meet the schedule, totaling 10 workers per day. The key word used above was "average". If the job required 2 days of framing to have adequate walls for the hangers to rock, then you would need to adjust the number of hangers per day. Possibly, you would use 4 hangers the first 2 days, then 6 hangers the remaining 3 days of the project to meet the schedule.

Complex building projects require the use of a more sophisticated type of schedule called the critical path method or CPM. This type of schedule

indicates the dependencies and interrelationships between different activities. Those activities are shown as a network. A CPM schedule shows the sequence of each activity, the start of each activity, the dependence of that activity on the completion of a preceding activity, and how the completion of that activity will restrict the commencement of subsequent activities. Built into a CPM schedule is a "float" which represents the number of days an activity can be delayed without delaying the entire project, with a critical activity having no float. In essence, the *critical path* is the shortest period of time it will take to complete all of the activities that compromise the project.

The CPM schedule shown on page 36 would require the gypsum board installation to begin on June 5th and complete on June 23rd. Notice the insulation is required to be complete prior to the gypsum board installation as shown by the lines and arrows connecting the two activities together. The activities dependent on the gypsum board installation are the flooring, painting and specialties as shown on the schedule. The milestone for the interior finishes to begin would be June 23rd at the end of the gypsum board installation. A milestone is a significant event the owner or general contractor wants to track.

Daily Job Log

The most important approach to keeping records on the job will be your daily job log. Conversations with your workers, the job superintendent and other trades should possibly be recorded in your daily job log as to the importance of the conversation. Any delays to the construction schedule should be noted, what trade caused the delay, the reason for the delay and the impact to the drywall/lathing schedule. In some states, it is a requirement to maintain a daily job log. Make notes in your daily job log for the following reasons:

- Accidents
- Safety Issues
- Meetings- architect, GC's project manager or super
- Talks with trades, suppliers, your shop, workers
- Material/Equipment when received
- Broken/Stolen equipment or materials
- Problems, observe time of day and reason

- Inspections
- Manpower
    - Name of worker and hours worked
    - Name of anyone not showing up
    - Name and time of anyone leaving early

A simple note pad, pocket calendar or PDA works well for a daily job log. The reason for keeping good records is to substantiate any concern occurring on the job yesterday or three months ago. The more documentation you have, the better your company's chances are at recovering money from the general contractor or overcoming any back charge claim.

The following is an example of a daily job log for a residential job as filled out by the general contractor's superintendent. It gives you an example of what can occur on a job each day and unless there are records kept by the drywall/lathing foreman on his or her job, many discussions will never be remembered as to their importance, much less as to what was said.

Daily Job Log

Daily Job Log

Project: LaBarba Residence **Date:** Thursday, February 15, 1996

Address: Palos Verdes **Superintendent:** R.B. Kros

SUB CONTRACTORS	MEN	HRS	WORK PERFORMED
Rusher Air Conditioning	2	8	Remove ext'g (low efficiency) FAUs from attic location. Install new Carrier high-efficiency FAUs. **The FAU's are in place, but a plenum needs to be installed as well as PVC venting. Remainder of work to be completed tomorrow.**
DeHonor Roofing	3	2	Move 60 100# containers asphalt to rear yard (for security).
Ramage Masonry	1	3	Install fire screens at chimney caps. Clean up. Job complete.
BC Plastering	1	6	Finish final 2 exterior plaster samples.

CHANGE ORDERS	IN HOUSE WORK
DELIVERIES	**ORDERS PLACED**

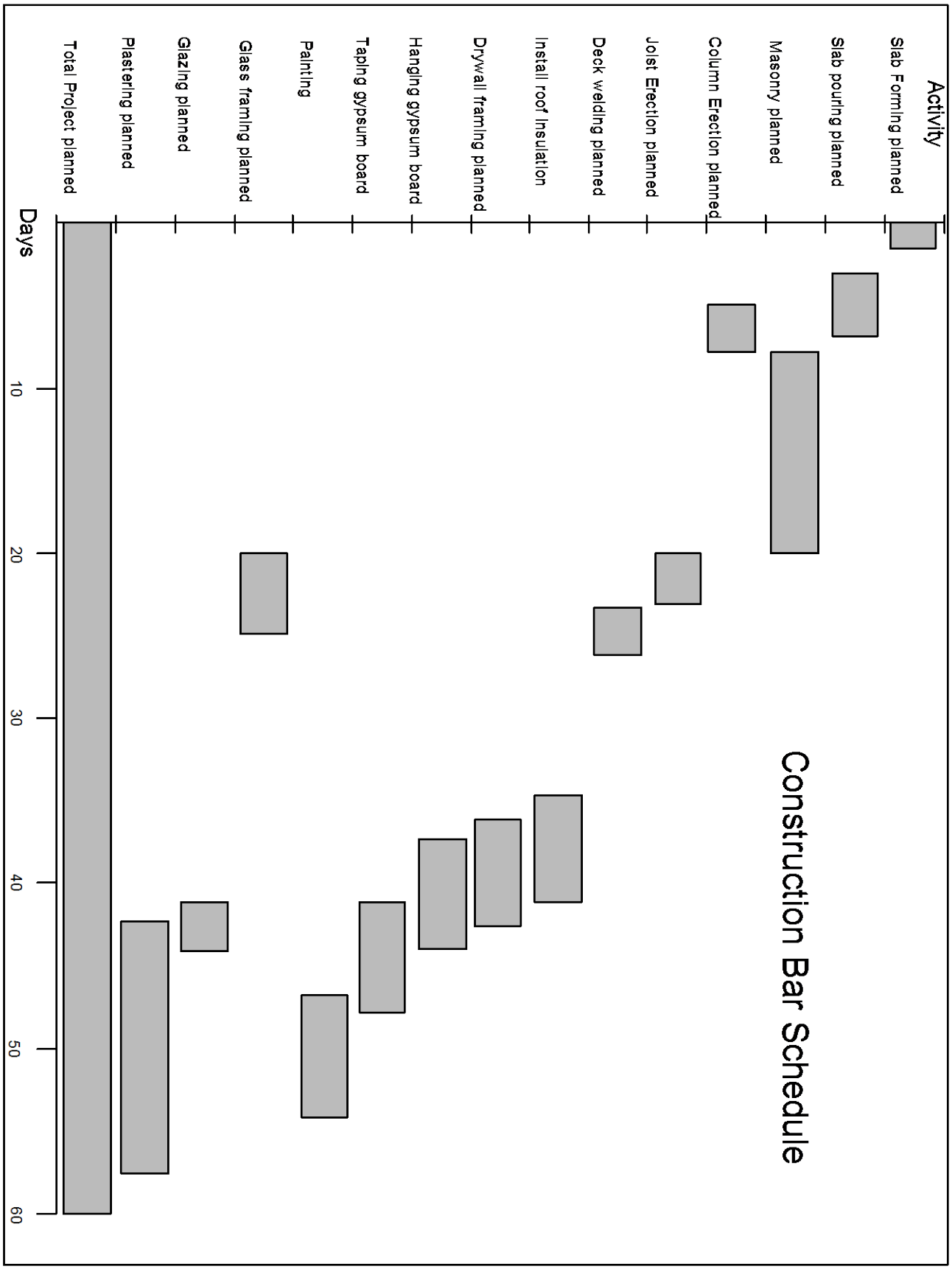
Meetings: **1)** George Shaw and Georgene on site @ 8:25 AM. Discussed using a plant-on pre-cast detail for coffered ceiling details @ entry and great room areas (George will redo sketches), pizza oven construction and venting details (George gave me some spec sheet on vent systems). I gave them the list of questions from **Mark Donner Electric** (Georgene and George will review by beginning of next week). I had Georgene look at Jim Maddens' set of *Dutfwy*plans (dated 6/28/94) and she noted that they spiral stair case niches are not on those plans (but were on the stamped set of plans dated several months later). Mark Donner on site @ 9:15 AM (after Georgene had left) to discuss several additional questions: specifics of Leviton powerline carrier switches (what do they control ?), and will there be a dimmer system on the great room chandeliers ? George indicated that he will get Mark the specifics on the Leviton system, but currently they are installed to handle any possible future control installation, and he will ask Jim and Georgene about dimming the great room, etc. Mark will return to work on site next Tuesday. As George and I walked job he indicated that we will need to add a 90° piece of copper (1"x2") to cover exposed sheet metal at all doors (under sill). Also, George feels existing flashing detail (with 7/8" milcor) is fine as it is, he is confidant there will be no leakage around window and door frames. George gave me a detail sheet on inline fans to use for bathroom ventilation (I will speak with Rich at General Sheet Metal). Finally; George indicated I should have the electrician move 2 conduits @ kitchen. **2)** Bruce Burrell on site @ 8:30 AM to speak with Wayne **(Rusher Air Conditioning)** re: location of new PVC ducts for high-efficiency FAUs. Bruce spoke briefly with Georgene re: he would see her this evening (presumably to settle his account). Bruce picked up his phone. **3)** Johnny Mac **(O-Mac Construction)** on site @ 11:30 AM re: did the sample pass George's approval ? I told John that George told me he'd prefer we stick with the original milcor detail, but he wanted to add a copper flashing below the sill, so I need a quote for this work from him ASAP. Also, since he plans to use Bituthane around all frames he needs to give me the additional quote for this before he starts so I can get an approval. He will have both quotes to me before noon tomorrow. **4)** Don Rasmussen **(Redland Clay Tile)** on site @ 12:30 PM to deliver roof tile samples: 6 ea. of "Old Sedonia" and "Peach Flash".

Misc. Notes: **1)** Called Wayne **(Rusher Air Conditioning)** @ 11:55 AM re: when will he install the condensate drains on the FAUs in the attic ? Wayne told me that his contract specifically excluded any condensate drains. I had previously spoke with the plumber (Lucian Plumbing) and I know his contract does not include them either. Wayne feels that this should probably be done by the plumber. I agree. **2)** Called Scott **(Deck Rite Waterproofing)** @ 12:40 PM re: I am still waiting for his quote for the decks and patios on the 1st. floor. Also, he told me he'd have a detail that I could show to the architect and have approved. LMTCB. **3)** Spoke with Jim @ 1:10 PM re: coffered ceiling details, told him that roof tile samples are in, and stucco sample is completed. Jim asked that I verify payment status with the temp. service (especially Pacific Mobil Offices) ASAP. **4)** Called Dusty **(Pacific Mobile Offices)** @ 1:15 PM re: status of outstanding invoices (if any) ? January is still outstanding for a total of $119.08. **5)** Spoke with Karen **(Coast A 1)** @ 2:40 PM re: account status on temp. toilet. She indicated that as of **1/31/96** the account was 2 months behind. Their accounting system does not allow anymore precise answer than that. **6)** Called Susan **(King Fence Co.)** @ 2:50 PM re: account status. Susan told me that Burrell has not yet paid for January ($30.00). **7)** Called Francis **(Performance Power Systems)** @ 3:00 PM re: account status. She told me that the account has been paid. There is only a $25 transfer fee charged to LaBarba. **8)** Called Mel Burns **(Creative Products)** @ 3:05 PM re: can we meet re: alarm system, etc. "yes" he will meet me on site tomorrow at 10:00 AM.

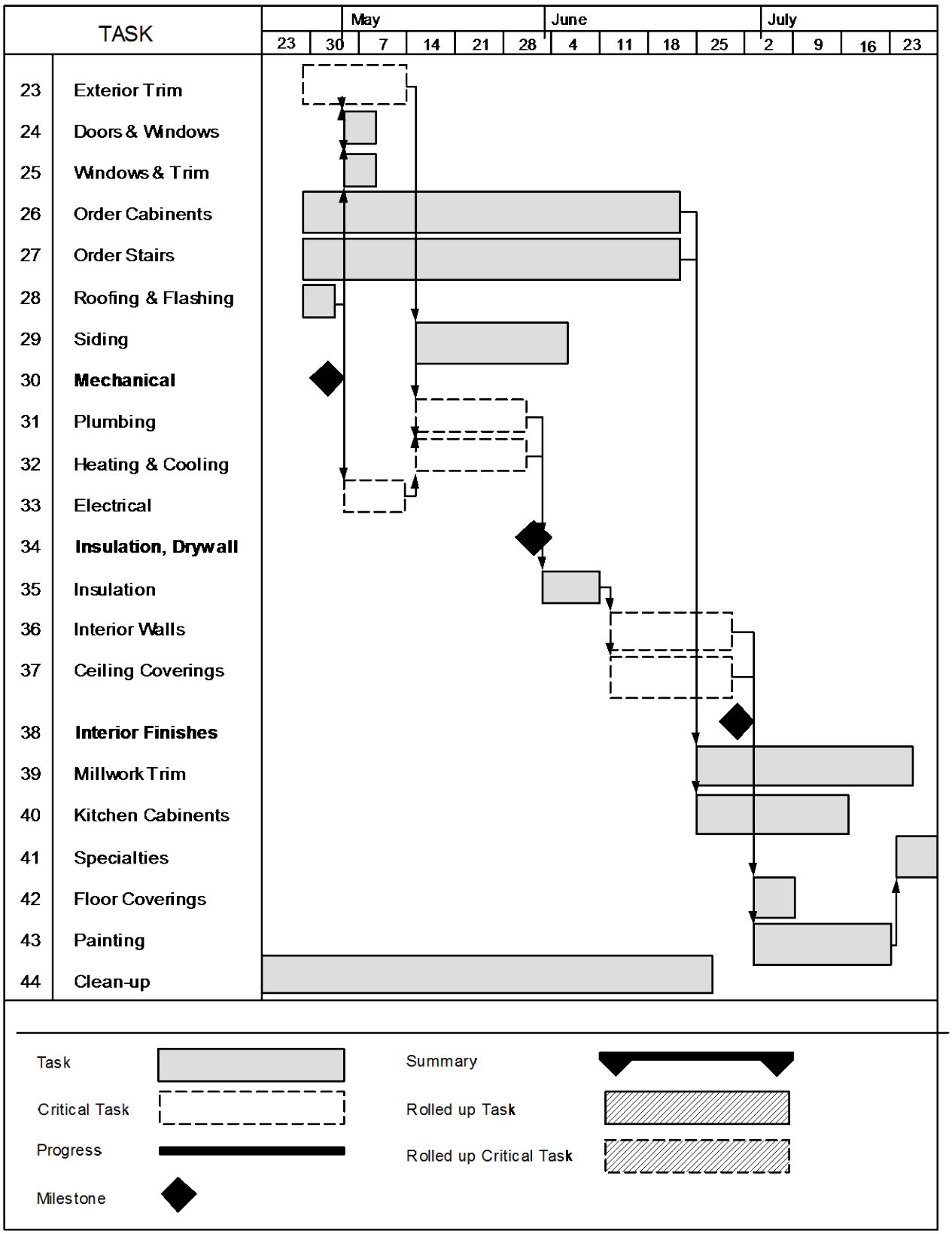
Temperature: AM: 55° (Light fog, cool) PM: 68° (Cloudy, warmer)

DATE 2/15/96 SIGNATURE _____

A Construction Bar Schedule



A CPM Construction Schedule



Progress Percentage

There are many ways to determine the progress of the job. The job progress could be determined from the expended labor hours, material used to date, a takeoff of completed work from the blueprints or by simply walking the job. The most accurate way of determining the percentage of completion of the job would be to calculate the percentage based on the labor hours estimated for the job versus the labor hours used on the job. Progress percentages are used to track a job during various stages to find out if the job is proceeding on schedule, behind schedule or in other words, is it making money or losing money!

To decide the percentage of completion on the job used in the previous scheduling example on the prior page, you must determine the total man-hours allotted to the job or have the project estimator give you the estimated labor hours. If the framing was estimated for 165 man-hours and the hanging of the gypsum board was estimated at 210 man-hours, this would total 375 man-hours to complete the job. To determine the progress percentage after the 3rd day of working on the job, a total of the expended hours would be required. If there were 4 framers a day times 8 man-hours per day, this would total 96 man-hours, plus the 5 layout man-hours or 101 man-hours after the 3rd day. (3 days x 4 men x 8 hours per day = 96 man-hours + 5 layout hours = 101 total hours). The hangers hours will be added to the framers hours. If there were 6 hangers a day times 8 man-hours per day, this would total 144 man-hours after the third day. (3 days x 6 men x 8 hours per day = 144 man-hours). Add the framing and hanging man-hours together for a total of 245 expended man-hours. To figure the completed percentage, divide the expended hours of 245 by the estimated hours of 375 for the complete job. The percentage complete would be 65% after the third day. (245 expended man-hours ÷ 375 estimated man-hours = .653 or 65% complete).

As you gain experience as a drywall/lathing foreman, the job should "feel" 65% complete. Another way to get a rough estimate of the job's completeness, is to monitor the material, although this **not** as accurate as calculating the man-hours. For example, if 144 man-hours were used for installing the gypsum board at the end of the third day and 210 man-hours were estimated, 69% of the hanging hours have been used. If there were 580 sheets of gypsum board delivered at the start of the job, then there should be

approximately 180 sheets left to hang after the third day. (580 sheets x 69% = 400 sheets installed, 580 - 400 = 180 sheets to be installed).

Production Figures

The following production figures will give you a range for calculating the labor hours required to complete various tasks. Estimating the amount of time to complete a task will have many variables, therefore an average production figure is used for day in and day out production. Some days the production will be more, some days it will be less, depending upon the jobsite conditions. These figures are based on production per *man-hour* for the most common wall framing, wall coverings and taping finishes.

- Wall Framing (16" & 24" o.c.)
  - Under T-Bar: 10-15 LF
  - Full Height: 5-8 LF
  - Penetrating T-Bar: 5-10 LF
  - Low or Freestanding Wall: 3-5 LF
  - Exterior Structural: 3-5 LF
- Wall Coverings
  - Gypsum Board (Stand up): 145-175 sq. ft.
  - Gypsum Board (Railroad to 12'-0"): 132-165 sq. ft.
  - Gypsum Board (Railroad above 12'-0"): 64-128 sq. ft.
- Soffit Framing: 3-8 LF
- Ceiling Framing (16" & 24" o. c., joist): 35- 65 sq. ft.
- Ceiling Framing (Black Iron): 20-35 sq. ft.
- Taping
  - Fire tape: 250-350 sq. ft.
  - Skip texture: 145-165 sq. ft.
  - Smooth wall: 120-135 sq. ft.

To figure the amount of man-hours needed to install 48 sheets of 4' x 9' stand up gypsum board using the production figures above, the range would be 9.87 to 11.92 man-hours required to install the 48 sheets. Your equations would look like:

48 sheets x 36 sq. ft. = 1728 sq. ft.

1728 sq. ft./145 sq. ft = 11.92 man-hours

1728 sq. ft./ 175 = 9.87 man-hours

To figure the amount of man-hours needed to frame 150 lineal feet of partition, under the t-bar, the range would be 10 to 15 man-hours using the production figures above. Your equations would look like:

150 LF/10 LF = 15 man-hours
150 LF/15 LF = 10 man-hours

Keep in mind these figures are for total man-hours, so if you have a crew of two workers framing 150 lineal feet of under the t-bar partition, they would complete the framing in 7.5 or 5 hours respectively.

Record Keeping

To keep track of the paperwork related to the job, it is recommended you keep file folders in a file box or briefcase. Not all jobs will require a filing system or files, but the more difficult jobs will require you to manage the paperwork. There should be an individual file folder for each of the following:

- RFI's
- Extra Work Orders
- Material- (Purchase orders, Delivery tickets, etc.)
- Schedule
- Timecards
- Safety
- Equipment- (Purchase orders, Delivery tickets, etc.)
- Minutes from GC's foremen meetings

Chapter 2

Study Guide

Directions:

Using the words below, fill-in the blanks in the following statements.

A. Weekly	**F.** Management
B. Construction manager	**G.** Bar chart
C. Critical path method	**H.** Duration
D. Substantiate	**I.** Sequence
E. Impact	**J.** Documentation

1). The more _____ you have, the better your company's chances are at recovering money from the general contractor or overcoming any back charge claim.

2). The drywall/lathing foreman is concerned with the time and dates given to certain activities such as material delivery, layout, framing, gypsum board installation, etc. and any changes to the schedule will _____ the manpower required to complete each phase of the job.

3). A bar chart simply indicates when specific activities will start, the _____ of the activity and the finish date of the activity.

4). The general contractor or _____ _____ is responsible for the project's construction schedule.

5). A _____ _____ is usually used for smaller projects and for larger projects a critical path method (CPM) schedule is established.

6). Complex building projects require the use of a more sophisticated type of schedule called the _____ _____ _____.

7). For larger projects, communication between the general contractor and the subcontractors concerning the schedule is usually done _____ with jobsite progress meetings and prior to the start of the job.

8). A CPM schedule shows the _____ of each activity, the start of each activity, the dependence of that activity on the completion of a preceding

activity, and how the completion of that activity will restrict the commencement of subsequent activities.

9). The construction schedule is used as a tool for _____ of the job and for communication with the subcontractors.

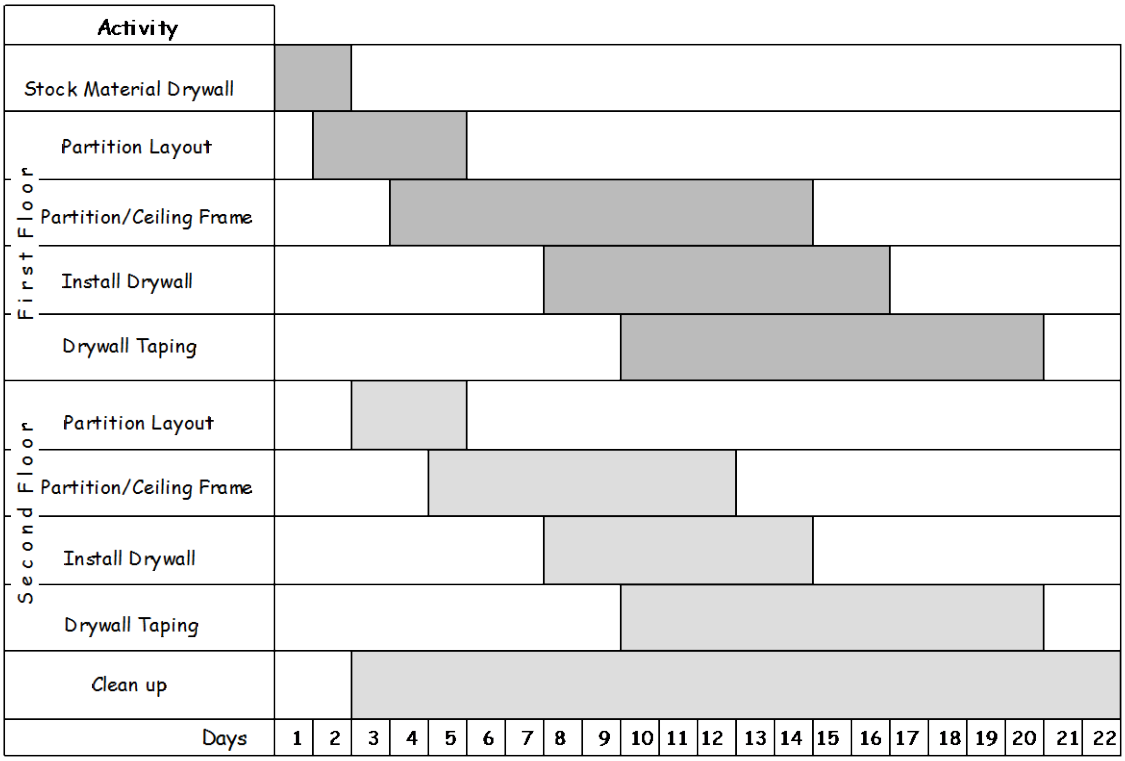
10). The reason for keeping good records is to _____ any concern occurring on the job yesterday or three months ago

Chapter 2

Bar Chart Exercise

Directions:

Answer the following questions using the bar chart schedule shown below. Use the bubble answer sheet for your answers.



1). How many days are scheduled for the material stocking?

A). 1
B). 2
C). 3
D). 4

2). How many days are scheduled to complete the first floor, excluding stocking of materials and clean up?

A). 17
B). 18
C). 19
D). 20

3). Installing the gypsum board would begin after how many days of first floor framing?

A). 2
B). 3
C). 4
D). 5

4). If 410 man-hours were estimated to complete the first floor framing, how many workers per day would be required to meet the schedule?

A). 3.66
B). 4.66
C). 5.66
D). None of the above

5). If 388 man-hours were estimated to complete the first floor gypsum board installation, how many workers per day would be required to meet the schedule?

A). 3.39
B). 4.39
C). 5.39
D). 6.39

6). If 580 man-hours were estimated to complete the first floor taping, how many workers per day would be required to meet the schedule?

A). 5.59
B). 6.59
C). 7.59
D). 8.59

7). What would be the maximum amount of framers, hangers and tapers on the first floor per day, based on the estimated hours in the previous questions?

A). 15.64
B). 16.64
C). 17.64
D). 18.64

8). How many days have the most framers, hangers and tapers on the first floor?

A). 3
B). 4
C). 5
D). 6

9). How many days are scheduled to complete the second floor, excluding stocking of materials?

A). 18
B). 19
C). 20
D). 21

10). Taping would begin after how many days of framing on the second floor?

A). 3
B). 4
C). 5
D). 6

11). If 380 man-hours were estimated to complete the second floor framing, how many workers per day would be required to meet the schedule?

A). 4.94
B). 5.94
C). 6.94
D). 7.94

12). If 300 man-hours were estimated to complete the second floor gypsum board installation, how many workers per day would be required to meet the schedule?

A). 3.36
B). 4.36
C). 5.36
D). 6.36

13). If 480 man-hours were estimated to complete the second floor taping, how many workers per day would be required to meet the schedule?
A). 3.45
B). 5.45
C). 6.45
D). 7.45

14). What would be the maximum amount per day of framers, hangers and tapers on the second floor, based on the estimated hours in the previous questions?
A). 15.75
B). 16.75
C). 17.75
D). 18.75

15). What would be the maximum amount per day of framers, hangers and tapers on the first and second floors, at the busiest time on the schedule, based on the estimated hours in the previous questions?
A). 32.39
B). 33.39
C). 34.39
D). 35.39

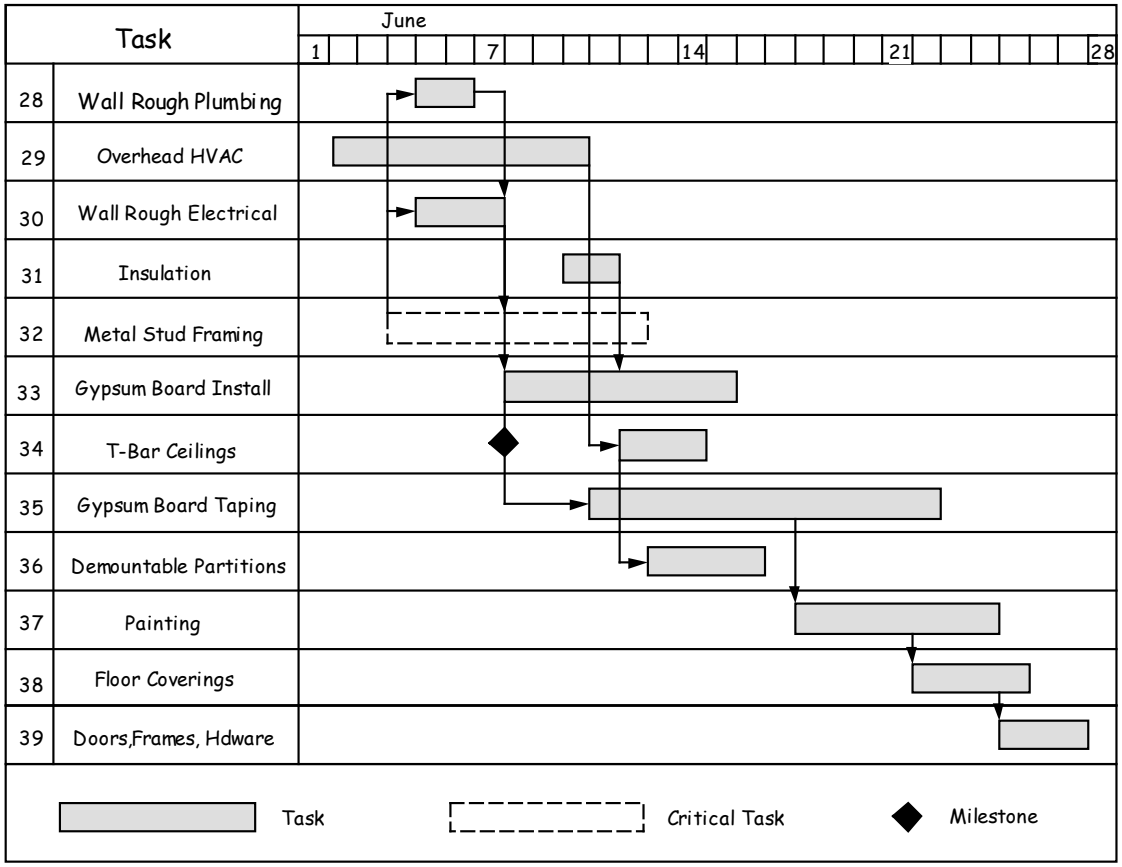
16). How many days would have the maximum amount of framers, hangers and tapers on the first and second floors?
A). 1
B). 2
C). 3
D). 4

Chapter 2

CPM Exercise

Directions:

Answer the following questions using the "Critical Path Method" schedule shown below. Use the bubble answer sheet for your answers.



1). What is the duration in days for the completion of the metal stud framing?

A). 7
B). 8
C). 9
D). 10

2). The metal stud framing is to start on what date in June?

A). 2nd C). 4th
B). 3rd D). 12th

3). The metal stud framing, gypsum board installation and taping will required how many days to complete?

A). 15
B). 16
C). 18
D). 19

4). What completed task is the milestone in this schedule?

A). Painting
B). Floor coverings
C). Wall rough electrical
D). Insulation

5). What are the dates in June where there will be framers, hangers and tapers on the job?

A). 10th & 11th
B). 11th & 12th
C). 12th & 13th
D). 13th & 14th

6). If 680 man-hours were estimated to complete the metal stud framing, how many workers per day would be required to meet the schedule?

A). 7.44
B). 8.44
C). 9.44
D). 10.44

7). If 890 man-hours were estimated to complete the gypsum board installation, how many workers per day would be required to meet the schedule?

A). 10.91
B). 11.91
C). 12.91
D). 13.91

8). If 570 man-hours were estimated to complete the gypsum board taping, how many workers per day would be required to meet the schedule?

A). 4.94
B). 5.94
C). 6.94
D). 7.94

9). What is the critical task shown in this schedule?
A). Painting
B). Gypsum board taping
C). Wall rough electrical
D). Metal stud framing

10). Which task are the demountable partitions dependent upon?
A). Electrical
B). T-bar ceilings
C). Insulation
D). Painting

Chapter 2

Job Scheduling Exercise

Directions:

Develop a 30-day job bar schedule to construct Offices 2127 through 2138 as found on the Coulter Pharmaceutical drawings. Do a detailed takeoff to determine the lineal footage and material quantities needed for the framing, drywall, insulation and taping, along with how many man-hours each phase of the drywall construction will take. Include the following activities in your bar schedule. Schedule each activity, as it should occur on the job, along with any inspections. Fill-in the blank bar schedule found on the following page.

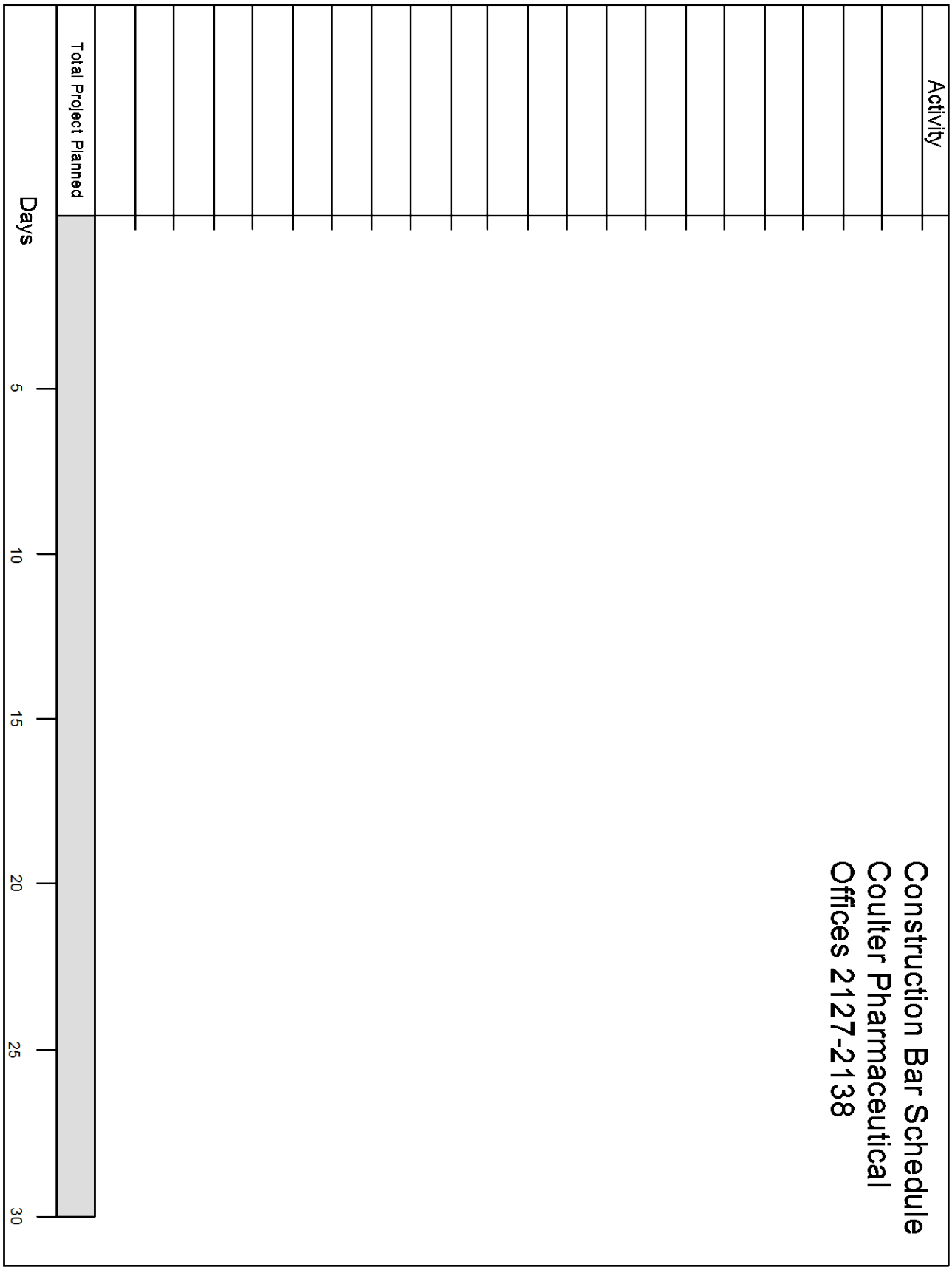
Activities

1). Mechanical
2). Doors/Frames/Hardware
3). Drywall taping
4). Flooring
5). Installation of drywall/insulation
6). T-Bar
7). Framing
8). Telephone
9). Glazing
10). Exterior Window Coverings
11). Painting
12). Electrical
13). All inspections, including fire and final inspection.

Drywall man-hours:

1). Framing _____
2). Hanging_____
3). Insulation_____
4). Taping _____

Job Scheduling Exercise

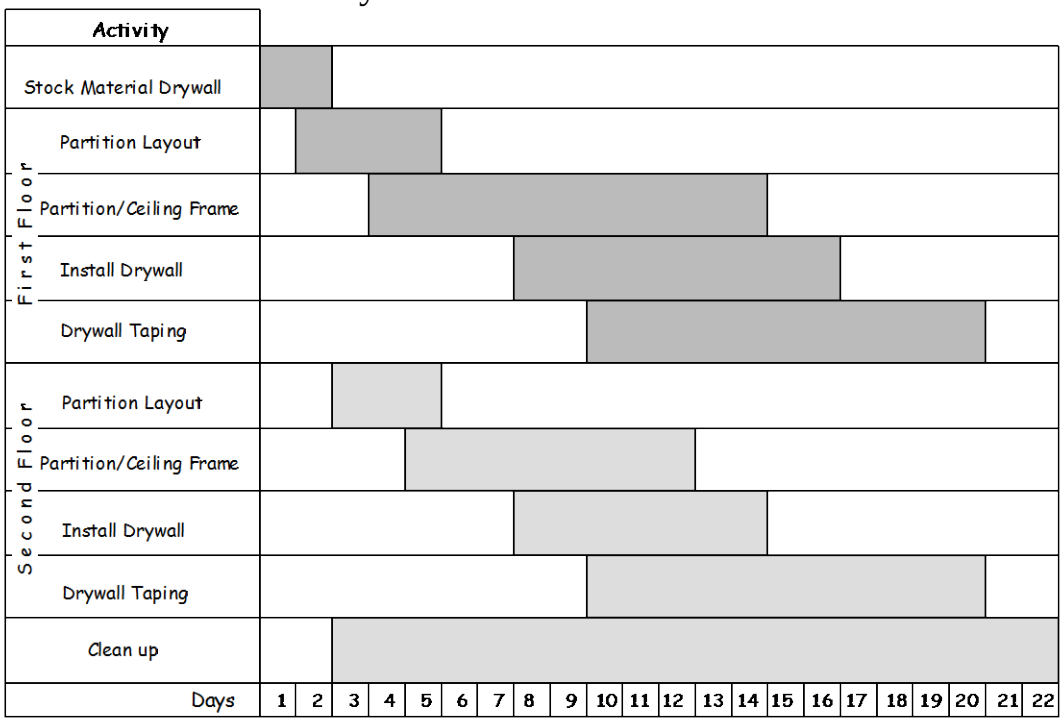


Chapter 2

Progress Percentage Exercise

Directions:

Determine the percentage of completion on various days for the following job using the bar chart schedule. You must first determine how many man-hours are required to meet the schedule on a daily basis and use these calculations to determine the percentage of completion based on the man-hours given below. Disregard any stocking labor, stocking by supplier. Use the bubble answer sheet for your answers.



Job #1

Total man-hours estimated for first floor activities:

A). Layout: 64 man-hours
B). Framing: 455 man-hours
C). Hanging: 645 man-hours
D). Taping: 510 man-hours

Total man-hours estimated for second floor activities:

A). Layout: 48 man-hours
B). Framing: 360 man-hours
C). Hanging: 490 man-hours
D). Taping: 368 man-hours
E). Clean up: 210 man-hours (both floors)

1). At the end of Day 5, what would be the closest percentage of completion for the entire job?

A). 7%
B). 9%
C). 11%
D). 13%

2). At the end of Day 12, what would be the closest percentage of completion for the entire job?

A). 56%
B). 58%
C). 60%
D). 62%

3). At the end of Day 15, what would be the closest percentage of completion for the entire job?

A). 83%
B). 85%
C). 87%
D). 89%

4). At the end of Day 18, what would be the closest percentage of completion for the entire job?

A). 90%
B). 92%
C). 94%
D). 96%

Chapter 3

Layout Procedures

Objectives:

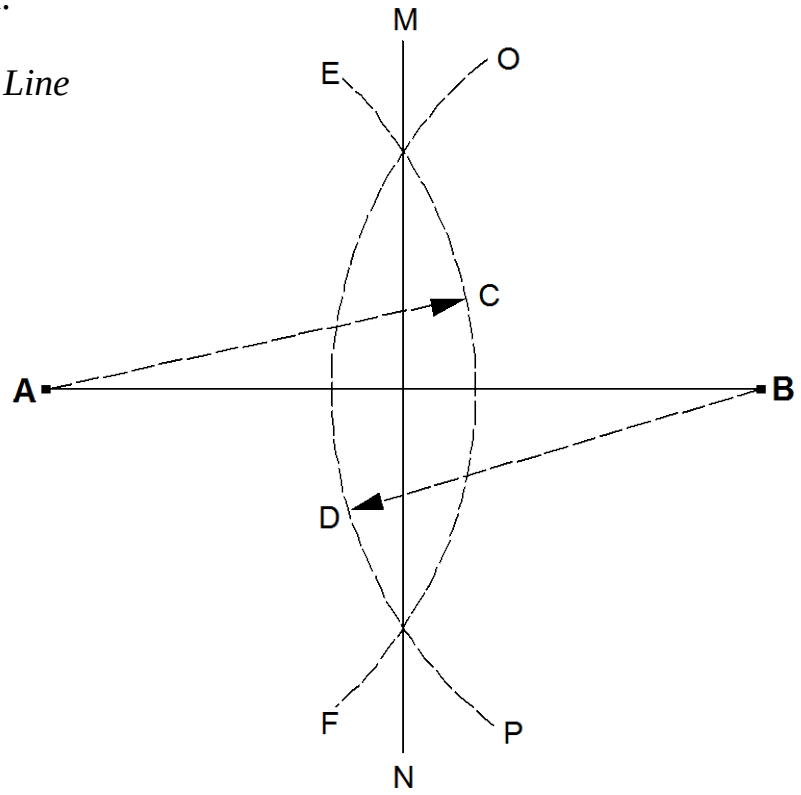
Upon completion of this chapter, students will be able to:

1). Bisect lines and angles for layout purposes.
2). Find the center of a circle to determine its radius and diameter.
3). Layout 30°, 45°, 60° angles, including odd angles.
4). Relate the circumference of a circle to degrees of an angle.

Bisecting

The term bisecting means to divide into two equal parts. Many of the following layout procedures utilize bisection and it is important to understand this procedure. The layout procedure for dividing a line into two equal parts is a simple one, with an added result of a perpendicular line exactly at the midpoint of the line being bisected. Bisecting a line is another way to create a 90° angle, just as easily as the 3,4, 5 method or shipbuilders method. The example below illustrates how to bisect a line with an explanation.

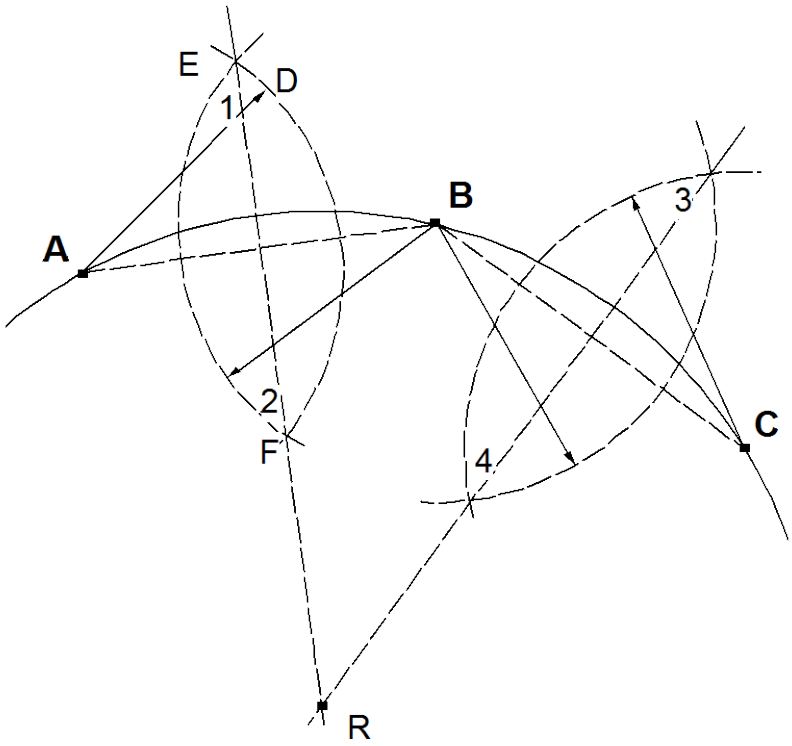
Bisecting a Line



The basic tools needed to bisect a line are a tape measure, carpenters pencil and a chalk box.
Start the layout procedure by striking the line **A-B** as shown in the diagram. Establish two points anywhere on the line, in this case the points **A** and **B** are established.
To determine the radius of the arcs used in this procedure, measure the distance between points **A** and **B** and pick *any* measurement greater than half the distance of line **A-B**.
For example, if line **A-B** measured 12'-0", the radius of the arcs should be anything greater than 6'-0". If a radius of less than 6'-0" were chosen, the arcs would not intersect with each other.
Using the *same* radius measurement for both arcs, swing arc **E-F** from point **A** and **O-P** from point **B** as shown.
At the intersection of these two arcs, strike the line **M-N**.
The result is line **A-B** being divided into two equal parts and line **M-N** is perpendicular or 90° to line **A-B**.

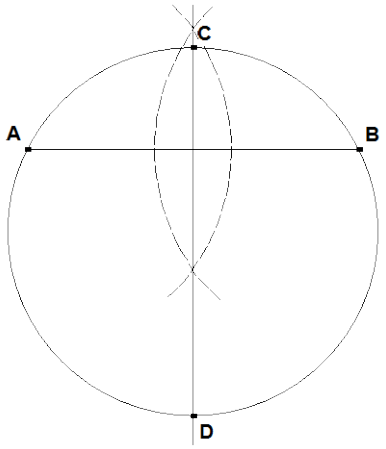
Another interesting layout procedure is to incorporate any three points, not in a straight line, into a single arc by bisecting the two lines formed by the three points as shown below.

Establishing the Center of 3 Points



In the example **A**, **B** and **C** are the three points to be joined by a single arc.
Start by snapping a line between points **A** and **B**, creating line **A-B**.
Duplicate this for points **B** and **C**, creating line **B-C**.
Bisect both lines using the procedures given the previous example; remember to use a measurement greater than half the length of each line to scribe the arcs.
For line **A-B**, the measurement **D** is used to scribe the arc **E-F**.
Using the same measurement, duplicate this arc from point **B** to create the intersection of the arcs as shown by points **1** and **2**.
Bisect line **B-C** in the same manner as line **A-B** creating points **3** and **4**.
Snap a line through points **1** and **2**.
Snap a line through points **3** and **4**. The intersection of these two lines, point **R**, creates the radius point connecting the 3 points **A**, **B**, and **C** into a single arc.

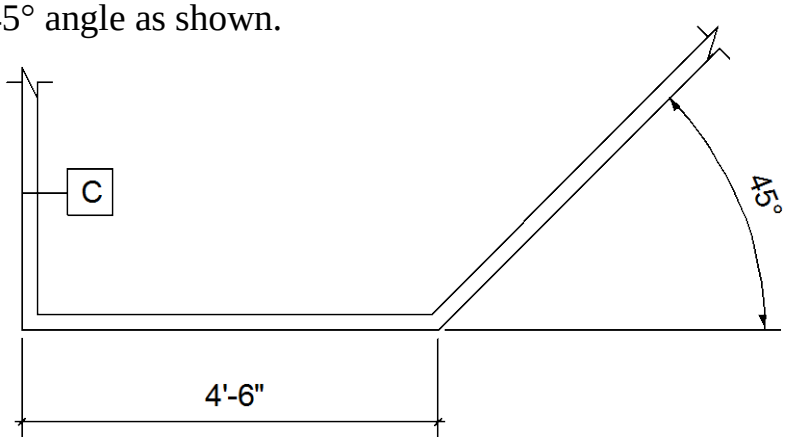
The same bisecting procedure can be used to determine the center, diameter and radius of any given circle as shown below.



In the example, a straight line is drawn between *any* two points on the circle's circumference, as shown by line **A-B**.
Bisect line **A-B** to create line **C-D**. Measure the distance between points **C** and **D**; half of this measurement will be the center of the circle and the radius point of the given circle.
The entire measurement from **C** to **D** will be the circle's diameter.
For example, if line **C-D** measured 6'-3", 3'-1 1/2" would be the radius point of the circle and the exact center of the circle.
The radius of any circle is equal to 1/2 of the diameter.

30, 45 and 60-Degree Angles

The procedure to divide a 90° angle into two 45° angles is accomplished by bisecting the 90° angle. In the example given below, the architect wants a 45° angle as shown.



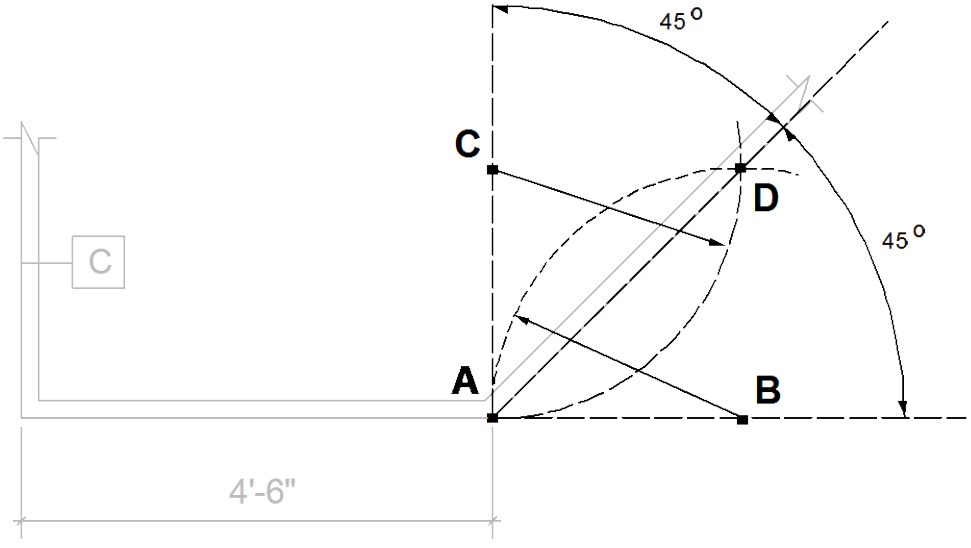
To layout this angle, you must determine the starting point of the angle. Measure 4'-6" from the outside of the perpendicular angle as shown on the drawing below and make a mark (point **A**). This is the starting point or vertex of the 45°angle and assumes all dimensions are to frame.

At the mark of 4'-6", layout a line parallel to the type **C** wall, duplicating the 90° angle. There is not a need to 3, 4, 5 or bisect a line, because the 90° angle has been established and doing so would be a waste of time.

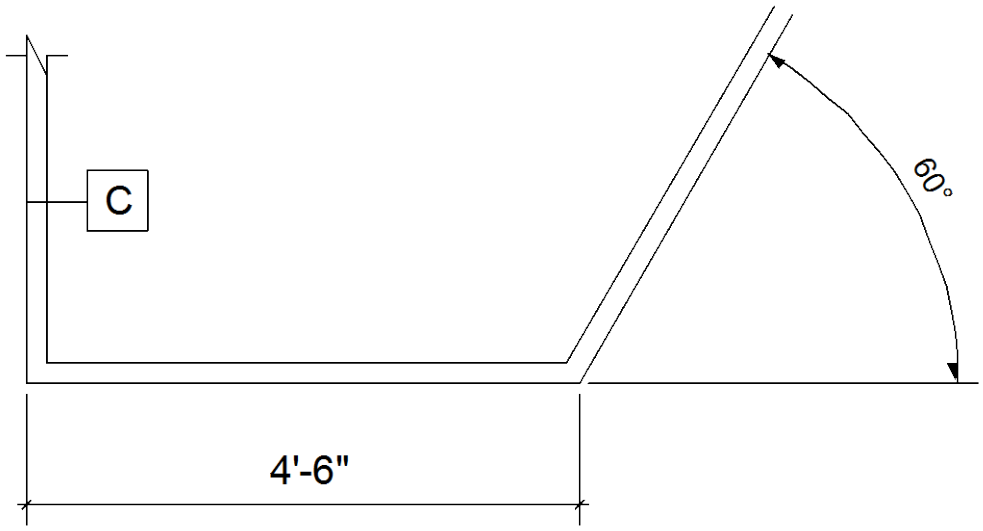
Establish two points **B** and **C** an equal distance from the 4'-6" mark (point **A**), along each line creating the 90°angle, (this can be any distance as long as they are equal).

From points **B** and **C** scribe two arcs equal to the measurement used to establish both points. The intersection of these two arcs creates point **D**.

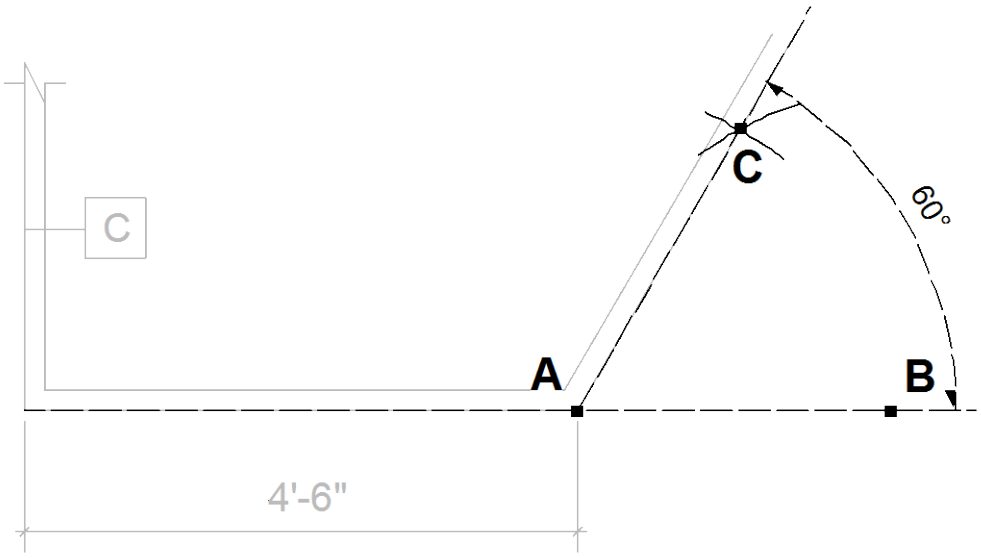
Snap a line from point **A** through point **D** creating the required 45° angle.



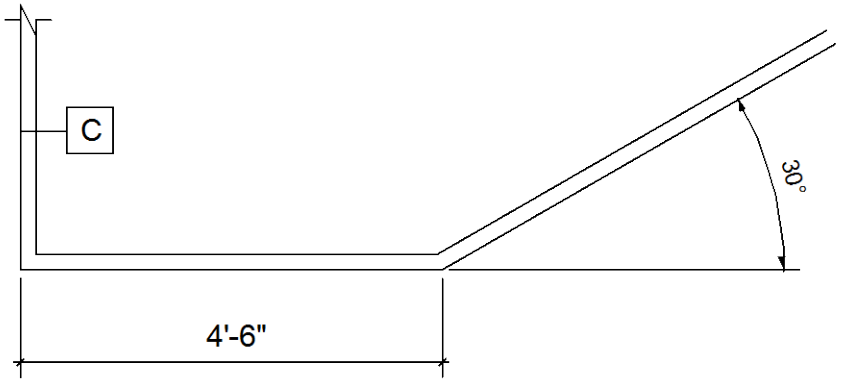
In the following example, the architect wants a 60° angle as shown and the layout procedure is very simple.



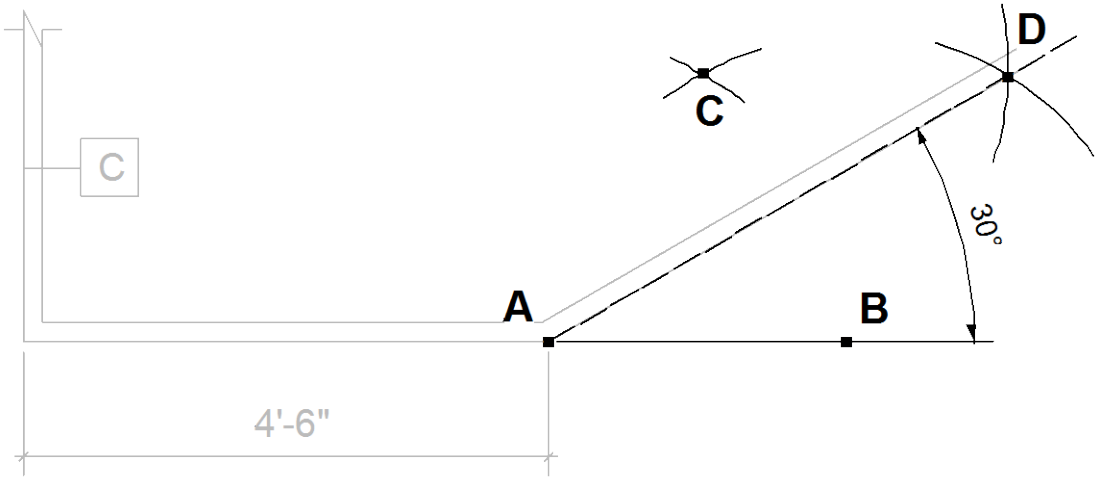
The starting point of 4'-6" must be established and marked as point **A**.
Extend the line beyond point **A** any distance proportionate to your layout.
Along this line, mark point **B** using a measurement of your choosing.
Using points **A** and **B** as the radius points, scribe the two arcs intersecting at point **C**, the measurement from point **A** to point **B** is the radius dimension when scribing the two arcs.
Snap a line through points **A** and **C** creating a 60° angle.



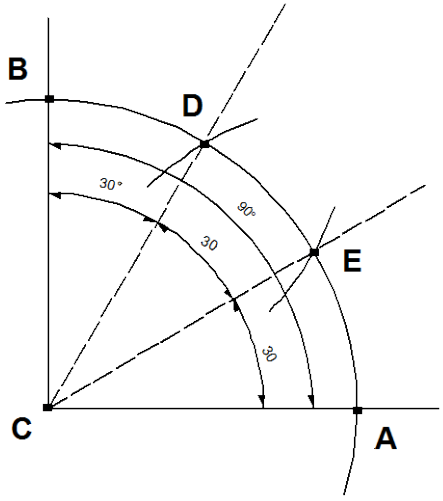
In the following example, the architect wants a 30° angle as shown and as you may have guessed, we will be bisecting the 60° angle into two 30° angles.



Again establish the starting point of 4'-6". Proceed exactly as directed for the 60° angle, establishing points **A, B** and **C**.
From points **B** and **C**, scribe two arcs intersecting at point **D**, using the same measurement from point **A** to point **B** as the radius dimension for both arcs.
Scribe a line from point **A** through point **D** creating a 30° angle.



Another method can be used to divide a 90° angle into three 30°angles as shown in the drawing below. Mark two points **A** and **B** an equal distance from point **C**. With point **C** as a center and a radius of **C-A**, scribe the arc **A-B**. Using point **A** as a center, scribe arc **A-D** with a radius of **A-C**, cutting arc **A-B** at point **D**. With point **B** as a center and a radius of **B-C**, scribe the arc **B-E**, cutting the arc **A-B** at point **E**. Next snap the lines **C-E** and **C-D** dividing the 90° into three 30° angles.



Odd Angles

Some situations may require an angle to be something other than 30, 45, 60, or 90 degrees. In this case, we will use the basic geometry figure of a circle to determine these angles. The circumference of a circle is the distance around the outside, having a total of 360 degrees, which can be divided into four 90-degree right angles. If 1 degree represented 1 inch on the circumference of a circle, then a 10-degree angle would be 10 inches of the circle's circumference, a 36-degree angle would be 36 inches of the circle's circumference and so forth. The next step is determining what radius would produce a circle with a circumference of 360 inches, which can be used for laying out any desired angle. The following formula is used to determine the radius of a circle with a circumference of 360 inches.

Circumference = pi x diameter

360 inches = 3.14 x diameter

Diameter = 360/3.14

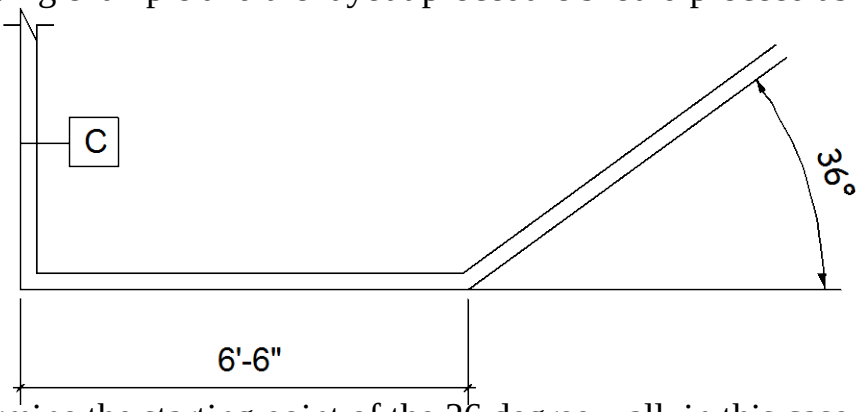
Diameter = 114.65 inches

Radius = 1/2 of the diameter

Radius = 114.65/2

Radius = 57.32 inches or 57 5/16"

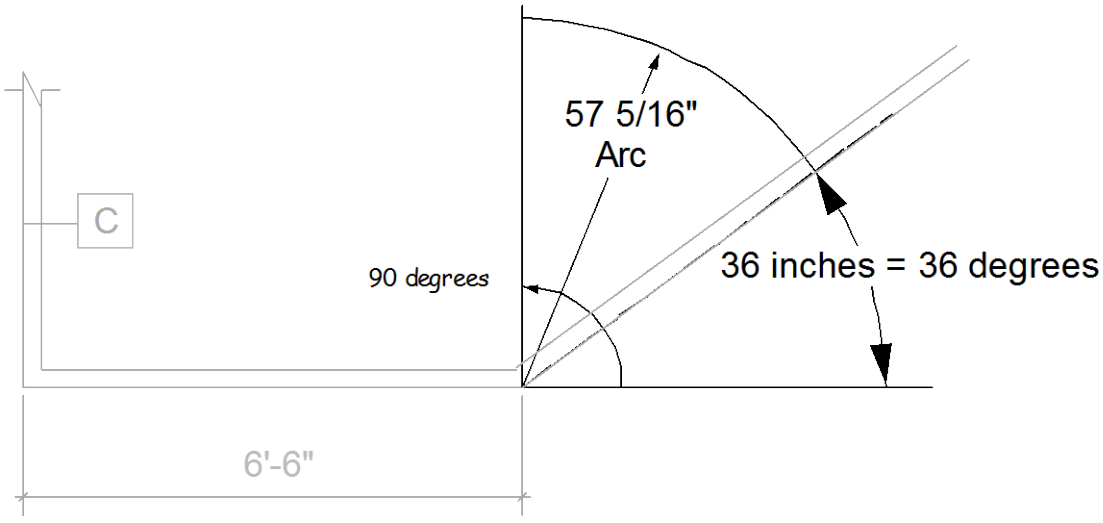
A circle with the radius of 57 5/16" would have a circumference of 360 inches as shown above. The architect is requesting a 36-degree angle in the following example and the layout procedure should proceed as follows:



Determine the starting point of the 36 degree wall, in this case, the measurement is 6'-6". At the 6'-6" measurement, construct a perpendicular angle using the 90° angle of the type C wall and scribe a quarter circle with a radius of 57 5/16" using the same 6'-6" measurement point as the radius point.

The next step is to measure 36 inches along the 57 5/16" arc and establish a mark for the wall layout. The correct way to measure along the arc would be to make 1-inch incremental marks totaling 36 inches. However, a faster method would be to mark a piece of t-bar wire or any flexible wire at 36 inches and follow the curvature of the arc transferring the measurement from the wire to the arc.

Snap a line through the 36" mark and the 6'-6" mark establishing the 36° wall line. A word of caution, you must be accurate to the 16th of an inch in your measurements when using this procedure or the results will not be satisfactory.



Chapter 3

Study Guide

Directions:
Answer the following questions using the bubble answer sheet.

1). The term bisecting means to divide into _____ equal parts.
A). Two
B). Three
C). Four
D). Five

2). The center of a circle can be determined from bisecting a line between any two points on a circle's circumference.
A). True
B). False

3). When bisecting a line, the radius of the intersecting arcs should be less than one half the length of the line's measurement.
A). True
B). False

4). When establishing a 60° angle, the distance between the two radius points of the intersecting arcs, equals the radius dimension of the two intersecting arcs.
A). True
B). False

5). When bisecting a 60° angle to form two 30° angles, the radius dimensions of the two intersecting arcs are different.
A). True
B). False

6). When dividing a 90° angle into three 30° angles, the radius dimension is the same for all intersecting arcs forming the three 30° angles.
A). True
B). False

7). What would be the radius dimension of a circle having 360 inches around its circumference?

A). 55 7/16
B). 57 7/16
C). 57 5/16
D). None of the above

8). If a circle had a circumference of 360 inches, every inch of the circumference would represent 2 degrees.

A). True
B). False

9). When bisecting a line, the intersection of the arcs occurs on each side of the line being bisected.

A). True
B). False

10). When bisecting a 90° angle to form two 45° angles, the radius points of the intersecting arcs are equal in distance from the vertex of the 90° angle.

A). True
B). False

Chapter 4

Segmented Arches and Equal Dimensions

Upon completion of this chapter, students will be able to:

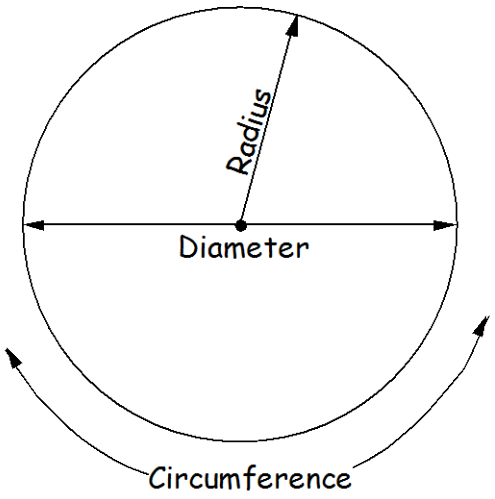
1). Determine the radius point of a segmented arch from its span and rise.
2). Layout segmented arches using different methods and procedures.
3). Understand the mathematical calculations of radius and rise relative to a segmented arch.
4). Establish equal dimensions between partitions having different widths and finishes.

Introduction

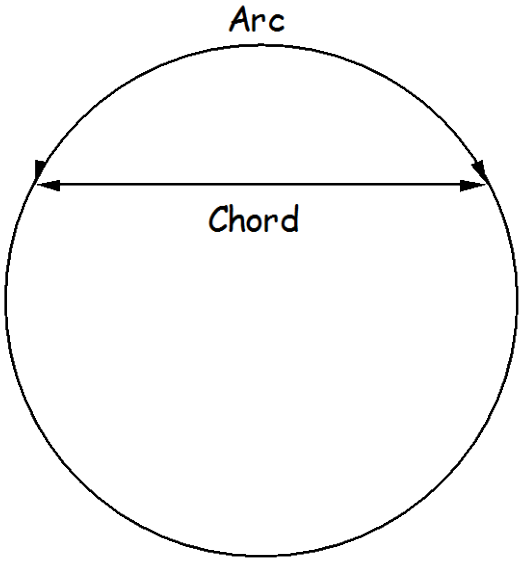
The simplest of all geometric figures is the circle. In the following examples, we will define the various parts of a circle to give you a better understanding of their relationship with each other and how a segmented arch is part of a circle.

Parts of a Circle

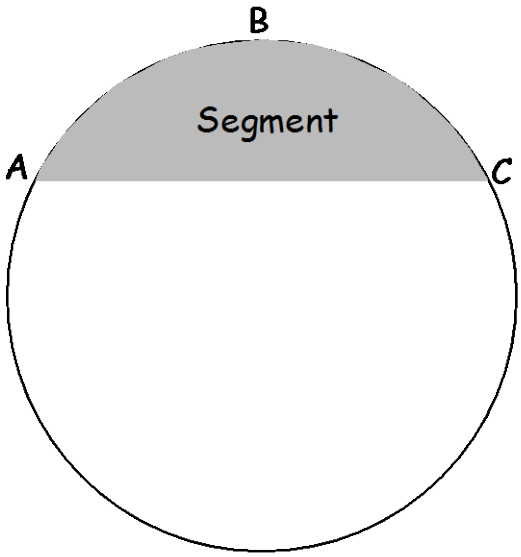
We have previously discussed parts of a circle such as radius, diameter and circumference. In the drawing below, these terms are graphically shown to help you recognize their association with one another. The distance around a circle is called the *circumference*. The distance across a circle thru the center is called the *diameter*. Half of the circle's diameter is the *radius*. The distance from the center of a circle to any point on the circumference defines the radius of a circle.



The following terms such as chord, arc and segment are shown in the following drawings.



A part of the circle's circumference is called an *arc*, shown in the drawing above. A straight line connecting the two extreme points of an arc is called the *chord* of the arc. When discussing an arch, the term *spring line* is used, which means the arch starts or springs from a line, similar to the chord of an arc.

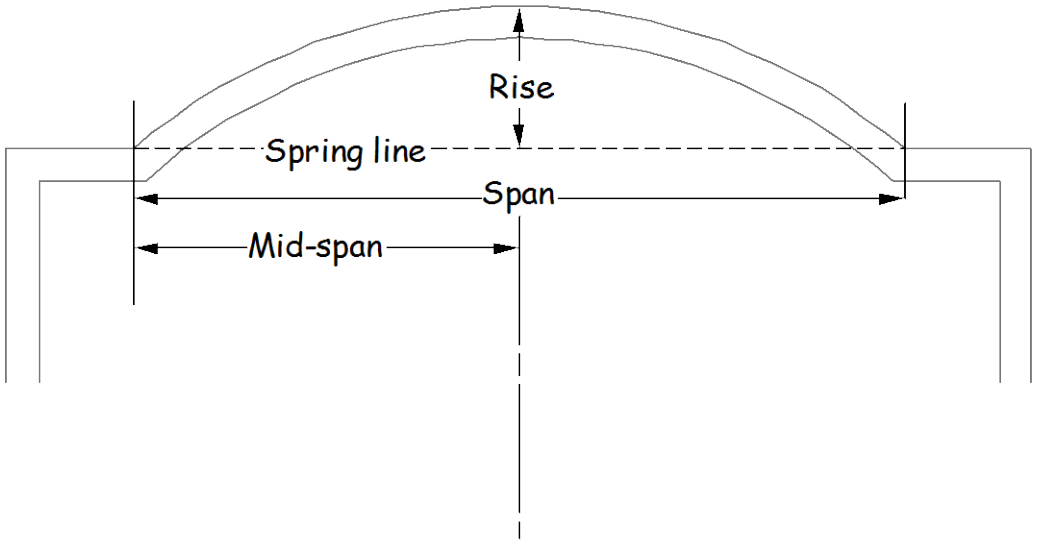


A *segment* is defined as being part of a circle, as the shaded area above shows. The straight line, **A-C**, and the circumference, **A-B-C** of the circle, define this segment. A segment of any circle would have the same radius as

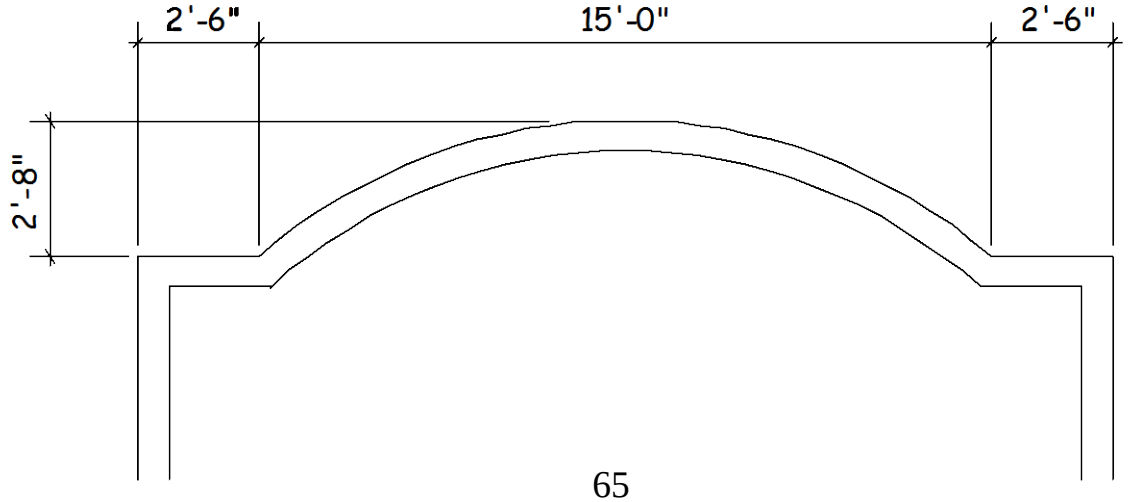
the circle itself; therefore if we had to layout a segmented arch, it would be helpful to determine the radius point.

Parts of a Segmented Arch

The following terms describe portions of a segmented arch and are commonly used on the jobsite. When discussing the layout of a segmented arch, it is important to understand these terms. The *span* of an arch is the distance across the arch measured at the spring line. The *spring line* is where an arch will start and stop at its most extreme points. The term *rise* is the highest point of an arch, measured from the spring line, occurring at the middle or *mid-span* of the arch. The mid-span of an arch is the exact middle or half of the span measurement.



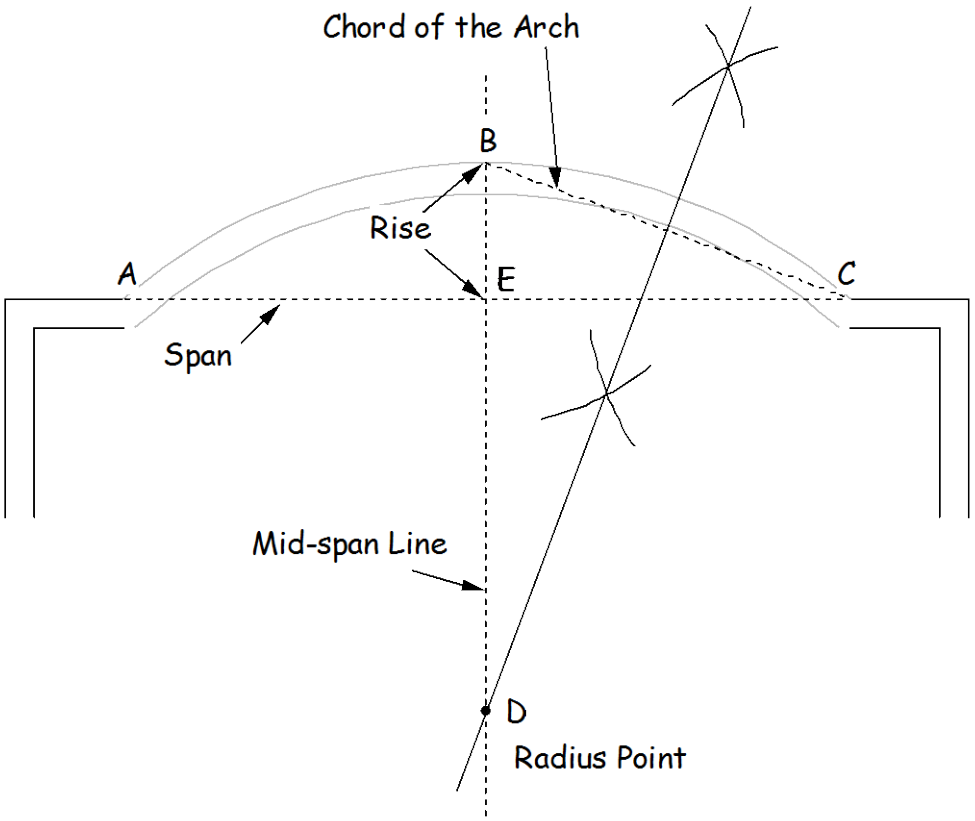
In the drawing below, the architect has dimensioned the span and the rise of the segmented arch. It is essential to realize the dimension and extension lines are defining either the top of the arch or the bottom of the arch. In this case the architect is defining the top or outside of the segmented arch.



Bisecting the Chord

The following layout procedure produces the radius point of the segmented arch shown in the previous drawing. Layout the typical walls using the architect's dimensions as usual. Define the span of the arch and establish the mid-span line. Measure from point **E** and mark the rise at point **B.** Scribe the chord of the arch as shown below. The mid-span, span and chord lines are labeled in the drawing.

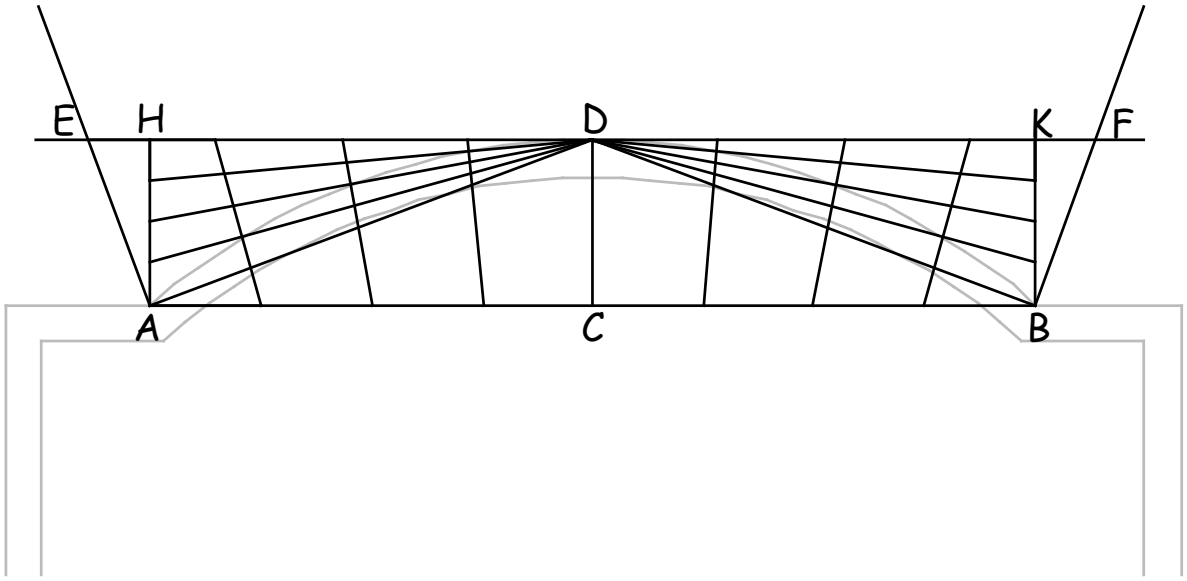
Bisecting the chord of the arch uses the same technique as bisecting a line. The secret is to choose a number greater than half of the measured distance of the chord and scribe lines *above* and *below* the chord, using points **B** and **C**. Use the same number to scribe all four arcs. Snap a line thru the intersecting arcs and the mid-span line. The intersection at the mid-span line, point **D**, produces the radius point for the segmented arch. If the procedure was done correctly, the measurement from point **D**, to points **A**, **B**, and **C** will be the same. Connect these points to produce the top of the arched wall and assuming all dimensions are to frame, subtract the width of the track to produce the bottom of the arched wall. Use radius point **D** when scribing both wall lines. If, for whatever reason, the measurement is not the same for points **A**, **B** and **C**, check the bisection of the chord for accuracy, this is usually where the problem exists.



Graphing the Arch

Another layout method used for segmented arches, is to graph the arch. In this procedure, you will divide lines into equal portions creating exactly what the name implies, a graph. The span and rise measurements of the arch are necessary for this layout procedure.

Layout the typical walls using the architect's dimensions as usual. Establish the span, **A-B**, and rise, **C-D**, based on the given dimensions. Scribe the diagonal lines from **A-D** and **D-B**. Draw lines **A-E** and **B-F** perpendicular to **A-D** and **D-B**. Divide **E-D**, **D-F**, **A-C**, **C-B**, **H-A**, and **K-B** into equal parts. Connect the lines and the intersections will create the curve of the segment arch, as you can see with the arch in the background. This procedure can be used when the radius point is obstructed by a wall or column. It is advantageous to divide the lines into more than four sections each when the span and rise have larger dimensions. Dividing the lines into more sections produces a truer arch. A piece of 9-gauge hanger wire or PVC pipe could be used to scribe the arch at the intersections of the graph lines.

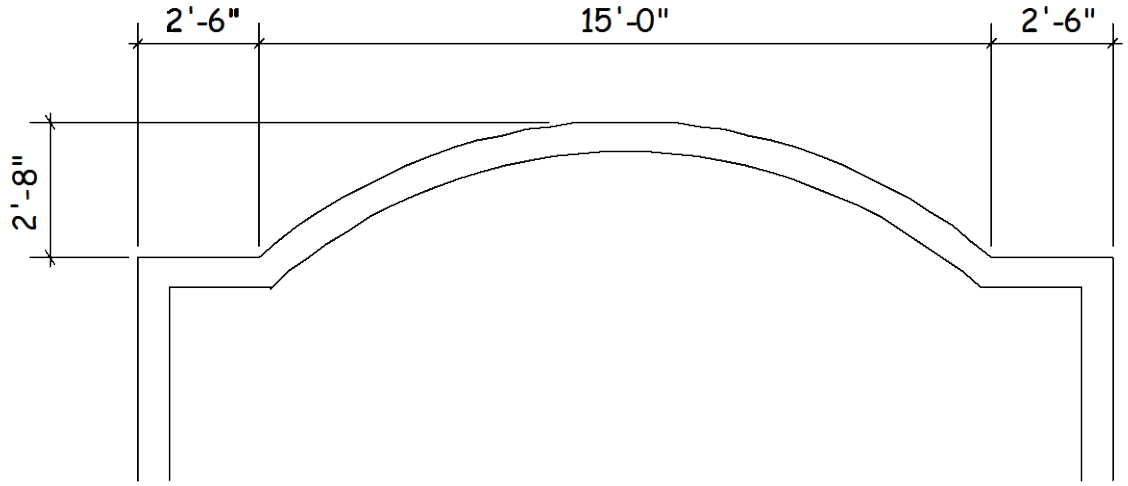


Radius Formula

The radius point of a segmented arch can be determined mathematically, yet the mechanical means of bisecting the chord used in the earlier example is the most accurate. There are many different formulas to use in determining the radius point for a segmented arch, but we will use the subsequent formula when the span and rise measurements of the arch are given.

$$\text{Radius} = \frac{(1/2\ \text{span})^2 \div \text{Rise} + \text{Rise}}{2}$$

The easiest way to calculate the answer is to convert all of the dimensions into decimal feet, then plug in the decimal numbers for span and rise. Using the same example for the prior segmented arch, we will convert the span and rise into decimal equivalents. *We will round off all our figures to the nearest hundredth when calculating the answer.*



Decimal Equivalents:

Span = 15'-0" or 15.0

Rise = 2'-8" or 2.67, (8 ÷ 12 = .67)

The formula should look like the following, with decimal equivalents:

$$\text{Radius} = \frac{(7.50)^2 \div 2.67 + 2.67}{2}$$

Calculating the answer using the figures above:

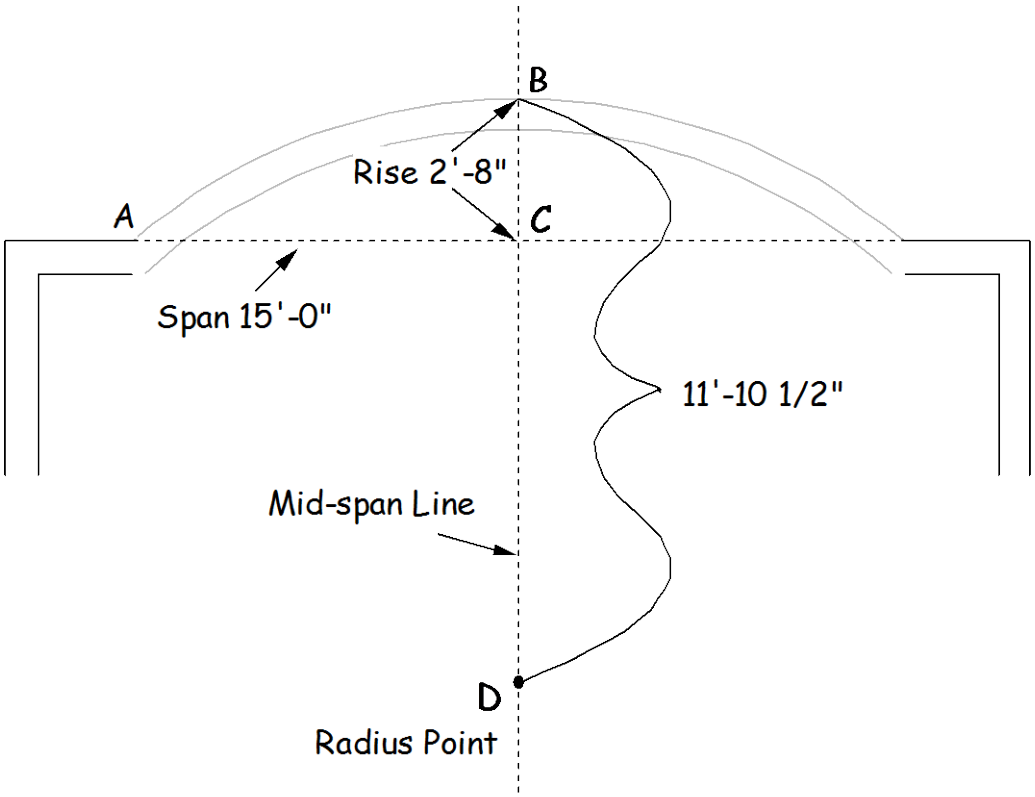
$$\text{Radius} = \frac{(56.25 \div 2.67) + 2.67}{2}$$

$$\text{Radius} = \frac{21.07 + 2.67}{2}$$

$$\text{Radius} = \frac{23.74}{2}$$

Radius = 11.87' or 11'-10 1/2"

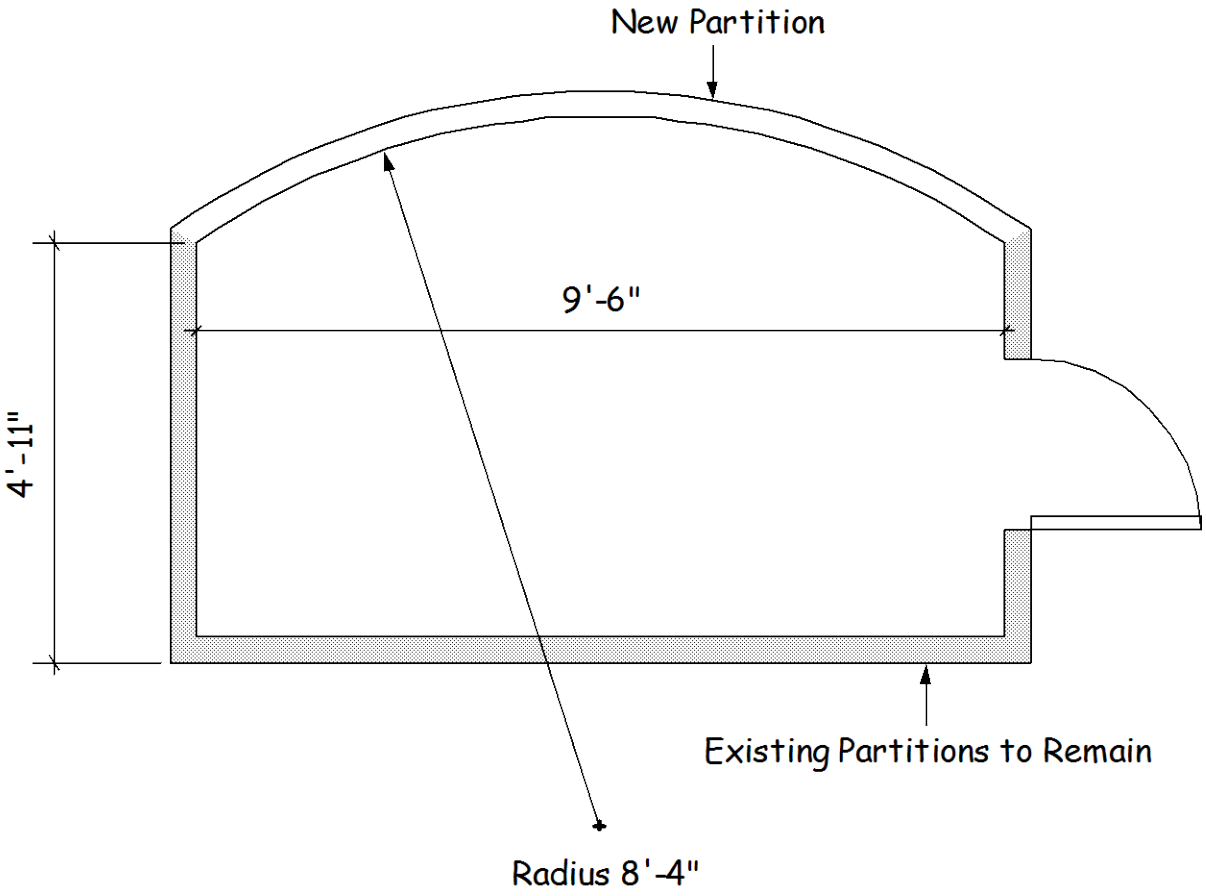
Once the radius has been calculated, proceed with the following layout procedures. Layout the typical walls using the architect's dimensions as usual. Establish the span and mid-span lines. Measure along the mid-span line, starting at point **C** and establish point **B**, the rise of the segmented arch, in this case 2'-8". From point **B**, measure down the mid-span line and establish point **D**, the radius point of 11'-10 1/2". Once the radius point **D** is established, scribe the arc connecting the outer most points of the span and rise, completing the layout procedure.



Huygens (Rise) Formula

Another layout method can be used when the radius point of the segmented arch is outside of the building or somehow obstructed. In this case, the radius and span for the segmented arch is given and we will need to determine the rise of the arch based on Huygens formula. Once the rise of the arch is determined, the arch can be graphed. For your information, Christiaan Huygens was a famous mathematician who lived from 1629-1695, with part of his work devoted to theories of how light waves bend.

In the drawing below, the architect has specified a segmented arched wall, with the radius point blocked by the existing partitions. The span of the arch is easily determined and is based on measuring the distance between the existing partitions, in this case, it is shown as 9'-6". The radius is given, so we will need to determine the rise of the arched wall.



Using Huygens formula:

$$\text{Rise} = \text{Radius} - \sqrt{\text{Radius}^2 - \frac{\text{Span}^2}{4}}$$

The span of the arch is dimensioned at 9'-6", so we will plug in the decimal equivalents of the dimensions. All decimals and calculations are rounded off to the nearest hundredth and the formulas will look like:

$$\text{Rise} = 8.33 - \sqrt{8.33^2 - \frac{9.50^2}{4}}$$

$$\text{Rise} = 8.33 - \sqrt{(8.33 \times 8.33) - \frac{(9.50 \times 9.50)}{4}}$$

$$\text{Rise} = 8.33 - \sqrt{69.39 - \frac{90.25}{4}}$$

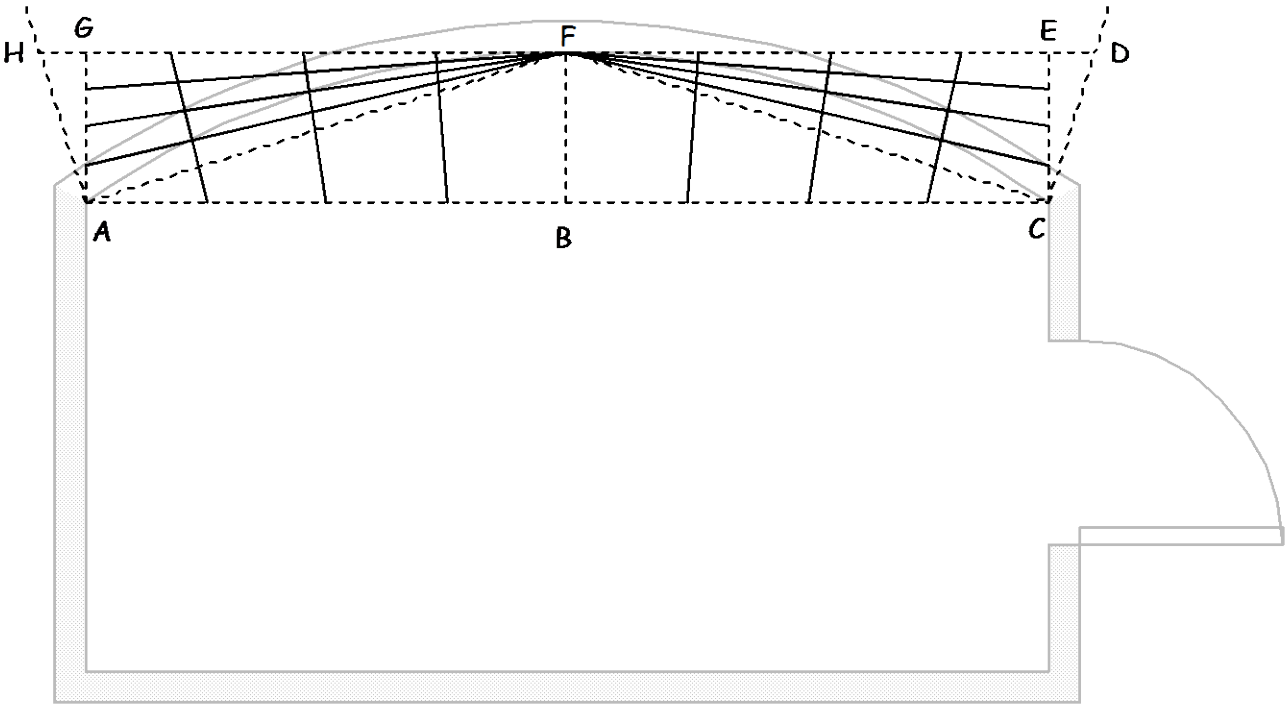
$$\text{Rise} = 8.33 - \sqrt{69.39 - 22.56}$$

$$\text{Rise} = 8.33 - \sqrt{46.83}$$

$$\text{Rise} = 8.33 - 6.84$$

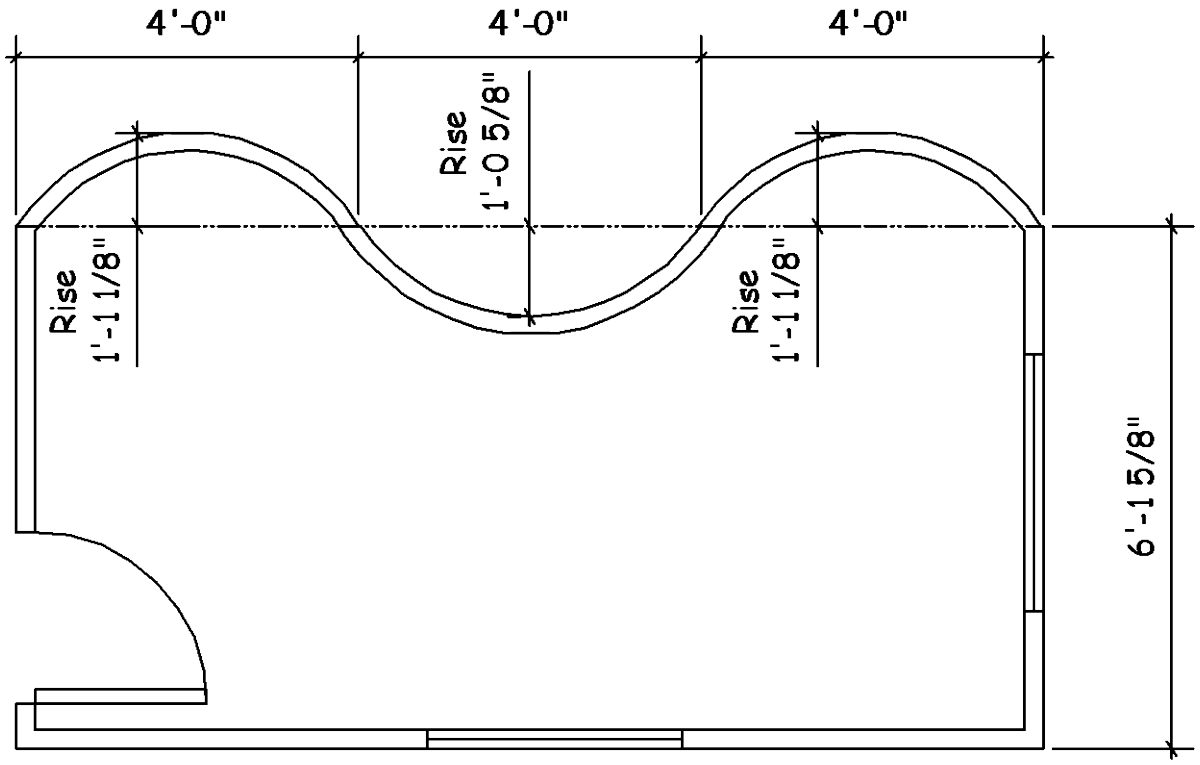
$$\text{Rise} = 1.49' \text{ or } 1'-5\ 7/8"$$

The graphing of the arch is shown in the following drawing and is executed as follows. The sidewalls have been cut to length at 4'-11", as the previous drawing indicated. Snap a line for the span, **A-C** and at mid-span, snap the rise **B-F**, at 1'-5 7/8". Extend the sidewall lines, **G-A, E-C**. Snap the diagonals **F-A** and **F-C** as shown. Snap lines **H-A** and **D-C**, perpendicular to the diagonal lines. Divide the lines of **H-F, F-D, E-C, G-A, A-B** and **B-C** into equal parts and snap the graph lines. The intersections of the graph lines are the points for the segmented arch, with has a radius of 8'-4". In this particular arch, all of the dimensions are shown to the bottom of the wall, as are the intersections of the graph lines.



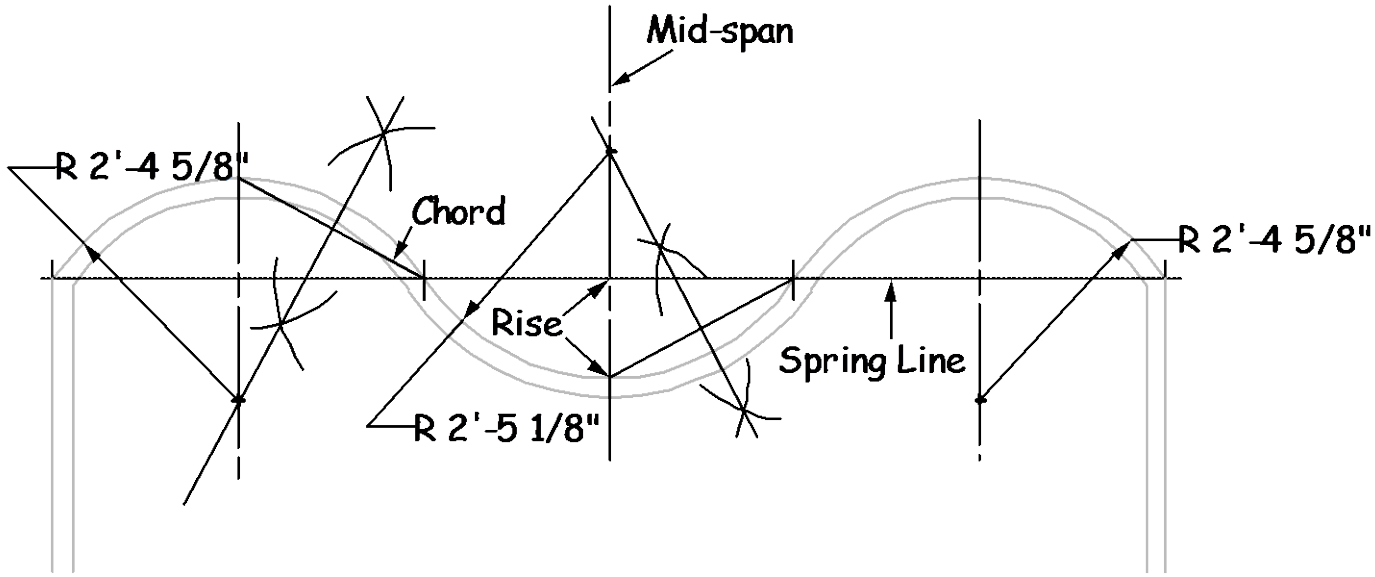
Serpentine Walls and Soffits

Serpentine walls and soffits are series of segmented arches linked together. The layout process is exactly the same as a segmented arch, as a matter of fact; you should approach the serpentine layout process one segmented arch at a time. Each segmented arch may have a different span; rise and radius point or a serpentine wall can have identical segmented arches. Usually the segmented arches will be the same for every other arch, because it is easier to match the transition between different arches, unless the segmented arches are true semi-circles. The drawing below shows a serpentine wall.

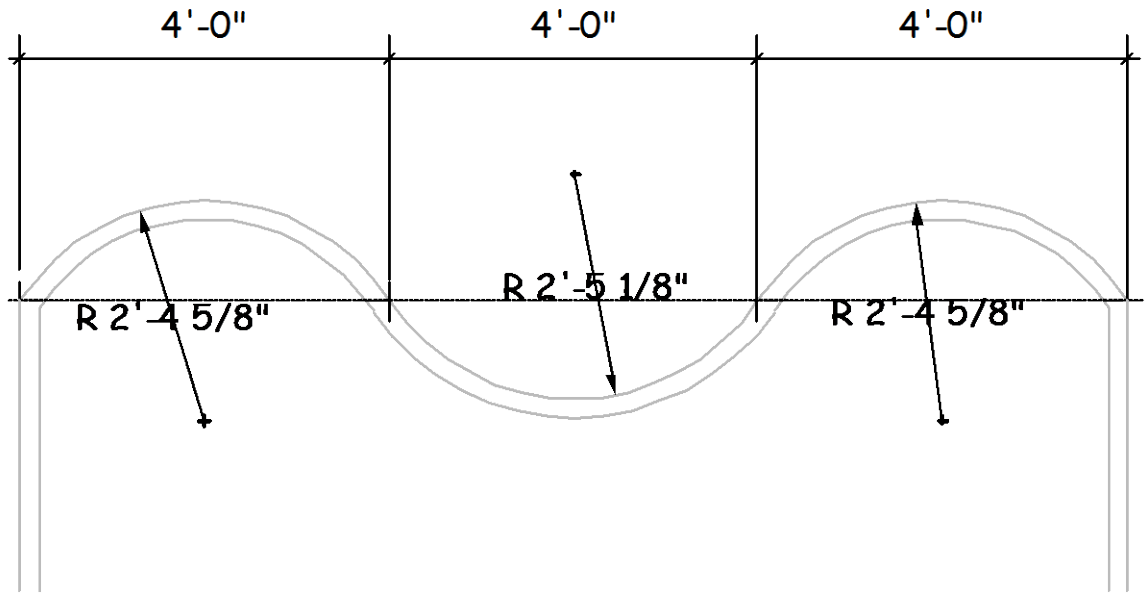


The architect has given the span and rise of each segmented arch comprising the serpentine wall. This layout procedure requires bisecting the chord of the different arches to establish the radius points and then duplicate the radius point for the identical arch.

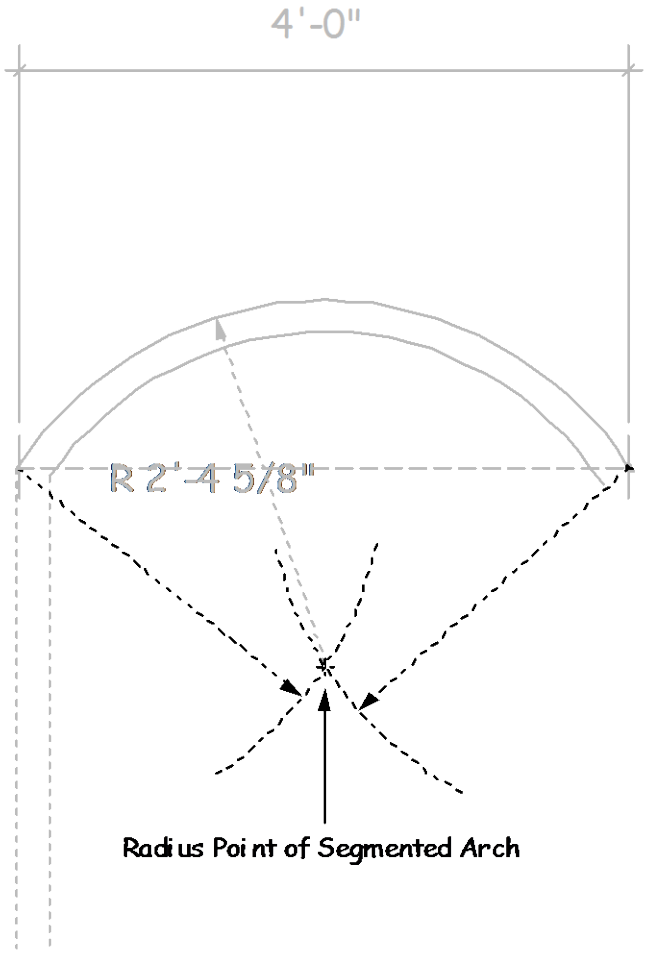
Start the layout of the typical walls using the architect's dimensions as usual. Establish the spring line as shown, measure and mark the required dimension for the span of each arch, in this case the span is 4'-0" for all three arches. We will assume all of the dimensions are to frame lines; otherwise you would need to adjust the dimensions. Install the mid-span lines for all three arches. Measure from the spring line and make a mark on the mid-span line for the rise. Snap the diagonal chord of the arch. Bisect the chord of the arch and snap a line intersecting with the mid-span line to produce the radius point of the segmented arch and scribe the arch. Duplicate this procedure for the other segmented arch. Again, make sure you are on the side of the arch where the dimensions are marked, in this example, the dimensions are to the outside, inside and outside, respectively for the arches. Measure from the top of the rise, down the mid-span line, of the identical arch and mark the radius point of 2'-4 5/8" and scribe the final arch.



The architect may give the radii of the segmented arches as shown below and will not locate the radius point with actual dimensions. The best way to locate the radius point is to swing arcs with the given radius using the outside points of the span. Where the two arcs cross, is the exact radius point for the segmented arch.

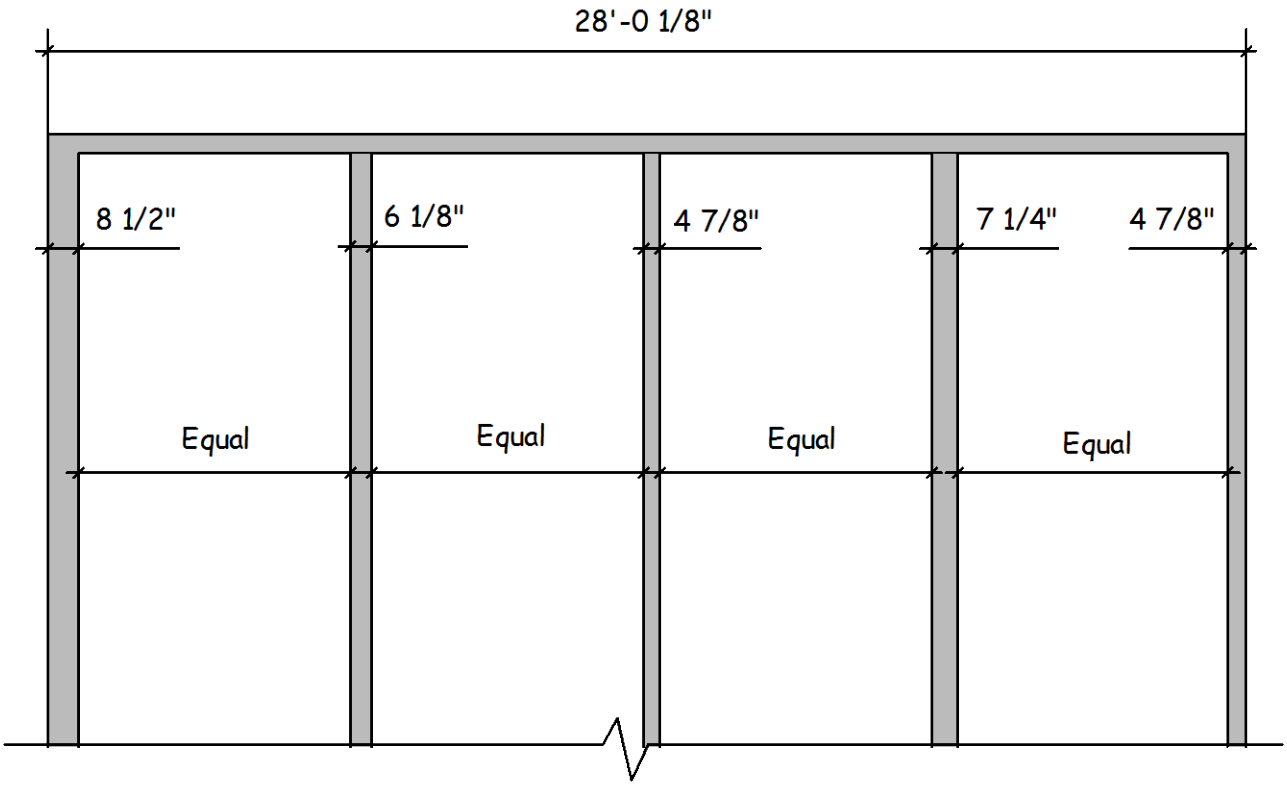


The example below illustrates how to locate the radius point when the radius dimension is given. The dotted lines represent the radius of the segmented arch intersecting at the actual radius point when the arcs are scribed from the outside points of the span.



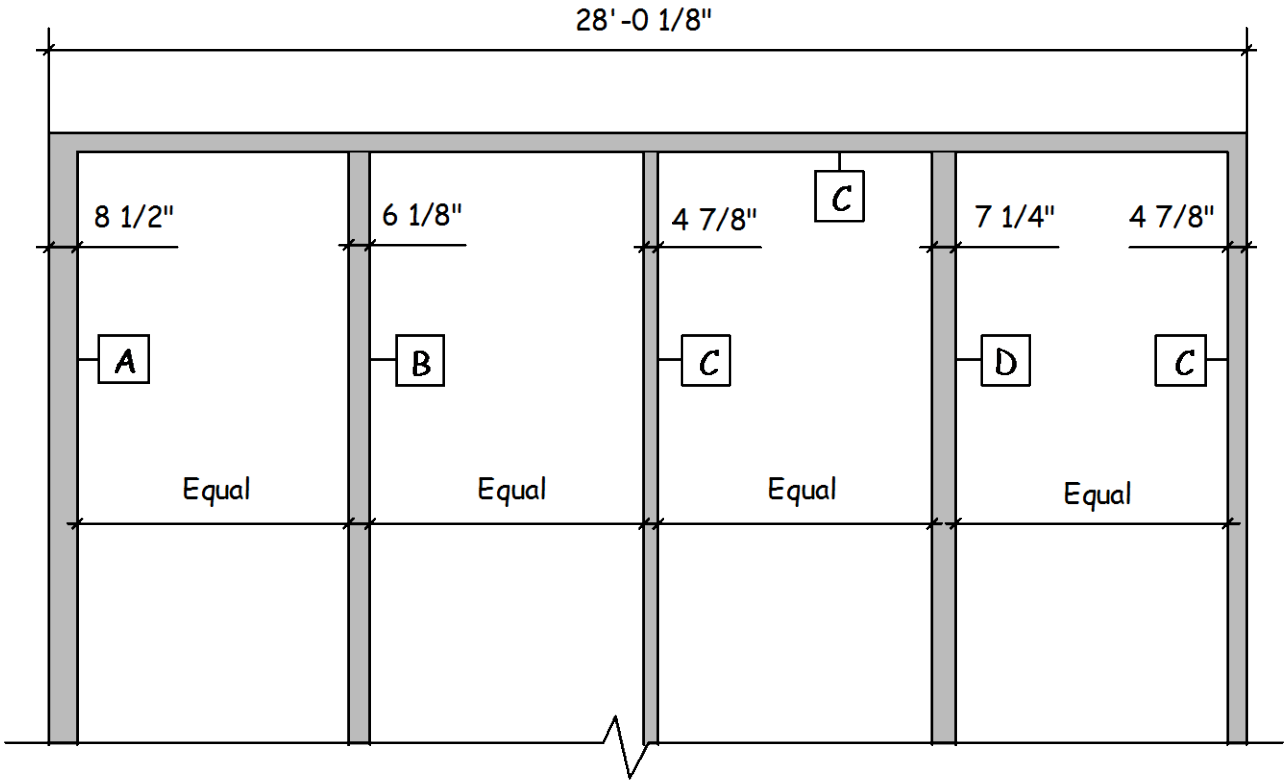
Partition Layout with Equal Dimensions

Partition layout is usually a simple process when the architect's dimensions are given on the drawings. There are situations when the architect requires equal dimensions between rooms and this becomes challenging when partitions are different sizes. The drawings will have the term "equal" shown and it is up to the drywall/lather to determine the layout. An example of a partition layout is shown below with the term equal shown.



In this example, we will assume the dimensions are given to frame lines. The best way to approach the layout would be to subtract all of the walls thick nesses from the overall dimension of 28'-0 1/8", then divide the remaining number by 4, for the four equal spaces shown. Subtracting all of the walls, totaling 2'-7 5/8", from 28'-0 1/8", leaves 25'-4 1/2". Divide 25'-4 1/2" by 4, which equals 6'-4 1/8". This is the "equal" space between the partitions as specified by the architect. Proceed with the layout starting from the outside of the first wall, either on the left or right side, measure and mark for the wall thickness, mark the dimension of 6'-4 1/8", measure and mark for the next wall thickness and so forth until the layout is complete.

If the previous example had finished dimensions, we would need to determine the track sizes and the thickness of the finishes for each partition and calculate for the required frame line dimensions. The drawing below has the information needed to layout the partitions to frame lines using finished dimensions.



A 6" Track, with 2 layers 5/8" gypsum board each side

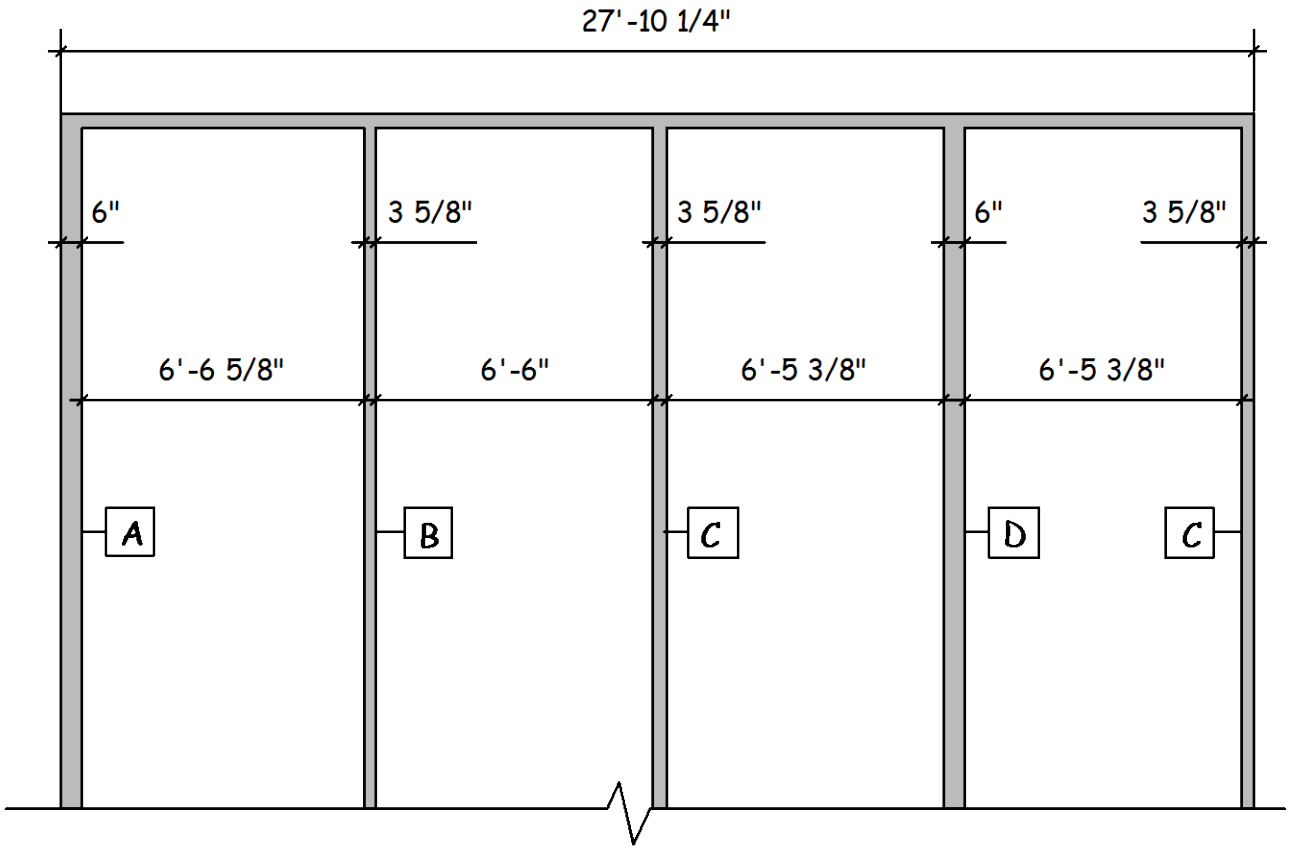
B 3 5/8" Track, with 2 layers 5/8" gypsum board each side

C 3 5/8" Track, with 1 layer 5/8" gypsum board each side

D 6" Track, with 1 layer 5/8" gypsum board each side

We would start this layout procedure by determining the "equal" finished dimension between partitions of 6'-4 1/8". This is accomplished using the same method as in the previous example. Subtracting the outside finishes from the overall dimension of 28'-0 1/8". Subtracting 3 layers of 5/8" gypsum board from 28'-0 1/8" equals 27'-10 1/4", the outside frame line dimension. Snap the outside lines of the framing. Working from left to right with the drawing, measure over 6" and snap the inside of the track line. Add 2 1/2" to the measurement of 6'-4 1/8" for the four layers of gypsum board, totaling 6'-6 5/8". Measure over 3 5/8" for the track and add 1 7/8" to the measurement of 6'-4 1/8" for the three layers of gypsum board, totaling 6'-6". Measure over 3 5/8" for the track and add 1 1/4" to the measurement of 6'-4 1/8" for the two layers of gypsum board, totaling 6'-5 3/8". Measure over 6" for the track and add 1 1/4" to the measurement of 6'-4 1/8" for the

two layers of gypsum board, totaling 6'-5 3/8". If the layout was done properly, the remaining measurement should be 3 5/8", the width of the track for the last partition. All frame line dimensions are shown in the drawing below.



A construction calculator would be very helpful when calculating dimensions, but be aware they may have a default setting of 1/32". In other words, if you have 4 equal spaces as we did in the above drawing, your overall measurements could be off as much as 1/8", not that it would matter when building the partitions, but the calculations will not add up exactly.

Chapter 4

Study Guide

Directions:
Answer the following questions using the bubble answer sheet.

1). When bisecting the chord of an arch, it is necessary to scribe intersecting arcs above and below the chord.
A). True
B). False

2). When graphing an arch, the span and rise dimensions are necessary.
A). True
B). False

3). The distance around a circle is called the diameter.
A). True
B). False

4). A part of a circle's circumference is called an arc.
A). True
B). False

5). For layout purposes, it is essential to realize the dimension and extension lines are defining either the top of the arch or the bottom of the arch.
A). True
B). False

6). The distance across a circle thru the center is called the _____.
A). Circumference
B). Radius
C). Diameter
D). Arc

7). The _____ of an arch is the distance across the arch when measured at the spring line.
A). Rise
B). Mid-span
C). Span
D). Segment

8). The radius point of a segmented arch can be determined mathematically, yet the mechanical means of bisecting the chord is the most accurate.
A). True
B). False

9). Serpentine walls and soffits are series of segmented arches linked together.
A). True
B). False

10). Half of a circle's diameter is the _____.
A). Radius
B). Circumference
C). Segment
D). Arc

11). An arch starts or springs from the spring line.
A). True
B). False

12). A segment of any circle would have the same _____ as the circle itself.
A). Circumference
B). Chord
C). Radius
D). Span

13). The _____ is the highest point of an arch measured from the spring line.
A). Mid-span
B). Rise
C). Span
D). Segment

14). The distance from the center of a circle to any point on the diameter defines the radius of a circle.
A). True
B). False

15). A straight line connecting any two extreme points of an arc is called the _____ of the arc.

A). Chord
B). Segment
C). Radius
D). None of the above

16). The easiest way to calculate the answer when using formulas, is to convert all of the dimensions into decimal feet.

A). True
B). False

Chapter 4

Radius Formula Exercise

Directions:
Use the following formula to determine the radius of the segmented arch. Show your work below. *Round off your figures before calculating and the final answer to the nearest hundredth***.** *Convert the decimal answer into feet and inches.*

$$\text{Radius} = \frac{(1/2\ \text{span})^2 \div \text{Rise} + \text{Rise}}{2}$$

1). Span: 15'-8"
Rise: 3'-9"

Answer: _____

2). Span: 32'-10"
Rise: 8'-2"

Answer: _____

3). Span: 65'- 7"
Rise: 23'- 11"

Answer: _____

4). Span: 74'-3"
Rise: 30'-5"

Answer: _____

5). Span: 92'-1"
Rise: 6'- 4"

Answer: _____

6). Span: 127'-11"
Rise: 16'-10"

Answer: _____

7). Span: 34'-7 3/4"
Rise: 5'-9 1/2"

Answer: _____

8). Span: 58'-2 3/4"
Rise: 14'-6 5/8"

Answer: _____

9). Span: 74'-11 1/4"
Rise: 23'-4 3/4"

Answer: _____

10). Span: 98'-10 1/8"
Rise: 42'-8"

Answer: _____

Chapter 4

Huygens Formula Exercise

Directions:
Use the following formula to determine the rise of the segmented arch. Show your work below. *Round off your figures before calculating and the final answer to the nearest hundredth***.** *Convert the decimal answer into feet and inches.*

$$\text{Rise} = \text{Radius} - \sqrt{\text{Radius}^2 - \frac{\text{Span}^2}{4}}$$

1). Radius: 6'-8"
Span: 4'-9"

Answer: _____

2). Radius: 24'-9"
Span: 12'-7"

Answer: _____

3). Radius: 45'-11"
Span: 33'-10"

Answer: _____

4). Radius: 76'- 7"
Span: 15'-3"

Answer: _____

5). Radius: 34'-2"
Span: 25'-0"

Answer: _____

6). Radius: 98'-3"
Span: 73'-11"

Answer: _____

7). Radius: 56'- 9 3/4"
Span: 45'-7 1/2"

Answer: _____

8). Radius: 34'-7 5/8"
Span: 29'- 3 1/4"

Answer: _____

9). Radius: 146'- 6 1/2"
Span: 98'- 0 1/2"

Answer: _____

10). Radius: 2304'-2"
Span: 2065'- 5 1/2"

Answer: _____

Chapter 4

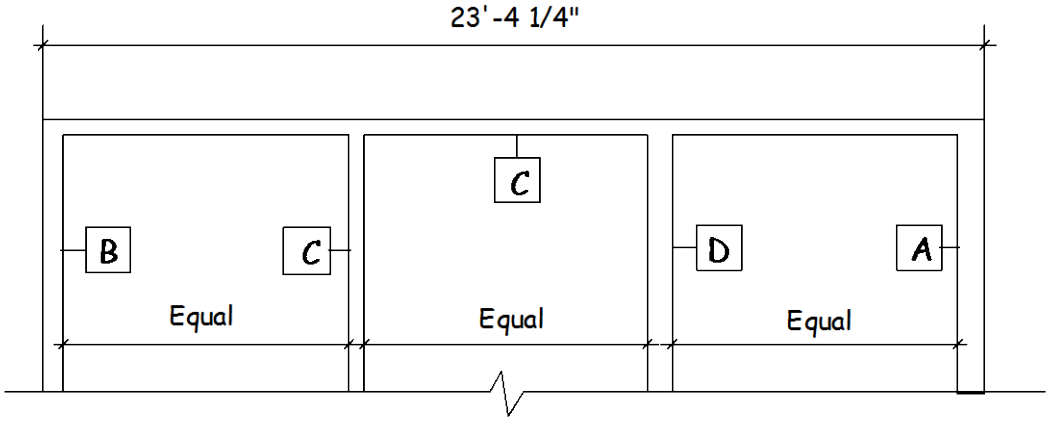
Equal Space Exercise

Directions:

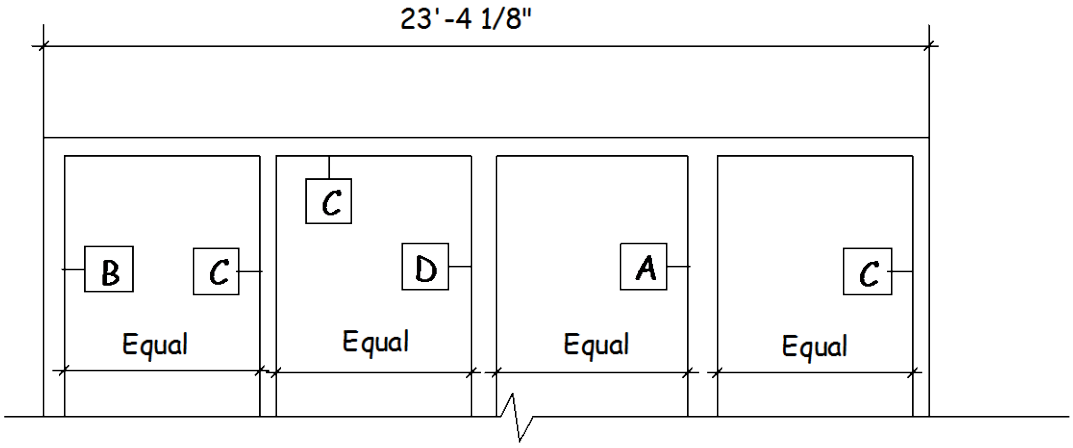
Determine the "equal" space, finish to finish, between the partitions using the dimensions given in each example. The dimensions are to finished surfaces and use the wall legend below for all exercises.

A	6" Track, with 2 layers 5/8" gypsum board each side
B	3 5/8" Track, with 2 layers 5/8" gypsum board each side
C	3 5/8" Track, with 1 layer 5/8" gypsum board each side
D	6" Track, with 1 layer 5/8" gypsum board each side

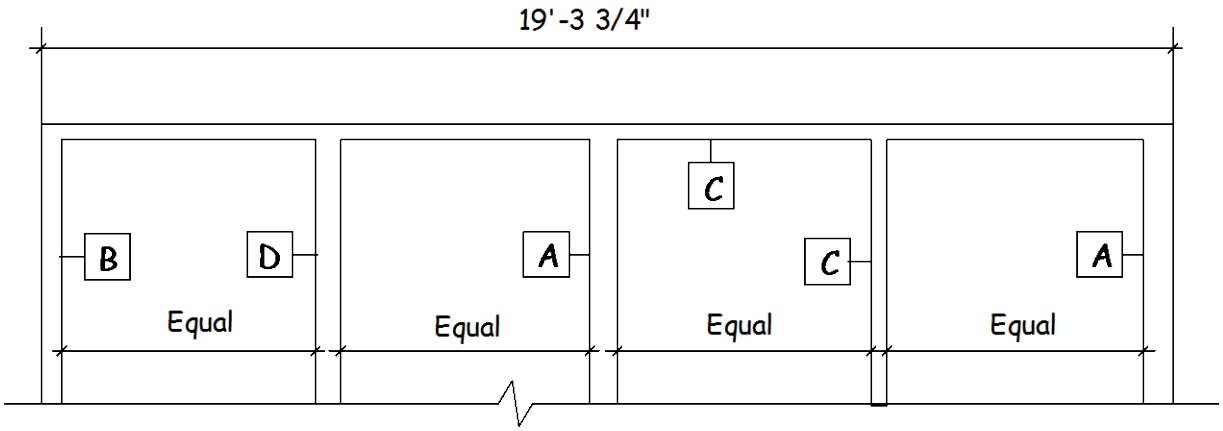
1). Equal Space: _____



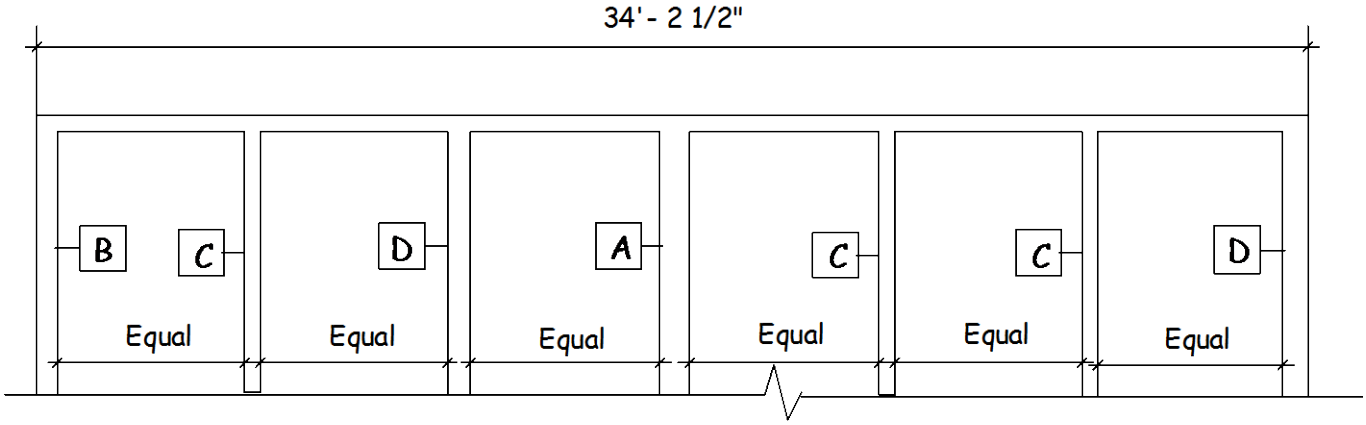
2). Equal Space: _____



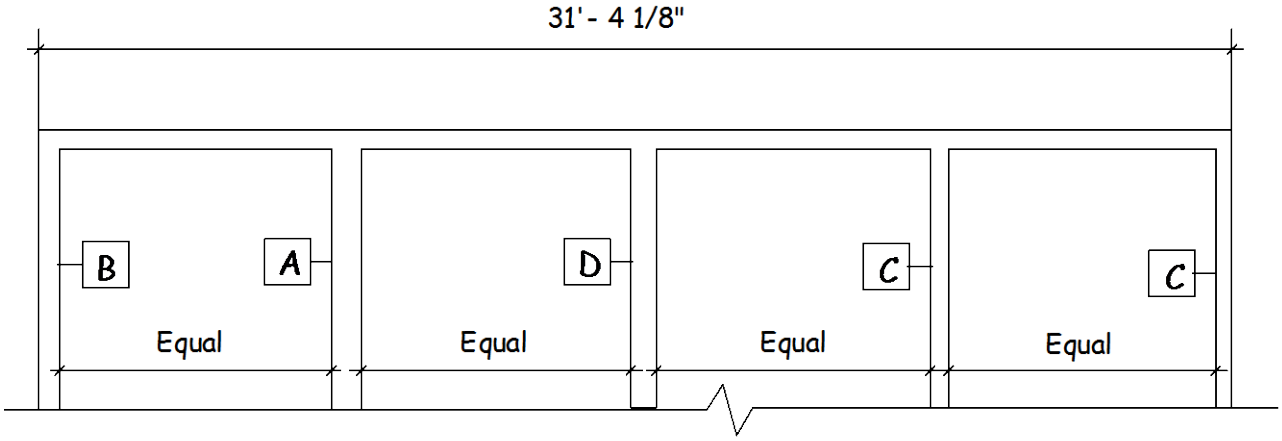
3). Equal Space: _____



4). Equal Space: _____

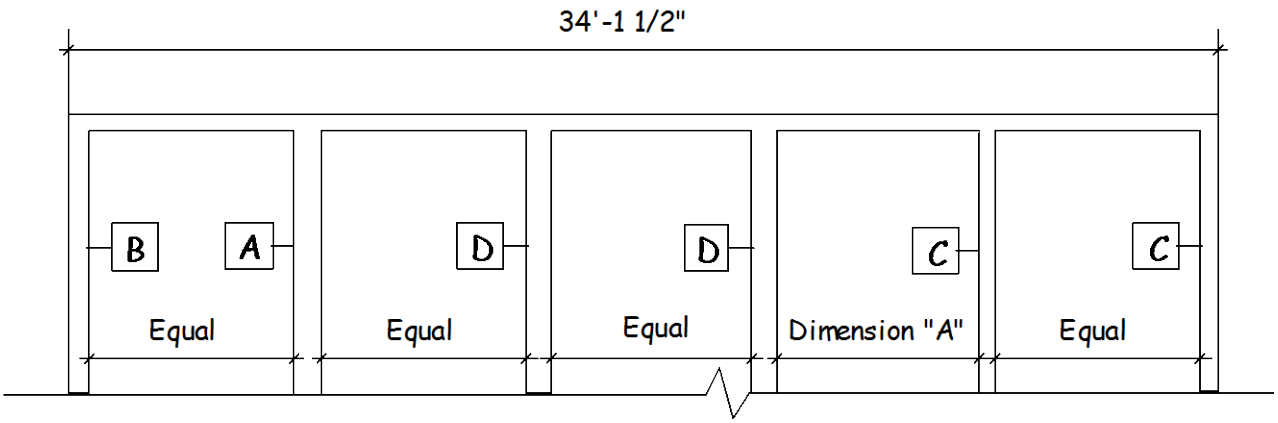


5). Equal Space: _____

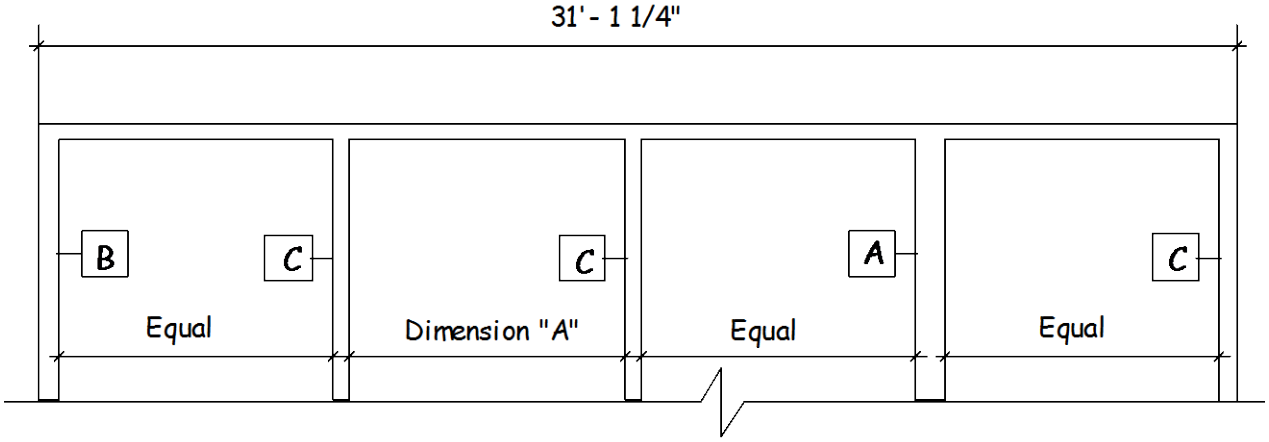


Determine the frame line to frame line dimension(s) for the following examples.

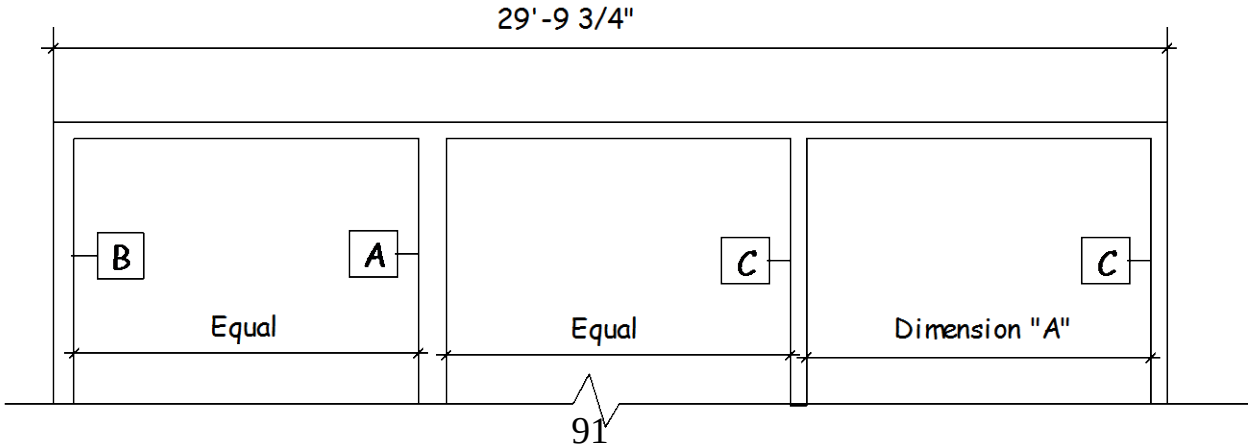
6). Dimension "A": _____



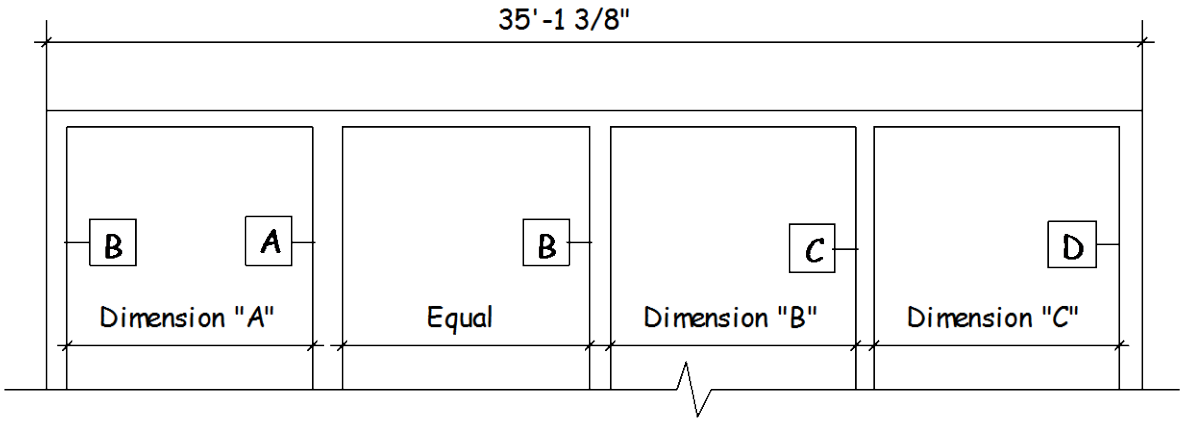
7). Dimension "A": _____



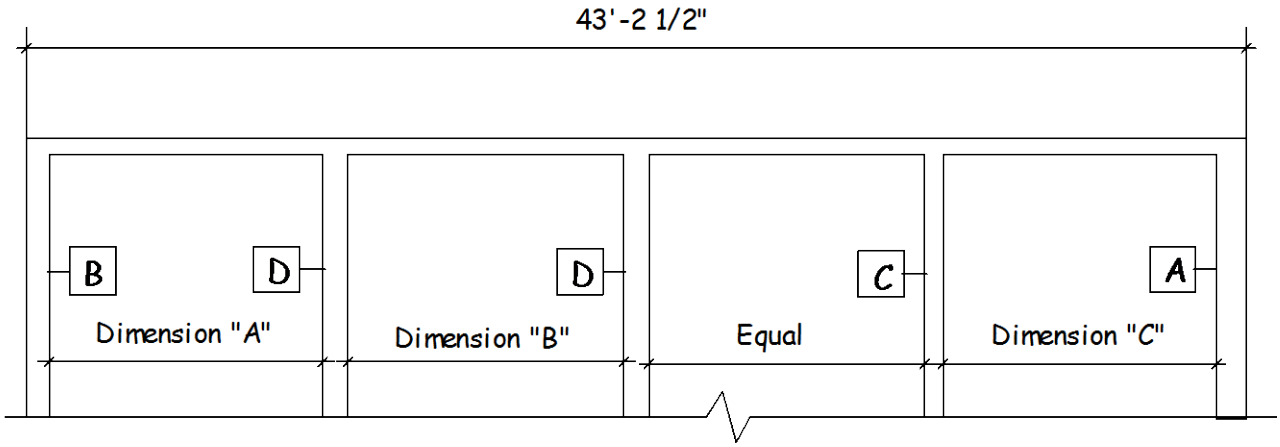
8). Dimension "A": _____



9). Dimensions: A: _____ B: _____ C: _____



10). Dimensions: A: _____ B: _____ C: _____



Chapter 5

Leadership

Objectives:

Upon completion of this chapter, students will be able to:

1). Apply leadership ideas and principles.
2). Understand how motivation of others is important to achieving the desired outcome.
3). Recognize how planning is critical to the success of a drywall/lathing project.

Introduction

If you desire to become a drywall/lather foreman, remember the title alone will not win the respect or loyalty of your fellow workers. How many foremen in charge of a job did you respect? What was it about others that you did respect and respond to? Good foremen will win others' loyalty along with their respect. Good leaders are not born they are made and if you have the aspiration and willpower to become a foreman you can.

What is leadership? Leadership is a multifaceted process in which a person influences others to accomplishing a task or goal and directs the job crews in a cohesive and coherent way. Although a foreman has the authority to accomplish certain things, this power does not make them a leader, it means they are your boss, whereas a leader makes their workers want to achieve high goals and objectives. When a person is deciding if they respect you as a leader, they are looking at what you do, so they know who you really are. A respected leader concentrates on what he/she is [*be*] (character and beliefs), what he/she *does* (provide direction, motivate, implement) and what he/she *knows* (job, tasks, human nature).

Leadership Principles

Below are nine principles of leadership to help you be, know and do.

- **Know yourself and seek self-improvement.** In order to know yourself, you have to know your be, know and do attributes. Seeking self-improvement means continually strengthening your attributes.
- **Be technically proficient.** You should know the job, blueprints and procedures of your job and the jobs of the ones you direct.
- **Seek responsibility and take responsibility for your actions.** Search for ways to be more productive and if something goes wrong, take responsibility for it, correct the problem and move on.
- **Make sound and timely decisions.** Use good decision-making, problem solving and planning tools when making your decision.
- **Set the example.** Be a good role model for your workers. They not only hear you, and they also see what you do, especially if you wear your tools as a foreman.
- **Know your workers and look out for their well-being.** Treating people as you would like to be treated is just human nature. Make sure they have proper equipment and follow safety procedures.
- **Keep your workers informed.** Know how to communicate with your workers, the job superintendent, building inspectors, architects and others in the company.
- **Develop a sense of responsibility in your workers.** Develop good character traits in your people that will make their job easier.
- **Ensure that tasks are understood, supervised and accomplished.** Communication is the key to this responsibility.

Factors of Leadership

There are four major factors of leadership and they are:

- **Follower-** People are different, so your leadership style would vary with each worker. An apprentice would require more supervision than a journeyman or an employee with a poor attitude would require a different approach than a highly motivated employee. When you understand human nature: needs, emotions and motivation, you also begin to know your workers and how to best accomplish your objectives.
- **Leader-** The followers will determine if you are a successful leader, not yourself or your superiors. To be successful, you must convince your followers that you are worthy of being followed. If someone lacks trust or confidence in you as a leader they will be uninspired.

- **Communication-** You lead through two-way communication. When you "set the example", that communicates to your workers that you would not ask anyone to do something you would not do. Much of what you communicate is nonverbal. What and how you communicate either builds or harms the relationship between you and your workers.
- **Situation-** How you handle a worker in one situation might not work in another situation with a different worker. You must use your judgment to decide what is the best course of action to take. If you need to confront a worker for poor work quality for example, being late, to harsh or to weak in your reprimand of that employee, then the results of your confrontation may prove ineffective.

Effective Leadership Qualities

As an effective drywall/lather foreman, you should demonstrate many of the following qualities:

- **Honesty**- Everyone appreciates the truth
- **Trust**- Being counted upon and having others feel they can be counted upon
- **Integrity**- Be true to yourself and what you believe in
- **Reliability**- Be relied upon, who likes a flake?
- **Commitment**- Commit to the end of the job or goal and so will your workers
- **Successfulness**- People notice what you achieve and how you act
- **Listening Skills**- People like to know they will be heard
- **Motivate**- You must be able to communicate and treat others as you would like to be treated
- **Confidence**- People believe in people who believe in themselves
- **A Plan**- Implement an effective plan for production and accountability on the jobsite
- **Vision-** Give your workers something to achieve

The more of these personal qualities you have, the more people will want to follow your leadership. These are some of the elements which makeup an effective leader, but the successful and respected drywall/lather foreman will be the ones who can manage, motivate, communicate, inspire, discipline and document on a fair and consistent basis.

Many times the drywall/lather foreman is the "Authoritarian Leader". People who fall into this category are very much task oriented and hard on their workers (autocratic). Heavily task oriented people will display these characteristics: they are very strong on schedules; they expect people to do as they are told without question or debate; when something goes wrong they tend to focus on who is to blame rather than concentrate on exactly what went wrong and how to prevent it and they are intolerant of what they see as dissent, so it is difficult for their workers to contribute or develop. This approach may be necessary for certain situations and many foremen use this leadership style. From experiencing many different situations, you will develop a leadership style that you are comfortable with and motivate those who work for you.

Here are some quotes you may find interesting:

The very essence of leadership is its purpose. And the purpose of leadership is to accomplish a task. That is what leadership does--and what it does is more important than what it is or how it works.
- Colonel Dandridge M. Malone

Leadership should be born out of the understanding of the needs of those who would be affected by it.
- Marian Anderson

Leadership is practiced not so much in words as in attitude and in actions.
- Harold Geneen

The quality of a leader is reflected in the standards they set for themselves.
- Ray Kroc, Founder of McDonald's

Genius is one percent inspiration and ninety-nine percent perspiration.
- Thomas Alva Edison

Give us the tools, and we will finish the job.
- Winston Churchill

Life is change. Growth is optional. Choose wisely.
- Karen Kaiser Clark

Motivation

The construction industry turns out approximately 50,000 trained workers each year. Many have gone through apprenticeship programs, others from learning on the job. The industry needs somewhere around 240,000 trained workers each year, so you can see how a shortage of trained workers exists. There are plenty of people entering the construction industry, but many see their jobs as temporary pay options and not the start of a rewarding career. The National Home Builders Association has shown that the average age of a skilled worker leaving the industry was 33, primarily from competition from other fields that are not subject to layoff and weather conditions. Although these are national statistics, we will provide you with ideas on maintaining productive work crews and what motivates them for the duration of this job and the next one.

A drywall/lather has a very demanding job. You are there to get the job done and want to get the job done, but you are dependent on many factors. Some demotivating factors are: inadequate supplies and material to get the job done properly, project confusion by supervisors and project managers, little communication and participation with the workers, to much downtime, and disrespectful treatment are some of the reasons production decreases. What you should do as a foreman is to have the job site organized and efficient as possible. At the end of the day, it is a good feeling to see how much board your crews have hung or how many feet of wall has been framed; it also gives you and your workers a sense of accomplishment.

Everyone is motivated by different needs, but two of the most common things people need is mutual respect and personal involvement. When workers feel good about themselves, the work they do and the company they work for, it is much easier to gain their support. Here are some ways to get the most from your workers:

- **Be aware of the morale level of your workers.** Know when or why it goes up or down.
- **Be sure to listen.** Always try to understand and listen to what your workers are expressing and communicating.
- **Always treat your workers with respect.** Be considerate of the person you are dealing with.
- **Ask for suggestions.** After all they are ones doing the work, they may have new ideas on how to do things better and more efficiently.

- **Maintain high standards.** Involve workers in establishing high standards of performance and work quality, building their pride and self-confidence.
- **Outline job responsibilities.** Make certain workers know what is expected of them and how they will be evaluated.
- **Give "constructive criticism".** Never make a personal attack, give constructive criticism.
- **Recognize your workers.** Show recognition and give praise for a job well done.
- **Keep workers informed.** Keep workers informed about changes on the job such as inspections, overtime and deadlines.
- **Develop a caring attitude.** Be available and interested in your workers ideas.
- **Cultivate strong skills in delegation.** Delegation means to convey responsibility and authority to your workers so they can carry out certain tasks. Leave it up to them to decide "how".

Although these are suggestions in how to deal with the workers on your job, there are a few other things to take into consideration. What motivates you as a worker may not motivate other workers. Different things motivate people. Fear is a great motivator, but only for a short period of time. Yelling won't light a spark under your workers for a very long time. Motivating people requires you to set up an environment in which people motivate themselves. As you can see motivation is not something to be worked on occasionally, it requires your attention every day.

Job Planning

As mentioned before, planning of the job is critical to the success of the project. You will need to create and execute a plan of action to achieve this success. A detailed plan must include the who, what, when, where, how and why. Who will do what? What are we going to do? When does it start? Where will it take place? How will it get done? Why must we do it? You will plan before the job starts and throughout the entire job. Each company you work for will obviously have different ideas and procedures for running work, but some common drywall/lathing procedures are given below:

- Meet with your company's **project manager** (PM) to discuss:
  - Any changes to the drawings that may have been negotiated

- Any questions or clarifications to the drawings
- Are any new drawings forthcoming
- Confirm the project number for record keeping, address, location and start date
- Confirm the material and equipment suppliers, has it been put out to bid?
- Any material lead times?
- Get phone numbers for suppliers, superintendent, GC and architect
- Production requirements and labor hours
- Document meeting in daily log book

- Meet with the **job superintendent** to discuss:
  - The drywall/lathing schedule and start date, try to obtain a copy for your records
  - Door and window rough openings in writing
  - Any stocking issues you are not aware of, (i.e. window removal, after hours, use of elevator)
  - Will workers require badges?
  - Any power problems?
  - Document meeting in daily log book

- Walk the **jobsite**:
  - Confirm power
  - Clean up required prior to stocking or partition layout?
  - Any safety violations (i.e., safety railings, openings not covered, scaffold violations, etc.), *note* in log book
  - When will layout start? Any other trades material need moved?
  - Request additional clean up labor if needed
  - Check your plans with actual conditions
  - Meet other trades foremen

- Plan the **stocking** of the materials:
  - Talk with material supplier on delivery dates, confirm with GC
  - Coordinate with other trades foremen (avoid sprinklers, hvac, electrical runs, floor coring/drilling, plumbing trenches)
  - Reference the drawings, put material where it will not have to moved if possible
  - Keep all material on sloutters, for movement with forklift or pallet jack

- Locate material as close to where it will be most needed
- Place materials over column lines and beams
- Keep all of the same gauge material together, leave track on top, it will be used first
- Use apprentice labor to stock and keep crews supplied
- Inventory materials daily and upon delivery; this includes screws, shot and pin, chop saw blades, etc.
- Give shop advance notice of material needs
- Locate area for scrap and confirm with GC
- Document meetings and discussions in daily log

- Schedule delivery of **equipment** needed to get started:
  - Gang box, screw guns, chop saws, shotguns
  - Screw tips, shafts, shotgun piston/clips, etc.
  - Scaffolds, extensions, rock carts, chains/locks
  - Contact scissor lift supplier for delivery
  - Cords, Y's, W's, lights, adaptors

- Start ***detailed*** **record keeping and documentation**:
  - From job meetings with GC
  - When meeting with other trades
  - Recording any problems with delays and schedules
  - Any accidents, fill out W/C paperwork
  - Meetings with the architect
  - Material and equipment received, including delivery tags
  - Workers not showing up or leaving early, discipline problems
  - Fill out timecards daily, along with production quantities if required
  - Any changes, RFI's (request for information), confirm with project manager

One of the most important things you will do is documenting everything that occurs on your job. Keep all of the paperwork received in a job folder or individual files. Keep detailed records of any delays, changes, damage to your work, extra work authorizations and conversations with the job superintendent and others. Detailed records include dates, time of day, who you talked to, reasons and results of your conversations. It is much easier for the company's project manager to recover monies from the GC when items are properly detailed and recorded. It could be the difference between a

profitable job and one, which is not profitable. Record keeping will be covered again with greater detail in a following chapter.

Chapter 5

Study Guide

Directions:
Using the words below, fill-in the blanks in the following statements.

A. Multifaceted	**F.** Mutual respect
B. Document	**G.** Followers
C. Situations	**H.** Human nature
D. Two-way	**I.** Do
E. Leadership	**J.** Communicate

1). Know how to _____ with your workers, the job superintendent, building inspectors, architects and others in the company.

2). From experiencing many different _____, you will develop a leadership style that you are comfortable with and motivate those who work for you.

3). You lead through _____ communication.

4). The _____ will determine if you are a successful leader, not yourself or your superiors.

5). Leadership is a _____ process in which a person influences others to accomplishing a task or goal and directs the job crews in a cohesive and coherent way.

6). People are different, so your _____ style would vary with each worker.

7). These are some of the elements which makeup an effective leader, but the successful and respected drywall/lather foreman will be the ones who can manage, motivate, communicate, inspire, discipline and _____ on a fair and consistent basis.

8). When a person is deciding if they respect you as a leader, they are looking at what you _____, so they know who you really are.

9). Everyone is motivated by different needs, but two of the most common things people need is _____ _____ and personal involvement.

10). When you understand _____ _____: needs, emotions and motivation, you also begin to know your workers and how to best accomplish your objectives.

Chapter 5

Leadership Exercise

Directions:

There are nine leadership principles listed in the beginning of this chapter. List the principles in order of importance as you rate them according to your preference for leadership, with number 1 being the most important leadership quality.

1).

2).

3).

4).

5).

6).

7).

8).

9).

Chapter 5

Effective Qualities Exercise

Directions:
There are eleven effective qualities a drywall/lathing foreman should demonstrate. List the qualities in order of importance as you rate them according to your preference for effectiveness, with number 1 being the most important quality.

1).

2).

3).

4).

5).

6).

7).

8).

9).

10).

11).

Chapter 5

Motivation

Directions:
There are eleven motivational ways given in this chapter to get the most out of your workers. As a drywall/lathing foreman, list the most important motivational approaches, with number 1 being the most important technique.

1).

2).

3).

4).

5).

6).

7).

8).

9).

10).

11).

Chapter 5

Job Planning Exercise

Directions:
Match the following statements with the correct heading given below.

A. Meeting with your company's project manager.
B. Meeting with the job superintendent.
C. Walking the jobsite.
D. Stocking of materials.
E. Delivery of equipment.
F. Record keeping and documentation.

1. _____ Get phone numbers for suppliers, superintendent, GC and architect.

2. _____ Locate material as close to where it will be most needed.

3. _____ Recording any problems with delays and schedules.

4. _____ Fill out timecards daily, along with production quantities if required.

5. _____ Door and window rough openings in writing.

6. _____ Talk with material supplier on delivery dates, confirm with GC.

7. _____ Confirm power.

8. _____ Will workers require badges?

9. _____ Reference the drawings, put material where it will not have to moved if possible.

10. _____ Any safety violations (i.e., safety railings, openings not covered, scaffold violations, etc.), *note* in logbook.

11. _____ Request additional clean up labor if needed.

12. _____ Scaffolds, extensions, rock carts, chains/locks.

13. _____ Inventory materials daily and upon delivery; this includes screws, shot and pin, chop saw blades, etc.

14. _____ Any questions or clarifications to the drawings.

15. _____ Meetings with the architect.

16. _____ Screw tips, shafts, shotgun piston/clips, etc.

17. _____ The drywall/lathing schedule and start date, try to obtain a copy for your records.

18. _____ Any stocking issues you are not aware of, (i.e. window removal, after hours, use of elevator).

19. _____ Place materials over column lines and beams.

20. _____ Are any new drawings forthcoming?

21. _____ Check your plans with actual conditions.

22. _____ Workers not showing up or leaving early, discipline problems.

23. _____ Give shop advance notice of material needs.

24. _____ Production requirements and labor hours.

25. _____ Coordinate with other trades foremen (avoid sprinklers, hvac, electrical runs, floor coring/drilling, plumbing trenches).

26. _____ Keep all of the same gauge material together, leave track on top, it will be used first.

27._____ Keep all material on sloutters, for movement with forklift or pallet jack.

28. _____ Confirm the material and equipment suppliers, has it been put out to bid?

29. _____ Any material lead times?

30. _____ Clean up required prior to stocking or partition layout?

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