The Building Industries Occupations course is a two-year program of approximately 160 three-period teaching days per year. The required course content is designed to be effectively taught in 80 percent of the total course time, thus allowing 20 percent of the time for instruction adapted to such local conditions as employment prospects, student ability and motivation, and physical plant characteristics. Each unit is subdivided by the following trade area units: site work/carpentry (40 percent), masonry (12 percent), electricity (15 percent), plumbing (10 percent), heating (12 percent), air conditioner installation (3 percent), and painting/decorating (8 percent). The area units contain a suggested average time to be devoted to learning experiences, a content outline, performance objectives, and additional information for the teacher. The final pages contain a resource list of texts and references, films, filmstrips and transparencies organized by trade area, and a directory of sources of these materials. (BP)
BUILDING INDUSTRIES OCCUPATIONS

SYLLABUS
BUILDING INDUSTRIES OCCUPATIONS
1973 REPRINT
A Suggested Syllabus of Basic Instruction in the Trades of

CARPENTRY

MASONRY

PLUMBING

HEATING

ELECTRICITY

AIR CONDITIONING

PAINTING AND DECORATING

The University of the State of New York/The State Education Department
THE UNIVERSITY OF THE STATE OF NEW YORK

Regents of the University (with years when terms expire)

1985  Everett J. Penny, B.C.S., D.C.S., Vice Chancellor ----------------- White Plains
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Director, Division of Occupational Education Instruction
Robert H. Bielefeld

Chief, Bureau of Trade and Technical Education
Carl G. Benenati
The course in Building Industries Occupations is concerned with seven of the major construction trades. Traditionally, each trade has been taught in some depth as a distinct, separate course, thus requiring an early choice by the student and restricting his field of employment. The Building Industries Occupations course will provide the student with basic knowledge and entry-level skills in each of the included areas, thus allowing a delayed and broadened choice of occupation.

During the summer of 1969 a curriculum writing committee composed of Allen Rowe, Ulster County BOCES, and Clinton Savoury, Putnam County BOCES, assisted and guided by Charles Stebbins, Associate, Bureau of Trade and Technical Education, prepared the course outline which was subsequently developed for publication by Joseph J. Messier, Associate in Vocational Curriculum.

The syllabus is organized in sections by trade area for more efficient use by those planning a Building Industries Occupations course, and in those programs utilizing a team of trade-specialist teachers. It is written in a manner calculated to aid the sole teacher of this multifaceted course formulating those areas of the course of study in which, although knowledgeable, he is not a specialist.

The content and format of this syllabus was so well accepted by occupational educators, within and without New York State, that the format was adopted for several subsequent curriculum publications, and this 1973 reprinting became necessary.

G. Earl Hay, Supervisor
Vocational Curriculum Unit
Bureau of Secondary Curriculum Development

Gordon E. Van Hooft, Director
Division of Curriculum Development
TO THE TEACHER

The Building Industries Occupations course is a 2-year program of approximately 160 three-period teaching days per year. The required course content is designed to be effectively taught in 80 percent of the total course time, thus allowing 20 percent of the time for instruction adapted to such local conditions as employment prospects, student ability and motivation, and physical plant characteristics. The 80 percent segment is subdivided to allot percentages of:

<table>
<thead>
<tr>
<th>Trade Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Work/Carpentry</td>
<td>40</td>
</tr>
<tr>
<td>Masonry</td>
<td>12</td>
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<tr>
<td>Electricity</td>
<td>15</td>
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<tr>
<td>Plumbing</td>
<td>10</td>
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<tr>
<td>Heating</td>
<td>12</td>
</tr>
<tr>
<td>Air Conditioner Installation</td>
<td>3</td>
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<tr>
<td>Painting/Decorating</td>
<td>8</td>
</tr>
</tbody>
</table>

The syllabus is organized in units by trade area, each unit containing a suggested average time to be devoted to those learning experiences. It is expected that some minor modification of the time allotments will be made in adapting the content to a specific teaching situation.

A three-column format is used, the first column of which is a content outline. The second column describes in performance terms the objectives of each unit of instruction. The final column suggests methods of presentation and of limiting the instruction to the scope of the course. Some of the expanded content is background or introductory information, included for use at the teacher's discretion, for motivational value, or for educating the more capable students who may wish to specialize in a particular trade.

The Objectives column is written to reflect this division of content. Those items titled "The student should:" are motivational, introductory, or informational in nature, or are prerequisite knowledge. Items titled "The student should be able to:" are required course content and are stated so that they describe a test of the student's entry-level ability.
The Information column identifies some additional content which should be reserved for presentation to those particular students who can benefit from the additional depth or breadth of instruction. This column also contains suggested methods of presentation which are included to stimulate and aid the teacher in devising effective methods. These suggestions should not be used in lieu of the teacher-prepared lesson plan; they should be carefully selected, adapted, or built-upon at the teacher's discretion.

The final pages of the syllabus contain a resource list of texts and references, films, filmstrips and transparencies organized by trade area, and a directory of sources of these materials.

This syllabus, like all syllabuses, presents required content in a logical progression, but not necessarily in a teaching sequence. It should serve well in guiding the individual teacher in formulating a course of study for his teaching situation, which will present the required content and such additional skills and knowledge as circumstances may warrant.

Carl G. Benenati, Chief
Bureau of Trade and Technical Education

Robert H. Bielefeld, Director
Division of Occupational Education Instruction
OBJECTIVES

In preparing this syllabus, three distinct groups of objectives were considered.

Planning
To provide to those planning a Building Industries Occupations course, the —
Scope of the course
Trade level of the course
Student level considered necessary for probable success in the course and in the trade
Instructor qualifications for teaching the course
Basis on which to tentatively estimate the nature and cost of facilities, equipment, and supplies

Teaching
To provide to those implementing a Building Industries Occupations course, aid in —
Establishing course content
Establishing the scope of the course
Forming a comprehensive method of teaching
Establishing the depth of instruction and the level of skill to be attained

Content
To prepare the student for entry-level employment in the building construction industry by aiding the student in —
Developing tool skills necessary for entry-level employment
Developing an awareness of the importance of good work habits and safe procedures
Preparing to adjust to employment conditions
Developing the personal and social qualities necessary for success in employment, and for being a well-adjusted member of a free society

To form the basis of the student's future advancement in the industry by —
Providing sufficient related information to enable the student to develop an attitude of self-reliance and initiative
Providing sufficient background information to enable the student to make sound trade judgments
Motivating the student to desire continual self-improvement
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOREWORD</td>
<td>iii</td>
</tr>
<tr>
<td>TO THE TEACHER</td>
<td>iv</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>vi</td>
</tr>
<tr>
<td>SYLLABUS</td>
<td></td>
</tr>
<tr>
<td>Site Work</td>
<td>1</td>
</tr>
<tr>
<td>Carpentry</td>
<td>4</td>
</tr>
<tr>
<td>Masonry</td>
<td>55</td>
</tr>
<tr>
<td>Plumbing</td>
<td>71</td>
</tr>
<tr>
<td>Heating</td>
<td>80</td>
</tr>
<tr>
<td>Electricity</td>
<td>86</td>
</tr>
<tr>
<td>Air Conditioner Installation</td>
<td>91</td>
</tr>
<tr>
<td>Painting and Decorating</td>
<td>98</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
</tr>
<tr>
<td>Books</td>
<td>108</td>
</tr>
<tr>
<td>Transparencies</td>
<td>112</td>
</tr>
<tr>
<td>Filmstrips</td>
<td>113</td>
</tr>
<tr>
<td>Sound Films</td>
<td>115</td>
</tr>
<tr>
<td>Source List</td>
<td>115</td>
</tr>
</tbody>
</table>
SITE WORK

I. BUILDING CODES — Suggested Time: 1 Day

A. Type
   1. State
   2. Local

B. Procedure
   1. Obtaining permits
   2. Inspections

II. BLUEPRINT READING — Suggested Time: 1 Day

A. Boundaries
   Be sufficiently familiar with residential blueprints to be able to locate thereon the land boundaries and the position of buildings and appurtenances.

B. Elevations
   1. Contour lines
      Understand the relationship of contour lines to lot topography.
   2. Bench mark
      Be acquainted with the relationship of the bench mark and construction elevations.
   3. Construction elevations

INFORMATION FOR THE TEACHER

The student should:

Be aware of the existence of regulatory codes, understand their purposes, and be acquainted with some inherent advantages and disadvantages.

The student should not be required to know code content.

Opaque projection of a plot plan, preferably in conjunction with individual student copies, is an effective teaching method.

Using an opaque projector, display exemplary sections of a code. Relate by use of anecdote.

The student should not be required to set or to figure elevations at this point.
III. SITE PREPARATION — Suggested Time: 5 Days

A. Lot lines
   1. Locating corner markers
   2. Setting lot lines

B. Clearing the site
   1. Marking and protecting trees to be retained
   2. Using the scrub axe
   3. Using the scrub sickle
   4. Using the chain saw
      a. Maintenance
      b. Safety
   5. Disposing of felled trees and brush

C. Setting primary building lines

D. Setting batter boards
   1. Function of batter boards

The student should be able to:
   Set lot lines to an accuracy of ± 1/2 inch, when given the plot plan of a quadrilateral lot, proper equipment, and preset mere stones.

The student should:
   Be acquainted with the fluorescent tapes used as markers. Understand the need to protect trees from damage to bark, limbs, and roots.

Demonstrate safe and proper use of site clearing tools and equipment.

Understand the relationship of tree shape to direction of fall.

Be aware of the possibility of local prohibitions on burning as a means of disposal.

Be aware of the necessity of maintaining at least the code minimum setback from the lot lines.

Build serviceable batter boards using supplied tools and materials, and emplace them properly in relation to building lines.

The teacher should be aware of the legal differences between vocational instruction and employment. He should periodically consult the current edition of "Laws Governing Employment of Minors in New York State."

The student's work should be judged on the basis of field standards for batter boards.

County Health Departments can provide rulings regarding areas within that county.
2. Construction and placement

E. Setting final building lines

1. Builder's transit
   a. Proper setup and maintenance
   b. Establishing 90° and 180° angles
   c. Simple elevations

2. Triangulation

3. Identical diagonals

4. Establishing line position on batter boards

**OBJECTIVES**

The student should be able to:

- Properly set up a builder's transit, leveling it to the inherent capabilities of the instrument.
- Make efficient use of the builder's transit in establishing angles of 180°, and of 90° left and right.
- Make efficient use of the builder's transit in establishing an elevation above and below the bench mark.
- Establish an angle of 90° at the intersection of building lines by using a tape measure to obtain multiples of units 3, 4, 5.
- Square-up the corners of a rectangle by using a tape measure to obtain diagonal measurements of 1/4-inch equality.
- Secure building lines in their final position on the batter boards, using personally selected tools.

**INFORMATION FOR THE TEACHER**

Accuracy should be stressed. Speed is of no importance since the student is demonstrating possession of know-how rather than skill.

One elevation above and one below the bench mark should demonstrate the student's ability to perform the proper arithmetical functions.

Overhead projection of overlays of successively larger 3, 4, 5 triangles may be successful. Stress use of the largest practical multiple in each case.

Overhead projection of two-color overlays of a rectangle and a rhomboid, each containing two diagonal lines, will demonstrate the relationship.

Emphasize unsuitability of pencil marks and nails in retaining the final position of the lines on the batter boards.
CONCRETE FORMS — Suggested Time: 4 Days

A. Footing

1. Definition of footing
   a. What it is
   b. Where it is
   c. Why it is needed

The student should be able to:
   Identify footings as depicted in sketches, blueprints, and sectional drawings supplied to him.

2. Definition of pressure
   a. What it is
   b. How it is calculated

The student should:
   Demonstrate an understanding of pressure as weight on a surface of specified size (force per unit area).
   Demonstrate an understanding of area measure, as related to linear measure.

CARPENTRY

OBJECTIVES

The student should:

The student should be able to:

OBJECTIVES

INFORMATION FOR THE TEACHER

The symbols for footings and for poured concrete should be learned through repeated use of blueprints and other visuals.

Compare the bearing strength of several soils and rock strata.

INFORMATION FOR THE TEACHER

Pressure may be more easily understood by use of comparisons:

A heavy, sharply-pointed knife is placed, handle down upon the palm of the hand. No injury results. However, if the same knife, evidently weighing the same, was so placed on its point the skin would be penetrated.

A student steps into deep snow, sinking to his waist. The same student dons skis or snowshoes and, although now heavier, does not sink.
**CONTENT**

3. How a footing functions

4. Types of footing forms
   a. Job built
   b. Prefabricated

5. Form materials
   a. Plank
   b. Panel
   c. Hardware

6. Construction
   a. Placing components
   b. Maintaining dimensions
   c. Bracing
   d. Keyways
   e. Leveling, plumbing, straightening

**OBJECTIVES**

The student should be able to:

- Figure soil pressure in tons per square foot, to an accuracy of ± 5 percent, when given the size of the building, the width of the footing, and the total dead weight.

- Identify by name and function, the standard parts of a footing form as shown on a pictorial drawing.

- Build a plank footing form using personally selected tools and materials, and conforming to a supplied plan.

- Explain the need for, and the function of, keyways.

The student should:

- Be acquainted with the various materials, both rough and commercially prepared, which are available for constructing footing forms.

- Be aware of the need for maintaining exact dimensions, and of building all forms level, plumb, and straight.

The student should:

- Be aware of the need for maintaining exact dimensions, and of building all forms level, plumb, and straight.

**INFORMATION FOR THE TEACHER**

Accuracy in computing pressure is important only insofar as this exercise aids the student in understanding the function of the footing.

Opaque projection of working drawings and jobsite photographs of the various form materials is of value.

Quality of work should be judged by field standards. Time should be appropriate to existing conditions.

Cut two thin sections from the end of 1-inch S4S stock, and two from 1-inch T&G. Manipulate in an opaque projector to illustrate the function of a keyway.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7. Estimating quantities</strong></td>
<td>The student should be able to: Estimate to an accuracy of -0 to +20 percent, the materials needed to build footing forms of given dimensions.</td>
<td>It is important that the student acquire an insight as to the procedures used in estimating materials. It is not necessary that he, at this level, be capable of performing the functions.</td>
</tr>
<tr>
<td><strong>8. Removing the forms</strong>&lt;br&gt;a. Stripping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Cleaning for reuse</td>
<td>The student should: Be aware of the reusability of most of the form materials, and thus, the need for careful removal.</td>
<td></td>
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<tr>
<td>c. Safety</td>
<td>Be aware of the hazards inherent in neglecting to immediately remove nails and neatly pile the material.</td>
<td>While there must be continual emphasis on safety, overemphasis can produce a negative reaction.</td>
</tr>
<tr>
<td><strong>B. Slabs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Setting form sides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Reinforcement</strong>&lt;br&gt;a. Why it is needed</td>
<td>Be aware of the low tensile strength of concrete, and the high tensile strength of steel.</td>
<td>Be sure that the student understands the meaning of tensile strength, coefficient of expansion, and alkaline. Use the commonplace as examples.</td>
</tr>
<tr>
<td>b. How it works</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Materials&lt;br&gt;1) Rods&lt;br&gt;2) Net</td>
<td>Be aware of the identical coefficient of expansion of the two materials. Be aware of the completely rust-preventative nature of the alkalines in concrete.</td>
<td></td>
</tr>
</tbody>
</table>
CONTENT

3. Screeds  
   a. Function of screeds  
   b. Materials  
   c. Setting  
   d. Selecting a straight-edge  
   e. Removing screeds

OBJECTIVES

The student should be able to:

- Emplace screeds to a correct height, strength, and straightness, using personally selected tools and materials.
- Select and prepare a usable straight-edge. Demonstrate knowledge of correct removal procedure.

INFORMATION FOR THE TEACHER

The balance between required rigidity and easy removal should be emphasized.

II. LUMBER — Suggested Time: 1 Day

A. Dimension materials

1. Preferred species

   List the three chief species of DIM lumber, and the properties of each.

The student should:

- Recognize the difference between the nominal and actual sizes of DIM lumber.

2. Sizes
   a. Nominal
   b. Actual

Be aware of the existence of grades of lumber, the defects involved in grading, and the relationship of grade to use.

The student should understand why grading is needed, but should not be required to recognize the grade of specimen pieces.

3. Grades
4. Board measure

The student should:
Be aware of the difference between board measure and cubic measure.

The student should be able to:
Determine the board footage of a supplied list of DIM lumber.

B. Sheathing

1. Boards
   a. Species
   b. Sizes
   c. Types

   State the three purposes of sheathing. Identify boards as being S4S, shiplap, or T&G. Properly sheath a section of deck, using supplied material and personally selected tools and fasteners.

   The student should:
   Be acquainted with the various species, sizes, types, and grades of deck sheathing panel materials, and the properties and uses of each.

2. Plypanels
   a. Sizes
   b. Types
   c. Grades

   Be acquainted with the various species, sizes, types, and grades of deck sheathing panel materials, and the properties and uses of each.

III. PLATFORM FRAMING — Suggested Time: 15 Days

A. Sills

1. Function of sills

   Be acquainted with the standard materials used for sills, and the common methods of construction.

2. Materials

   Emphasize the necessity of selecting a sill width sufficient to cover the holes in concrete block where termite block cap is not used.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Installation</td>
<td>The student should be able to:</td>
<td>Emphasize necessity of placing each hole exactly, and boring perpendicular to the sill face.</td>
</tr>
<tr>
<td>a. Anchor bolts</td>
<td>Properly secure nailing blocks in a concrete block foundation wall, using personally selected tools and materials.</td>
<td>An effective teaching aid consists of two sets of two 1 x 4 boards prepared for face dowel jointing. One set is properly done; the other contains dowels and holes which are out-of-position, or off-angle.</td>
</tr>
<tr>
<td>b. Nailing blocks</td>
<td>Correctly lay out and secure sills to the nailing blocks, using personally selected tools and fasteners.</td>
<td>Transparencies and transparency masters for overhead projection, presenting both function and form of girders, are available from several commercial suppliers.</td>
</tr>
<tr>
<td>B. Girders</td>
<td>Correctly lay out and bore sills to be secured to an existing anchor-bolted foundation wall, using personally selected tools.</td>
<td></td>
</tr>
<tr>
<td>1. Function of girders</td>
<td>The student should:</td>
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<tr>
<td></td>
<td>Understand the function of a girder as a joist support.</td>
<td></td>
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<tr>
<td>2. Types</td>
<td>Be acquainted with the standard types of residential girders, and with the relative strengths and weaknesses of each.</td>
<td></td>
</tr>
<tr>
<td>a. Steel</td>
<td></td>
<td></td>
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<tr>
<td>b. Built-up wood</td>
<td></td>
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</tr>
<tr>
<td>CONTENT</td>
<td>OBJECTIVES</td>
<td>INFORMATION FOR THE TEACHER</td>
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<tr>
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</tr>
<tr>
<td>3. Fabricating a built-up beam</td>
<td>The student should: Be aware of the necessity of placing all joints over a supporting column, and of alternating joints and solid timber to reduce lateral deflection. Be aware of the necessity of placing all components so that the crowns lie in the same direction.</td>
<td>Bench demonstration: Using 1/8-inch rippings of 5/4-inch pine, and 1/4-inch dowels, construct a scale, 4-member, built-up beam.</td>
</tr>
<tr>
<td>a. Correct spacing of joints</td>
<td></td>
<td></td>
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<tr>
<td>b. Correct placing of crowned material</td>
<td></td>
<td></td>
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<tr>
<td>c. Nails and nailing</td>
<td>The student should be able to: Assemble to field standards the supplied components of a built-up beam, using personally selected tools and fasteners.</td>
<td></td>
</tr>
<tr>
<td>4. Installing the girder</td>
<td>The student should: Be aware of such basic principles of safe scaffold construction as maintaining level and plumb, and properly cross-bracing. Be acquainted with the properties of preferred materials and fasteners.</td>
<td></td>
</tr>
<tr>
<td>a. Scaffolding</td>
<td>The student should be able to: Properly erect a horse scaffold which will comply with section 23.19 of Industrial Code Rule 23, New York State Labor Department. Construct from supplied material, a rigid and well-braced, double-post scaffold which will conform to requirements of State Labor Department.</td>
<td></td>
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<tr>
<td>1) Double post</td>
<td></td>
<td></td>
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<tr>
<td>2) Horse and plank</td>
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<td></td>
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<tr>
<td>CONTENT</td>
<td>OBJECTIVES</td>
<td>INFORMATION FOR THE TEACHER</td>
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<tr>
<td>b. Beam pockets</td>
<td>The student should: Be aware of the necessity of preventing direct contact between masonry and a wooden beam. Be acquainted with the standard methods of preventing direct foundation/beam contact.</td>
<td></td>
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<td></td>
<td>The student should be able to: Select, measure, cut, and assemble with personally selected tools and fasteners, the 2 x 4 &quot;T&quot; posts needed to fit a described position.</td>
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<tr>
<td>c. Temporary posts</td>
<td>The student should: Be aware of the hazards in placing primary strain on other than the leg and arm muscles when moving heavy objects.</td>
<td></td>
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<tr>
<td>d. Body mechanics</td>
<td>The student should be able to: Select and properly use the tools and equipment necessary for the block-and-line method of straightening and bracing a girder.</td>
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<tr>
<td></td>
<td>The student should: Be acquainted with the types of columns available, and with the sizes, properties, and uses of each.</td>
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<tr>
<td>5. Straightening and bracing</td>
<td>Shop demonstration: Have students supply a dry piece of softwood (publicly check its moisture content with a meter, if possible). Place the wood on a water-soaked concrete block for several hours. Demonstrate that the moisture content has increased beyond the 20 percent decay point.</td>
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<td>Shop demonstration: Using such common items as concrete block, 50-pound boxes of nails, and 94-pound sacks of cement, demonstrate the proper manner of lifting and pushing.</td>
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<tr>
<td>C. Columns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Adjustable</td>
<td></td>
<td></td>
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<tr>
<td>b. Fixed</td>
<td></td>
<td></td>
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</tbody>
</table>
2. Installation
   a. Connection to girder
   b. Contact with pad

D. Sill header

1. Layout for joists
   a. Standard
   b. Allowance for joist by-passing
   c. Allowance for centering plypanels
   d. Doubling joists under partitions
      1) Full contact
      2) Spacer blocks
   e. Framed openings
      1) Trimmers
      2) Headers
      3) Tail joists

The student should be able to:
Select the required tools, and properly align, plumb, and secure in place the type column supplied.

The student should:
Be acquainted with the standard on-center spacing for joists.
Be aware of the need to set back the first space to provide for overlapping the joists and centering plypanel decking.
Be acquainted with the method of framing under partitions, of framing openings in the floor, and with the terminology involved.
Select and lay out sill headers for correct placement of joists, doublings, and framed openings as indicated on a supplied plan.

Printed masters and/or transparencies for overhead projection, which should be of assistance in teaching theory and practice of floor framing, are available from several commercial suppliers.

Several cardboard "plypanels," scaled 1 inch = 1 foot, freely superimposed in an opaque projector on a joist layout of equal scale, should aid in presenting this material.

Teach use of the square in "picking-up" the layout on successive headers, in order to avoid arithmetic error.
2. Installation
   a. Crown direction
   b. Nailing

E. Joists
   1. Selection
   2. Installation
      a. Crown direction
      b. Straightening the header
      c. Nailing
   3. Ledger boards and joist hangers

The student should:

- Be aware of the necessity of setting all components "crown up."
- Be aware of the temporary nature of nailing done at this point.
- Be acquainted with sizes, graces, and species of lumber appropriate to this use.
- Be aware of the need for squaring the end which contacts the header.

The student should be able to:

- Select and properly use the equipment necessary to straighten the headers by the block-and-line method.
- Select and properly use the correct fasteners in nailing the platform framing permanently in place.
- Be aware of the need for ledger boards and joist hangers.
- Be acquainted with the relative values of ledger boards and joist hangers.

Emphasize the reduced strength of the ledger board system due to the eventual splitting of the notched timbers.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>F. Bridging</td>
<td>The student should: Be acquainted with the purpose of bridging and the manner in which it fulfills its purpose.</td>
<td>Bench demonstration: Tie several hardwood dowels into a secure bundle. Demonstrate their shear resistance. Untie the bundle and break one of the dowels. Diagram the cross section of several joists tied with cross-member bridging. Show the distribution of forces acting on one joist. Project by either method.</td>
</tr>
<tr>
<td>1. Function of bridging</td>
<td>Be acquainted with the types of bridging, bridging materials, and the relative values of each.</td>
<td></td>
</tr>
<tr>
<td>2. Types</td>
<td>Be acquainted with the use of the framing square in laying out bridging.</td>
<td>Bench demonstration: On chalkboard draw a cross section view of two 2 x 8 joists, 16 inches OC. Demonstrate use of the square in laying out bridging. Deliberately lay out with cut-points on the same side of stock. Show lack of fit. Discuss cause. Rework correctly, demonstrating proper fit.</td>
</tr>
<tr>
<td>a. Crossmember</td>
<td>Be acquainted with standard methods of cutting bridging, both with handsaws and portable power saws.</td>
<td></td>
</tr>
<tr>
<td>1) Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Metal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Solid block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Fabricating cross-member bridging</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CONTENT

OBJECTIVES

The student should be able to:
Lay out the length and angles of bridging for a given floor, using the framing square and material supplied; build a jig for cutting the bridging with a handsaw; produce a given number of pieces in an appropriate length of time.

The student should:
Be acquainted with the regulations and practice regarding the placement of bridging.

The student should be able to:
Properly place a line to guide the installation.

Properly prenail bridging, using personally selected fasteners.

Properly secure the bridging in place.

G. Subflooring

1. Aligning and bracing joists

Properly align and brace the floor joists, using personally selected tools and materials.

INFORMATION FOR THE TEACHER

Shop demonstration:
Build a jig and cut a number of bridging. Properly prenail and stack in "squares."

Emphasize nailing only at the top of each piece, at this point. Explain when the bottoms are nailed, and why that is delayed.

The student should understand the present and future difficulties which may arise from neglecting to straighten the joists before installing the subflooring.
CONTENT

2. Installation of board subfloor
   a. Materials
   b. Angled run
   c. Cutting and nailing
   d. Pulling-up crowned boards

OBJECTIVES

The student should:

Be acquainted with the purposes of subflooring. Be aware of the benefits of running the boards at 45° or 30° to the header, rather than at 180°.

Be aware of the necessity of cutting the ends of each board to fully bear on a timber, and of "staggering" the joints.

Be acquainted with the methods of straightening crowned boards.

The student should be able to:

Recognize such standard subflooring materials as S4S, shiplap, and T&G.

Install a section of supplies subflooring, using personally selected tools and fasteners.

INFORMATION FOR THE TEACHER

Bench demonstration:

Construct a scale joist and header model. Use 1/2-inch brads to fasten several 1/16 x 3/4 pine rippings at 90° to the joists. Place sufficient pressure against one corner to "rack out-of-square." Remove the rippings, resquare the frame, and replace the rippings at 45° or 60° to the joists. Demonstrate the greatly increased force required for "racking."

Shop demonstration:

Lay a section of shiplap or T&G, showing both the cutting and nailing methods of "pulling-up" crowned boards.

The student's work should be judged by field standards.
### CONTENT

3. Installation of Plypanel subfloor  
   a. Materials  
   b. Joints  
   c. Guideline  
   d. Nailing  

II. Estimating quantities

### OBJECTIVES

The student should:

- Be acquainted with the properties of the types, grade, and sizes of plywood sheathing.
- Be aware of the variety of suitable fasteners available.
- Be aware of the necessity of "staggering" end joints.

The student should be able to:

- Lay out and snap a chalkline guide.
- Emplace and correctly nail a section of plywood deck sheathing, using provided tools and materials.
- Be acquainted with the methods of estimating quantities of materials to be needed.

### INFORMATION FOR THE TEACHER

To improve hammer skill supply only box nails. Do not introduce stapling/nailing machines at this point.

Proficiency in performing the arithmetic functions involved should not necessarily be required of every student.

### IV. WALL FRAMING — Suggested Time: 7 Days

A. Shoe and plates

1. Layout  
   a. Standard stud spacings  
   b. First space adjustment  

   Be aware of the necessity of maintaining standard stud spacing.

   Be aware of the need to adjust the size of an initial space.
c. Corner posts
   1) Function of corner posts
   2) Methods of assembling corner posts

d. Framed openings
   1) Jack studs
   2) Cripple studs

OBJECTIVES

The student should be able to:

Use a framing square to lay out a section of shoe and plate for studs 16" OC, to a maximum cumulative error of ± 1/4-inch over 50 feet.

The student should:

Be acquainted with the purpose of corner posts.

Be acquainted with the several common methods of framing corner posts.

Properly select, measure, cut, and assemble the components of a specified style corner post.

Be acquainted with the function of jack studs and with their proper number and placement.

Be aware of the necessity of continuing the OC stud spacing through the cripple studs.

Be acquainted with the terminology involved.

Correctly lay out a framed opening on the shoe and plate, maintaining a given R.O.

INFORMATION FOR THE TEACHER

A tape measure should be used to check the layout for conformity to several 8-foot modules.

Overhead projection of a cross-section of different corner posts, with overlay of plate position should effectively demonstrate the function of corner posts.
B. STUDS

1. Cutting to Length
   a. Deriving stud length from ceiling height
   b. Cutting to length
      1) Multiple stud jigs
      2) Safe and proper use of the portable electric saw

2. Selection
   a. Separation of straight and crooked studs
   b. Methods of stacking

The student should be able to:

Obtain the stud length correct to ± 1/8-inch from the specified finished ceiling height.

Construct a jig capable of accurately cutting to length at least eight studs at one time.

Cut studs to length by safe and proper use of a jig and portable electric saw.

The student should:

Be aware of the reasons for separating the straight studs from the crooked studs, and of the lack of a standard for classification.

Be acquainted with the method of stacking studs to prevent warpage and reduce moisture absorption.

CAUTION! By its very nature — light, compact, high-speed operation, restrained only by the hand of the operator — the portable electric saw is one of the most dangerous carpentry tools. Its use by students should be only under direct and close supervision.

Class supply of DIM lumber should be a continual demonstration of proper stacking.
CONTENT

C. Framed openings

1. Location
   a. Center to center
   b. Edge to edge

2. Size
   a. Blueprint schedules and specifications
   b. The mill book

3. Lintels
   a. Types
   b. Sizes

D. Fabrication

OBJECTIVES

The student should:
Be aware of the existence of two methods of dimensioning framed openings.

The student should be able to:
Determine the correct location and dimensions of a framed opening from information provided in blueprints and the local mill book.

The student should:
Be acquainted with the standard methods of framing lintels, and the relative qualities of each.
Be aware that lumber expands and contracts most across the width of a board, and negligibly along the grain.

The student should be able to:
Measure and cut to an accuracy of ± 1/8-inch, and properly assemble the components of a given type lintel, using personally selected tools and fasteners.

INFORMATION FOR THE TEACHER

Masters and/or transparencies for projection, and residential blueprint reading texts with coordinated blueprints, are available from several commercial suppliers.

Opaque projection of appropriate pages of the mill book should aid in explaining its use.

Emphasize: Lintel length = R.O. + (stud thickness x number of jack studs).

The teacher should be prepared to explain this characteristic of wood as an effect of its fibrous construction. Multi-color charts are available from several lumber and paper producing corporations.

The student should be acquainted with all of the several methods of fabricating lintels, but ability should be judged on fabrication by the method favored in the employment area.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
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</tr>
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<tbody>
<tr>
<td>4. Jack studs</td>
<td><strong>The student should be able to:</strong> Measure and cut jack studs to an accuracy of ± 1/16-inch.</td>
<td>Reuse of the explicatory demonstration of pressure (Carpentry, 1-A-2, Information) should aid the student in understanding the need for more surface contact of jack studs and long lintels.</td>
</tr>
<tr>
<td>a. Correct length</td>
<td>Determine from the R.O. dimensions the number of jack studs required. Properly install jack studs using personally selected tools and fasteners.</td>
<td></td>
</tr>
<tr>
<td>b. Correct number</td>
<td>Fit and install the sill and cripple studs, using personally selected tools and fasteners.</td>
<td></td>
</tr>
<tr>
<td>5. Sills and cripple studs</td>
<td></td>
<td></td>
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<tr>
<td>E. Corner posts</td>
<td><strong>The student should:</strong> Be acquainted with the methods of estimating the quantities of materials needed to frame the walls.</td>
<td>The teacher must exercise judgment regarding student ability to estimate amounts of materials. While above entry level, proficiency in estimating should be developed in those students who may profit thereby.</td>
</tr>
<tr>
<td>1. Sizes</td>
<td>Measure and cut to an accuracy of ± 1/16-inch, and properly assemble a specified type corner post, using personally selected materials, tools, fasteners.</td>
<td></td>
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<tr>
<td>2. Fabrication</td>
<td></td>
<td></td>
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<tr>
<td>F. Estimating materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Assembling wall sections</td>
<td>Be aware of the advantages in placing all studs with crowns up.</td>
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</tr>
<tr>
<td>CONTENT</td>
<td>OBJECTIVES</td>
<td>INFORMATION FOR THE TEACHER</td>
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<tr>
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<tr>
<td>2. Nails and nailing</td>
<td>The student should: Be acquainted with the various fasteners and methods of fastening.</td>
<td></td>
</tr>
<tr>
<td>3. The doubled plate</td>
<td>The student should be able to: Properly fabricate a wall section from supplied components, using personally selected tools and fasteners.</td>
<td>Emphasize the increased strength obtained by: (A) overlapping the double plate at corners, and (B) eliminating &quot;knee action&quot; by properly spacing joints in line.</td>
</tr>
<tr>
<td>a. Backset for overlap at intersecting walls</td>
<td>Be aware of the function of the double plate, and the proper placing of joints in relation to joints in the plate below it.</td>
<td></td>
</tr>
<tr>
<td>b. Proper spacing of joints</td>
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</tbody>
</table>

H. Erecting and bracing walls

1. Snapping chalk guidelines | Lay out the position of the wall shoe, using either chalkbox or chalk and line, and a personally selected measuring device. | The student should be instructed in the finer points of wall erecting: Using a block of shoe material to establish the position of the inside of the wall. |
2. Tacking stop blocks to box frame | | |
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
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</tr>
</thead>
<tbody>
<tr>
<td>3. Securing brace blocks to deck</td>
<td>The student should be able to: Properly prepare a section of wall for erecting.</td>
<td>Raising the wall top onto blocks to provide handholds for erecting the wall.</td>
</tr>
<tr>
<td>4. Body dynamics - lifting</td>
<td>The student should: Be aware of the proper method of lifting heavy objects, and of the injuries probable if the proper method is not adhered to.</td>
<td></td>
</tr>
<tr>
<td>5. Nails and nailing</td>
<td>Be acquainted with the methods of preparing a straightedge for plumbing walls.</td>
<td></td>
</tr>
<tr>
<td>6. Plumbing and bracing</td>
<td>Be aware of the correct angles at which braces should set.</td>
<td>Bench demonstration: Clamp a 2 x 4 - 3(^\circ) to the bench. Using one 16d common nail at each point, form a triangle by nailing a 2 x 4 - 45(^\circ) to the end of the clamped piece, and to the end of another 2 x 4 - 45(^\circ). Do not nail the third joint. Keeping the third 2 x 4 perpendicular, move it along the clamped piece to set the &quot;brace&quot; at angles of 30(^\circ), 45(^\circ), and 60(^\circ), to the &quot;shoe.&quot; Demonstrate the brace strength of each angle by placing pressure against the top of the &quot;wall.&quot;</td>
</tr>
<tr>
<td>a. Making a straightedge</td>
<td>The student should be able to: Select and prepare to wall plumbing standards, a straightedge of specified type, using personally selected tools. Plumb a corner post or wall to the inherent accuracy of the equipment, using straightedge and carpenter's spirit level.</td>
<td></td>
</tr>
</tbody>
</table>
I. Straightening walls

1. Method of checking
   *The student should be able to:* Use line and blocks to check straightness.

2. Method of straightening
   Straighten a wall top, using pinch bar and planks.

J. Corner backing

1. Function
   *The student should:* Be aware of the need for backing all inside corners.

2. Methods and materials
   Be acquainted with the standard methods of backing inside corners.

   *The student should be able to:* Recognize the need for backing, determine the method to be used, select the proper materials, and install the backing to field standards.

V. SHEATHING — Suggested Time: 2 Days

A. Types

1. Plywood

   Recognize the common wall sheathing materials in a representative supply.

Transparencies and transparency masters for projecting sketches of standard methods of backing corners are available from several commercial suppliers.
CONTENT

2. Boards
3. Insulating board

OBJECTIVES

The student should:

B. Sizes, grades, and properties
   1. Tensile strength
   2. Compression strength
   3. Insulating value

The student should:
   Be acquainted with the standard sizes and grades of sheathing materials.
   Be sufficiently acquainted with the properties of each material to be aware of their relative advantages in use.

C. Methods of application

Be acquainted with the accepted methods of applying each sheathing material.

D. Nails and nailing

Be acquainted with the methods of estimating needed quantities of each sheathing material.

E. Estimating quantities

The student should be able to:
   Estimate to an accuracy of ± 10 percent, the amount of plywood/insulating board needed to sheath the walls of a given house.
   Lay out and properly install a given type sheathing, using personally selected tools and fasteners.

INFORMATION FOR THE TEACHER

The student should begin to retain knowledge of the available sizes, grades, and materials.

Relevant, commonplace comparisons should be used in explaining tensile and compression strengths.

The student should begin to show competency in estimating quantities of panels needed to sheath a rectangular building.
VI. SCAFFOLDING — Suggested Time: 3 Days

**CONTENT**

A. Types

1. Double post
2. Single post
3. Wall bracket
4. Tubular frame

B. Construction

1. Base preparation
2. Assembly
3. Plumb and level
4. Nails and nailing
5. Safety

**OBJECTIVES**

The student should:

- Be acquainted with the construction details of the common varieties of scaffolding.
- Be acquainted with the suitabilities of particular types of scaffolding.
- Be aware of the necessity of placing the scaffolding on firm, level ground.
- Be aware of the critical need for maintaining plumb and level.
- Be acquainted with the special fasteners available, especially duplex-head nails.
- Be acquainted with specific applications of general safety rules.

**INFORMATION FOR THE TEACHER**

- Explain the superiority of spruce as scaffold planking.
- Carpenter/Laborer union jurisdiction regarding tubular frame scaffolding should be mentioned.
- Demonstrate results of lateral deflection induced by out-of-plumb supports.
CONTENT

The student should be able to:

Construct a given type scaffold from personally selected components, using personally selected tools and equipment. The completed scaffold shall in all ways conform to Section 23.12, 23.13, and 23.20 of Industrial Code Rule 23.

VII. CEILING JOISTS — Suggested Time: 3 Days

A. Layout on wall double-plate

B. Securing joists in place
   1. Crowns
   2. Nails and nailing

C. Align and brace

Demonstrate those competencies acquired in installing floor joists, which are applicable to ceiling joists.

Straighten the joists "by eye," and correctly tie them with materials of his own selection, or —

Straighten and tie the joists, and measure, cut, and install bridging, using personally selected materials, tools, and equipment.

OBJECTIVES

INFORMATION FOR THE TEACHER

A current copy of Industrial Code Rule 23 can be obtained from:
State of New York
Department of Labor
Board of Standards and Appeals
11 North Pearl Street
Albany, New York 12207
### VIII. ROOF FRAMING — Suggested Time: 11 Days

**A. Types of roofs**

1. **Shed**
2. **Gable**
3. **Hip**
4. **Gambrel**
5. **Dormer**
6. **Combinations**

**B. Terminology**

1. **Roof**
   a. **Span**
   b. **Run**
   c. **Rise**
   d. **Pitch**

**The student should be able to:**

- Recognize, and clearly describe and sketch, the common styles of roof construction.
- Demonstrate an understanding of terminology by correctly matching the terms to definitions or to indicated areas of a sketch.
- Figure the rise of the roof when given the span and the pitch, whether pitch is given as $P = \frac{R}{S}$ or

---

**Opaque projection** of photographs, sketches, plan views, and overhead projection of handmade or commercially available transparencies should be valuable.

Pine blocks approximately $3 \times 5$ can be shaped to the contours of the common roof types and used as models.

The teacher should provide continual restatement of definition of terms as the terms are used in teaching this segment. He should, however, devise different approaches to restatement in order to prevent lack of attention due to boredom.
CONTENT

2. Rafter
   a. Line length
   b. Seat cut
   c. Ridge cut
   d. Cheek cut
   e. Overhang
   f. Projection

C. Types of rafters
   1. Common
   2. Hip and valley
   3. Jack
   4. Cripple

D. The rafter square
   1. Nomenclature
   2. Using the rafter tables

OBJECTIVES

The student should be able to:

Indicate on a provided sketch, the proper term for each part of a hip jack rafter.

The student should:

Be sufficiently acquainted with the four types of rafter to locate the position of each in the roof framing, and describe the inherent physical differences.

Be aware of the different dimensions of the body and blade of the square, and of the variety of scales thereon.

Be acquainted with the tables inscribed on the square.

The student should be able to:

Compute to an accuracy of \( \pm \frac{1}{4} \)-inch the line length of a common rafter, using the rafter tables and a given span and pitch.

INFORMATION FOR THE TEACHER

Transparencies and transparency masters for projection are available from several commercial suppliers.

A scale roof frame containing an example of each type rafter should be a useful teaching tool.

The advantages of the 12ths scale should be emphasized.

The seldom used board measure, brace, and octagon scales should merely be identified and explained.
The student should be able to:
Comput to an accuracy of ± 1/4-inch the line length of a hip rafter.

So compute the line length of any specific jack rafter.

E. Laying out a rafter

1. Finding the rise and run
2. Finding the line length
   a. Rafter tables
   b. Triangulation
   c. Stepping-off

Determine the line length of a rafter from a given span and pitch, using each of the three methods.

The student should:
Be aware of the efficiency and accuracy limitations of each method.

Bench demonstration:
Triangulation - Let a number on the body of the square represent the run, and a number on the blade represent the rise. Place the square on a straightedge running through these numbers, marking both arms of the square. Using the 12ths scale, measure between the marks. Consider 1 inch = 1 foot. This is the line length of a rafter.

line length

rise

run
3. Finding the angles of cuts
   a. Ridge cut
   b. Seat cut
   c. Cheek cut

   **OBJECTIVES**

   **The student should:**
   Be acquainted with both the rafter table, and "intersection" methods of establishing the angle of cheek cuts.

   **The student should be able to:**
   Lay out to an accuracy of ± 1/16-inch the angles of ridge cuts, seat cuts, and cheek cuts.

   **INFORMATION FOR THE TEACHER**

   Bench demonstration:
   Cheek angle - On the face of a length of rafter stock, lay out the angle of the ridge cut (A). Place a piece of the same thickness "on edge" against the line. Draw a line along the opposite side of this piece (B). Square both lines across the edge of the rafter (C). Draw a diagonal between appropriate corners. This "intersection" is the correct angle for the cheek cut (D).
CONTENT

4. Allowing for ridge board

5. Laying out the overhang

6. Backsetting a hip rafter

F. Cutting a rafter

1. Setting crown direction

OBJECTIVES

The student should be able to:

Properly cut back for half the thickness of the ridgeboard ± any error in the length and/or angle of cut.

Lay out a rafter overhang which will continue the pitch to within ± 1/2-inch of specified projection.

Backset or relieve a hip rafter sufficiently to maintain a flat plane across the upper edges of adjacent rafters.

Emphasize the relationship of the overhang/projection to rafter/ run, as that of proportional triangles. Angles/cut points are constant; only lengths change.

INFORMATION FOR THE TEACHER

line length

overhang

projection

run
<table>
<thead>
<tr>
<th>CONTENT</th>
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<tbody>
<tr>
<td>2. Safe and proper use of the portable saw</td>
<td><strong>The student should:</strong>&lt;br&gt;Be aware of the inherently hazardous nature of portable electric saws.&lt;br&gt;&lt;br&gt;<strong>The student should be able to:</strong>&lt;br&gt;Recognize the type saw blade required, and select, from a supply of the four common types, a properly set and sharpened blade of the correct type.</td>
<td>Stress the need for a clean, uncluttered, dry work area; correct power supply and leads; sharp, properly-set blades of the correct type; properly functioning blade guards; and secure lumber supports. Emphasize the wisdom of un-failing use of eye protectors and other safety devices.</td>
</tr>
<tr>
<td>a. The job site</td>
<td>Be acquainted with all safety regulations regarding the portable electric saw, its power supply, and the work area.</td>
<td>The student should be acquainted with job-built jigs which enable portable saws to bevel beyond 45° for making cheek cuts.</td>
</tr>
<tr>
<td>b. The saw blade</td>
<td></td>
<td>The student should not only know that rafter stock should be layed out &quot;crown up,&quot; he should understand why. He should know that the pattern must be held on the stock so that the edges coincide at ridge cut and seat cut.</td>
</tr>
<tr>
<td>c. The electricity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cutting and checking a pattern</td>
<td>Prepare the work area, check and set up the saw, and properly cut a rafter, assiduously observing all safety rules and procedures.</td>
<td></td>
</tr>
<tr>
<td>4. Cutting duplicate rafters</td>
<td>Make use of the prepared pattern in fabricating the additional rafters needed.</td>
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</tbody>
</table>
CONTENT

G. Laying out a ridge board
   1. Standard rafter spacings
   2. Adjustment of initial space
   3. Framed openings
      a. Dormer
      b. Chimney

H. Fabricating a roof
   1. Securing rafters to a ridge section
   2. Raising the section
   3. Securing rafters to the plate
   4. Plumbing and bracing the section
   5. Filling in remaining rafters

OBJECTIVES

The student should:

- Be aware that the ridgeboard material must be wider than the rafter stock.
- Be aware that rafter layout usually follows that of the ceiling joists.
- Be aware of the necessity of making the chimney rough opening 3 inches larger than the actual dimensions of the chimney.
- Be acquainted with the method of raising sections of roof frame.
- Be aware of the need to alternate sides of the ridge after emplacing no more than four successive rafters.

INFORMATION FOR THE TEACHER

Make a ridgecut on a length of DIM material. Place a block of the same material in the position of the ridgeboard, keeping the tops even. Describe the results of leaving the rafter ends partially unsupported.

Explain the difficulty in removing the lateral deflection in the ridgeboard which is induced by many rafters being emplaced on one side at a time.
The student should be able to:
Lead a peer group in assembling, raising, plumbing, and bracing a section of roof frame, using personally selected tools and equipment.

I. Cable ends

1. Laying out stud location
   Lay out stud location to an accuracy of ± 1/8-inch on 8-foot modules.

2. Using a story-pole to measure stud lengths
   Use the 2 x 4 and spirit level to obtain the lengths and cut of a number of gable studs.

3. Nails and nailing
   Stud-up a gable using personally selected tools and fasteners, maintaining the longitudinal straightness of the end rafter.

Emphasize the "fool-proof" nature of this method of transmitting lengths from measurer to sawyer.

The student should:

J. Collar beams

1. Function
   Be aware of the purposes of collar beams, and their location in the roof framing.

2. Materials
   Be acquainted with the materials commonly used for collar beams.

3. Locating
   a. Height
   b. Spacing

The student should be able to:
Properly install a set of collar beams, working alone and as a team leader, using personally selected tools and equipment.

The student should be acquainted with the making and use of an "old man."

35
K. Sheathing

The student should be able to:
Correctly sketch or describe the common types of roof sheathing, and select a given type from a representative sample group.

L. Estimating materials

Estimate to the degree of accuracy standard for each material, the amounts needed for the described area.

IX. EXTERIOR FINISH — Suggested Time: 23 Days

A. Cornice

The student should:
Be acquainted with the common styles of cornice.

1. Types
   a. Open
   b. Box

Be acquainted with the common materials used in cornices.

Opaque projection:
In estimating gable-end sheathing, cut a scale gable end from construction paper. Cut again on the rise line and join the pieces at the hypotenuses to demonstrate that a rectangle can be formed. Therefore, \( \text{run} \times \text{rise} = \text{area} \).
2. Building a box cornice
   a. Nomenclature
   b. Materials
      1) Type
      2) Quantities
   c. Fabrication
      1) Leveling and straightening
      2) Rake intersection
      3) Nails and nailing

B. Roofing

1. Types
   a. Roll roofing
   b. Strip shingles
   c. Hot built-up

2. Slater's felt
   a. Function
   b. Weights

The student should be able to:
Correctly identify the parts of a box cornice as shown on a furnished section drawing.

Properly build a box cornice on an existing frame, using personally selected tools and the materials indicated on a supplied plan.

The student should:
Be well acquainted with the weights, uses, and properties of such common materials as coated roll roofing, selvedge-edge roofing, strip shingles, and multiple-ply, hot built-up roofing.

Be aware of the difference between "waterproof" and "watershed."

Rake intersection angles can be obtained by the same method used for rafter cheek cuts (Carpentry, VIII, E.3).

Types a and b should be taught as part of a carpenter's and roofer's work. Type c may be so taught or merely explained as background information, at the teacher's discretion.

The relationship of roof pitch to selection of materials (waterproof/watershed) should be emphasized.
3. Drip edge
   a. Types
      1) Metal
         a) Aluminum
         b) Galvanized iron
      2) Cedar shingle
   b. Methods of application
   c. Special tools and fasteners

4. Flashing
   a. Materials
      1) Copper
      2) Aluminum
   b. Locations
      1) Valley
      2) Chimney
      3) Wall
   c. Special tools and fasteners

The student should:
Be aware of the function of drip edge.
Be acquainted with the properties of the more common types of drip edge.

The student should be able to:
Correctly apply slater's felt.
Correctly apply all common types of drip edge, using personally selected tools and fasteners.

The student should:
Be aware of the function of flashing, and of the properties of the two common materials.
Be acquainted with the common locations requiring flashing, and the shapes necessary to proper functioning in each such location.

The teacher should avoid use in class of those sheet metal forming tools which are not generally used by carpenters in fabricating flashing.

The student should be made aware of the high initial cost of cedar shingle drip edge, of the need to paint galvanized iron, of the low strength and high coefficient of expansion of aluminum.
### Content

<table>
<thead>
<tr>
<th>d. Methods of application</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Applying roofing</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Layout</td>
</tr>
<tr>
<td>b. Materials</td>
</tr>
<tr>
<td>1) Nails</td>
</tr>
<tr>
<td>2) Cements</td>
</tr>
</tbody>
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<th>c. Methods of application</th>
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<tr>
<td>1) Plane surfaces</td>
</tr>
</tbody>
</table>

| 2) Ridge and hip caps     |

| 6. Estimating roofing quantities |

<table>
<thead>
<tr>
<th>C. Window and door units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Types of window</td>
</tr>
<tr>
<td>a. Double hung</td>
</tr>
<tr>
<td>b. Casement</td>
</tr>
<tr>
<td>c. Vent</td>
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<tr>
<td>d. Gliding</td>
</tr>
</tbody>
</table>

### Objectives

**The student should:**

Be aware of the need to allow for considerable expansion and contraction of the metal.

**The student should be able to:**

Lay out and apply coated and selvedge edge roll roofing.

Select the correct nails and proper cement locations for various given roofing problems.

Lay out vertically and horizontally for strip shingles.

Properly apply strip shingles, 5 inches to the weather.

Fabricate from strip shingles, and properly install ridge and hip caps.

Estimate to an accuracy of + 1 roll, or + 2 bundles the roofing required, given span, pitch, and roof type.

Identify by sight or sketch the four common window types, and state the advantages and disadvantages inherent in each.

### Information for the Teacher

- The value of laying out from a vertical center should be emphasized.
- The fabrication and use of roof brackets should be taught, where pitch requires scaffolding.
- Units of purchase and the area covered thereby should be taught.
## CONTENT

2. Types of doorway
   a. Hinged
      1) Single
      2) Double
      3) Side light
      4) Dutch
   b. Gliding

3. Nomenclature of units

4. Use of the mill book

5. Methods of installation
   a. Plumbing, straightening, squaring
   b. Nails and nailing

D. Walls

1. Vapor barrier
   a. Slater's felt
   b. Polyethylene film

## OBJECTIVES

The student should be able to:

- Identify by sight or sketch the common types of doorway.
- Identify on supplied photographs or sketches such common parts as sills, head and side jambs, rails, stiles, and stop.
- Locate in the supplied mill book the door or window unit specified, and determine such important factors as size, cost, and included accessories.
- Install a given window/door unit to field standards of level, plumb, and square, using personally selected tools and equipment.

## INFORMATION FOR THE TEACHER

Photographs, sketches, section drawings, and mill book pages screened by *opaque projection* should aid in fixing identification.

The student should be familiar with the range of information contained in the mill book and how to find it, rather than be adept in its use.

The student should:

- Be aware of the function of vapor barrier, and the relative efficiency of the common materials.
### CONTENT

2. Siding materials
   a. Wood
      1) Shakes
      2) Bevel siding
      3) Vertical board, jointed
      4) Board and batten
   b. Aluminum
   c. Composition

3. Methods of application
   a. Story pole
   b. Siding hook
   c. Nails and nailing
   d. Special tools and fasteners
   e. Corner treatment
      1) Metal caps and extrusions
      2) Corner boards
      3) Compound bevels

E. Estimating quantities

### OBJECTIVES

The student should:

Be acquainted with the various materials currently used, and the properties of each.

Be acquainted with the methods of applying the more common siding materials.

The student should be able to:

Maintain field standards of workmanship in laying out and applying a representative section of a supplied siding material, using personally selected tools, equipment, and fasteners.

Estimate to an accuracy of ± 5 percent the amount of materials to be ordered.

### INFORMATION FOR THE TEACHER

The student should be required to prove entry-level proficiency only with the materials most commonly used in his geographical area. Quality of the work, and proper procedures should be the criteria — speed being, at this level, a negligible factor.

While careless arithmetical work should not be ignored, the correct method rather than the correct answer is of prime importance.
X. INTERIOR FINISH — Suggested Time: 27 Days

A. Insulation

1. Types
   a. Thermal
   b. Acoustic

2. Transfer theory
   a. Heat
   b. Sound

3. Materials
   a. Blanket and batt
      1) Mineral fiber
      2) Glass fiber
      3) Reflective foil
   b. Solid and fill
      1) Vegetable fiber
      2) Expanded mica
      3) Expanded polystyrene

4. Application
   a. Fasteners
      1) Nails and staples
      2) Mastics

The student should:

Be acquainted with the uses of insulation.

Be aware of the means by which heat and sound are transferred.

Be acquainted with the common insulating materials, their properties, and relative general efficiencies.

Select the proper tools, equipment, fasteners, and materials for insulating: 1) between studs, 2) between open ceiling joists, and 3) inside a small pipe duct, and —

Properly install insulation in the three specified places.

The teacher should be prepared to explain the theory of molecular motion. Use can be made of transfer of motion from cue ball to one or many pool balls, depending on the density of grouping.

Relate insulation type to means of transfer: reflectives/radiation, loose fibers/conduction packaged fibers/convection.

The student should be alerted to the need for eye protection when working with glass fiber insulation, and of the need to avoid inhaling particles or trapping them between skin and clothing.
b. Vapor barrier position

B. Walls and ceilings

1. Drywall
   a. Sizes
   b. Methods of application
   c. Special tools and fasteners
   d. Corner beads
   e. Finishing: joints and nailheads

2. Paneling
   a. Types
      1) Board
      2) Plywood
      3) Composition

The student should:
- Be aware of the necessity of placing vapor barrier between the room and the insulating material.

The teacher should be prepared to explain how being wet negates the insulating ability of most materials.

Bench demonstration:
Place on a contrasting background, a 4d blued lath nail, a 4d spiral-twisted nail, and a 1 3/8-inch annular-grooved nail. Screen together in an opaque projector, identifying each. Drive each nail 1-inch deep into a 2 x 4. Carefully pull the nails, emphasizing the force required for each. Repeat projection, showing torn wood clinging to annular-grooved nail.
b. Application
   1) Methods
   2) Special tools and fasteners
   3) Moldings

The student should:
Be acquainted with the methods of application used with the common paneling materials, and with the special tools, fasteners, and moldings required.

The student should be able to:
Estimate to an accuracy of ± 5 percent the amount of gypsum board or sheet paneling, and to ± 10 percent the amount of board paneling, moldings, and fasteners to be ordered for a specified part of a supplied blueprint/specification.

3. Estimating quantities

C. Floors

1. Strip flooring
   a. Species, sizes, grades
   b. Special tools and fasteners

The student should:
Be acquainted with the species, sizes, and grades of strip flooring in common use.
Be aware of the use of softwoods as well as hardwoods for strip flooring.
Be acquainted with the special tools and fasteners used in installing strip flooring.

The teacher should be prepared to explain why "cut" nails are less likely to split the flooring.

CAUTION! The toxic and flammable nature of most contact cements, and the necessity of following manufacturer's instructions concerning ventilation, temperature, and sources of possible ignition, should be strongly emphasized.
c. Installation
   1) Vapor barrier
   2) Marking joist location

   3) Laying out material
   Lay out material ahead of a nailer, properly cutting the ends to reduce waste.

   4) Fastening final rows
   Fasten flooring by use of both hammer and nailing machine.

   5) Changing direction
   Pull up to field standards of tightness, and fasten the final rows of flooring.

   d. Sanding and finishing
   1) Special tools and equipment

The student should be able to:
Properly install a vapor barrier, and mark the location of joists.

Objectives

Information for the Teacher

Bench demonstration:
Make a spline. Show how it is used to reverse the direction in which strip flooring is being laid.

Clamp a length of flooring to the bench. Show how groove end will fit to tongue edge and vice-versa in changing direction 90°. Cut a rabbet across the bottom of an end of flooring to show how a 90° fit can be made.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Methods of sanding</td>
<td>The student should: Be acquainted with the process of sanding and finishing strip flooring.</td>
<td></td>
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<tr>
<td>3) Methods and materials for finishing</td>
<td>Be aware of the variety of fillers, sealers, and finishes available.</td>
<td></td>
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<tr>
<td>2. Composition flooring</td>
<td>Be acquainted with the variety of materials available, and with the more important properties of each.</td>
<td></td>
</tr>
<tr>
<td>a. Types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Yard goods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Tiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Vinyl</td>
<td></td>
<td></td>
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<tr>
<td>2) Linoleum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Asbestos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Rubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Cork</td>
<td></td>
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<tr>
<td>c. Underlayment and vapor barrier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Layout</td>
<td></td>
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<tr>
<td>e. Adhesives and solvents</td>
<td>Be aware of the fire and health hazards inherent in some adhesives and solvents.</td>
<td></td>
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<tr>
<td>f. Special tools and equipment</td>
<td>Be aware of the special tools and equipment in use.</td>
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<td></td>
<td>Of primary importance is an awareness of the variety of materials available and the inherent characteristics which make any one unsuitable for some uses.</td>
<td></td>
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<td></td>
<td>Students should not be required to &quot;memorize&quot; a list of materials - properties - adhesives - uses, but rather, taught to &quot;check-out&quot; these aspects before selecting a material for a specific use.</td>
<td></td>
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</tbody>
</table>
## CONTENT

<table>
<thead>
<tr>
<th>g. Methods of cutting and laying</th>
<th>h. Cove base</th>
</tr>
</thead>
</table>

### 3. Estimating quantities

Select the proper tools and methods to perform the listed jobs:

<table>
<thead>
<tr>
<th>a. Straightening to required width</th>
<th>b. Cutting to required size</th>
<th>c. Assembling and bracing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straighten the parts of a stock door jamb, reducing for a stated wall thickness.</td>
<td>Cut jamb parts to proper length, assemble the jamb, and brace square and true.</td>
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<tr>
<th>d. Setting jambs</th>
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<tbody>
<tr>
<td>1) Leveling the head</td>
</tr>
<tr>
<td>2) Plumbing, shimming, straightening</td>
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<tr>
<td>3) Nails and nailing</td>
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</tbody>
</table>

### OBJECTIVES

**The student should be able to:**

- Lay out and install a section of flooring consisting of tiles of a specified material and vinyl cove base, choosing tools, adhesives, and solvents appropriate to the materials.
- Estimate to an accuracy of ± 10 percent the amount of strip flooring or composition tile which should be ordered for a specified installation.
- Select the proper tools and methods to perform the listed jobs:
  - Straightening to required width
  - Cutting to required size
  - Assembling and bracing
  - Setting jambs:
    1) Leveling the head
    2) Plumbing, shimming, straightening
    3) Nails and nailing

### INFORMATION FOR THE TEACHER

Student proficiency should be judged on the quality of the work, time being of little importance at this point.

Since the edges of the jamb are beveled, the trim setback is the point of measurement for width.

Emphasize the need for checking actual door width, jamb dado depth, and desired floor clearance before cutting jamb parts to length.

The effects on door function of out-of-plumb jambs should be explained.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Window stool and apron</td>
<td><strong>The student should be able to:</strong> Prepare and install to field standards,</td>
<td>The use of the coping saw in</td>
</tr>
<tr>
<td>a. Scribing the stool</td>
<td>the stool and apron of window trim, using personally selected tools and</td>
<td>returning the ends of apron</td>
</tr>
<tr>
<td>b. Finishing stool ends</td>
<td>materials.</td>
<td>and stool should be mastered.</td>
</tr>
<tr>
<td>c. Fitting the apron</td>
<td></td>
<td>The need for a brace between</td>
</tr>
<tr>
<td>d. Finishing the apron ends</td>
<td></td>
<td>apron and floor when nailing</td>
</tr>
<tr>
<td>e. Fastening in place</td>
<td></td>
<td>stool to apron should be</td>
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<td><strong>The student should:</strong></td>
<td>demonstrated.</td>
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<td></td>
<td>Be aware of the variety of styles available, and of the usefulness of the</td>
<td>Opaque projection of pertinent</td>
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<td>mill book in identifying and ordering a particular style.</td>
<td>pages of the mill book should</td>
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<tr>
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<td>be an effective method.</td>
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<tr>
<td>3. Casings and stops</td>
<td>Be acquainted with the several tools available for more efficient and</td>
<td>The student should be profi-</td>
</tr>
<tr>
<td>a. Styles —</td>
<td>accurate mitering and coping.</td>
<td>cient in use of the commer-</td>
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<td>the mill book</td>
<td></td>
<td>cial miter box and trimmer in</td>
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<tr>
<td>b. Mitered joints</td>
<td></td>
<td>mitering and in preparation</td>
</tr>
<tr>
<td>c. Coped joints</td>
<td></td>
<td>for coping.</td>
</tr>
<tr>
<td>d. Nails and nailing</td>
<td><strong>The student should be able to:</strong> Properly cut, fit, and install the</td>
<td>Proper use of the nail set</td>
</tr>
<tr>
<td></td>
<td>casings and stops required for a specified window and door jamb, using</td>
<td>should be taught.</td>
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<td></td>
<td>personally selected tools and equipment.</td>
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<tr>
<td>4. Baseboard and shoe</td>
<td>Properly cut, fit, and install in a specified area the required baseboard</td>
<td>Emphasize starting the instal-</td>
</tr>
<tr>
<td>a. Styles</td>
<td>and shoe, using personally selected tools and fasteners.</td>
<td>lation so that the final piece</td>
</tr>
<tr>
<td>b. Installation</td>
<td></td>
<td>will have an &quot;open&quot; end.</td>
</tr>
</tbody>
</table>
5. Doors
   a. Type
      1) Panel
      2) Flush
         a) Solid core
         b) Hollow core
   b. Materials
   c. Fitting a door
      1) Making a door jack
      2) Using the portable electric plane

The student should:
Be aware of the different type doors available and of the various species of wood used.

The student should be able to:
Construct a simple door jack from job site scrap materials.
Set up and safely operate the portable electric plane.

It is recommended that the student be proficient with the jointer before progressing to power planing.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>3) Back-beveling edges 4) Jamb clearance</td>
<td><strong>The student should be able to:</strong> Fit a door with 1/8-inch to 3/32-inch total side clearance, and properly back-beveled.</td>
<td>The need for back-beveling can be demonstrated by measuring the distance across the face of a door, and from edge to edge through its thickness.</td>
</tr>
<tr>
<td>d. Hanging a door 1) Laying out the gains 2) Using the butt gage 3) Using the portable router and template</td>
<td>Lay out gains for a correct swing of the door. Cut gains no more than 1/64-inch oversize, and install butts in both door and jamb.</td>
<td>The student should be proficient with butt gage and butt chisel, before progressing to router and jig. Only a light hammer blow should be necessary to enable the leaves of the butts to mesh.</td>
</tr>
<tr>
<td>4) Using power screwdrivers</td>
<td>Hang the door, placing hinge pins without moving the screws.</td>
<td></td>
</tr>
<tr>
<td>5) Adjusting the butts</td>
<td>Pack out butt leaves if necessary to properly align the door in its jamb.</td>
<td></td>
</tr>
<tr>
<td>6. Hardware a. Sash locks, lifts, balancers 1) Types 2) Installation</td>
<td><strong>The student should:</strong> Be acquainted with the several types of sash locks and operators in common use.</td>
<td>The student should be able to identify common sash locks as such, and have a basic understanding of the mechanical function of sash balancers and operators.</td>
</tr>
<tr>
<td>CONTENT</td>
<td>OBJECTIVES</td>
<td>INFORMATION FOR THE TEACHER</td>
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</tr>
<tr>
<td><strong>b. Door stops</strong>&lt;br&gt;1) Types&lt;br&gt;2) Installation</td>
<td><strong>The student should:</strong>&lt;br&gt;Be acquainted with such common door stops as the baseboard, floor, and hinge-pin types.&lt;br&gt;Be aware of the relative usefulness of each type.&lt;br&gt;Be aware of the method of installing each type.&lt;br&gt;<strong>The student should be able to:</strong>&lt;br&gt;Lay out to a specified height, the position of a tubular lock, using supplied templates or jigs.&lt;br&gt;Bore the required holes, using a personal choice of available tools.&lt;br&gt;Inlet the striker and plate, tight, true, and flush with the stile, using a personally selected and prepared wood chisel.</td>
<td>The student should be able to identify common door stops as such. Inclusion of pneumatic and hydraulic closers is at the teacher's discretion.&lt;br&gt;The student should be able to identify the common locks by type.&lt;br&gt;The teacher is cautioned against demonstrating the security weakness of a lock type. Proficiency in the use of both hand and power tools should be developed. Proper sharpening and safe handling of wood chisels should be stressed.</td>
</tr>
<tr>
<td><strong>c. Door locks</strong>&lt;br&gt;1) Types and properties</td>
<td>Be acquainted with the modern types of rim lock, mortise lock, and tubular lock, as well as simple bolts and safety chains.&lt;br&gt;Be aware of the method of installing each type.</td>
<td></td>
</tr>
<tr>
<td>2) Installation&lt;br&gt; a) Locating the height&lt;br&gt; b) Using templates&lt;br&gt; c) Using the expansive bit&lt;br&gt; d) Using the hole saw&lt;br&gt; e) Safe and proper use of chisels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTENT</td>
<td>OBJECTIVES</td>
<td>INFORMATION FOR THE TEACHER</td>
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<td>-----------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>f) Assembling the lock set</td>
<td>Assemble the lock set so that all parts are correctly aligned and function freely.</td>
<td>Emphasize care in avoiding marring the lock finish.</td>
</tr>
<tr>
<td>g) Locating and installing the striker plate</td>
<td>Adjust the stops to field standards of fit.</td>
<td>Teach use of installed striker to locate position of striker plate on the jamb.</td>
</tr>
<tr>
<td>h) Adjusting the stops</td>
<td></td>
<td>Emphasize allowing for the finish on stops and door when setting the stops.</td>
</tr>
</tbody>
</table>

E. Stairs

1. Terminology
   a. Rise
      1) Total
      2) Unit
   b. Run
      1) Total
      2) Unit
   c. Riser
   d. Tread
   e. Stringer
      1) Plain
      2) Housed
   f. Nosing
   g. Rail

The student should:

- Be acquainted with the sizes, grades, and species of materials commonly used in stair building.
- Be aware of the processes involved in building both plain and housed stringers.

Transparencies and transparency masters for projection are available from several commercial suppliers.

The student should merely see how a housed stringer differs, that he may understand the added work involved.

Only a simple wall-mounted rail should be considered at this level.
2. Building a plain stringer stairs

a. Determining total rise and run

b. Determining unit rise and run

c. Laying out the stringer
   1) Using the framing square
   2) Using stair gages

d. Dropping the stringer

e. Placing the stringers

f. Installing risers and treads
   1) Stock tread sizes
   2) Nails and nailing

g. Installing a rail
   1) Establishing dimensions

The student should be able to:

- Figure the total rise and run of a stairs from a sketch containing the ceiling height and other necessary information.
- Derive the unit rise and run on a basis of stock tread sizes and 7 1/2-inches, ± 1/2-inch as the rise.
- Properly allow for tread thickness.
- Assemble the components in the proper manner using personally selected tools and fasteners; the completed stairs conforming to field standards of rigidity and workmanship.
- Derive the length and height of rail from a supplied sketch.

This method should prove to be more easily taught than the obsolescent "easy stairs number" method.

This procedure can be related to the "stepping-off" method of figuring rafter length. (Carpentry, VIII, E.2c)

Bench demonstration:
Select some available object such as a work-bench top to serve as a "second-floor." Have the students figure a stairs to it. Use the correct figures to lay out and cut stringers. Install risers and treads, and plywood "finished floor" clamped to bench top.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The student should be able to:</td>
<td>Emphasize care in protecting the finish of walls, rail, and hardware, especially avoiding</td>
</tr>
<tr>
<td></td>
<td>Cut the supplied handrail to length and return the ends.</td>
<td>off-angled or burred screws.</td>
</tr>
<tr>
<td>2) Installing brackets</td>
<td>Properly locate and attach hardware to the rail.</td>
<td></td>
</tr>
<tr>
<td>3) Attaching the rail</td>
<td>Secure the rail to the wall, maintaining the correct position and angle.</td>
<td></td>
</tr>
</tbody>
</table>
# MASONRY

## CONTENT

**1. CONCRETE — Suggested Time: 4 Days**

### A. Composition

#### 1. Cement
   - **a. Preparation**
   - **b. Types**
       1) **Heavyweight**
       2) **Lightweight**
   - **c. Function**
   - **d. Proper storage**

#### 2. Aggregates
   - **a. Types**
       1) **Heavyweight**
       2) **Lightweight**
   - **b. Groups**
       1) **Course**
       2) **Fine**

## OBJECTIVES

**The student should:**

- Be acquainted with the nature and manufacture of portland and masonry cements.
- Be aware of the availability of various types of cements, each possessing unique qualities which adapt it for specific uses.
- Correctly describe in simple, non-technical terms, the function of cement in concrete.
- Describe the proper methods of storing cement in various hypothetical, but typical jobsite conditions.
- Be aware of the availability of different aggregates to meet specific weight requirements.
- Be aware of the existence of a wide range of aggregate particle sizes, and the need for several sizes in any concrete mix.

**The student should be able to:**

- Be aware of the availability of different cements, but not that he memorize types, properties, and designations.
- Describe the proper methods of storing cement to prevent exposure to moisture.

## INFORMATION FOR THE TEACHER

As introductory information, this material should not be subject to testing.

It is important that the student know that there are different cements, but not that he memorize types, properties, and designations.

It is important that the student know how to store cement to prevent exposure to moisture.
### CONTENT

<table>
<thead>
<tr>
<th>Function</th>
<th>Water</th>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Effects of excessive water in mix</td>
<td>c. Effects of excessive water in mix</td>
<td>b. Lean</td>
</tr>
<tr>
<td>1) Tensile strength</td>
<td>2) Compression strength</td>
<td><strong>OBJECTIVES</strong></td>
</tr>
<tr>
<td>2) Compression strength</td>
<td>3) Resistance to weathering</td>
<td>Be acquainted with the standard proportions of the common concrete mixes.</td>
</tr>
<tr>
<td>3) Resistance to weathering</td>
<td><strong>INFORMATION FOR THE TEACHER</strong></td>
<td>Be aware of the change in properties of the concrete caused by changing the type of cement or proportions of the mix.</td>
</tr>
</tbody>
</table>

### OBJECTIVES

<table>
<thead>
<tr>
<th>The student should:</th>
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</thead>
<tbody>
<tr>
<td>Be acquainted with the function of aggregates in the mix.</td>
</tr>
<tr>
<td>Be aware of the effects of oil, vegetable matter, and other impurities in the mix water.</td>
</tr>
<tr>
<td>Be aware of the function of water in the mix.</td>
</tr>
<tr>
<td>Be acquainted with the methods of mixing the components of concrete.</td>
</tr>
</tbody>
</table>

### INFORMATION FOR THE TEACHER

As a "rule-of-thumb," the mix water should be chemically and mechanically as pure as drinking water. The student should understand that water enters into the crystalline structure of the concrete, rather than evaporating, thus making it possible to "set" concrete under water. The student should know the proportions and aggregate sizes used in the standard mixes for footings and slabs. The student should not, at this point, be expected to know which mixes produce which properties, but merely that such changes are possible. Air-entraining cements should be explained.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>The student should be able to:</strong></td>
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<tr>
<td></td>
<td>Combine in correct proportion, the components of a specified amount of</td>
<td>The student should experience mixing, both by hand and in mixing machines.</td>
</tr>
<tr>
<td></td>
<td>concrete, and mix to proper consistency using the equipment provided.</td>
<td></td>
</tr>
<tr>
<td>C. Blueprints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Plan view</td>
<td></td>
<td></td>
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<tr>
<td>2. Section view</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Specifications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Pouring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Temperature</td>
<td><strong>The student should:</strong></td>
<td>The teacher should be prepared to explain the effects of freezing on the crystalline</td>
</tr>
<tr>
<td>limitations</td>
<td>Be aware of the need to prevent concrete from freezing during the curing</td>
<td>structure of concrete.</td>
</tr>
<tr>
<td>a. Covering</td>
<td>period.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>The student should know that many antifreeze preparations actually accelerate the harden-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ing of the mix rather than lower its freezing point, and that those true antifreeze</td>
</tr>
<tr>
<td></td>
<td></td>
<td>materials decrease the strength of the mix when added in amounts large enough to lower the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>freezing point appreciably.</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>b. Antifreeze materials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Type III cements</td>
<td></td>
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<tr>
<td></td>
<td>d. Heating the components</td>
<td></td>
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</tbody>
</table>
### CONTENT

#### Objectives

<table>
<thead>
<tr>
<th>Methods</th>
<th>The student should:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Chutes</td>
<td>Be aware of the common methods of pouring concrete on light-construction jobsites.</td>
</tr>
<tr>
<td>b. Buckets</td>
<td></td>
</tr>
<tr>
<td>c. Wheelbarrow</td>
<td></td>
</tr>
</tbody>
</table>

#### Hydration

| a. In air | Be acquainted with the precautions required to prevent dilution of concrete placed under water, or loss of water in mixes placed on sand. |
| b. Under water | Be aware that concrete produces heat while setting. |

#### Curing

| a. Maintaining temperature | Be aware that heat accelerates and cold retards curing of the mix so that concrete poured in temperatures of less than 50°F. must be protected during curing. |
| b. Maintaining moisture | Be aware that from 3 to 12 days is the normal span of curing time, and that the mix must be kept moist to develop full strength. |

#### Uses

| Footings and piers | The student should be able to: |
| a. Mixes | Demonstrate by simple definition, and by locating on a provided sketch or blueprint, an understanding of the nature of footings and piers. |

### Information for the Teacher

The student should be able to:

- Move concrete by chute and wheelbarrow. Films, field trips to jobsites, or individual observation should suffice for understanding the use of cranes and buckets.

- Emphasize the need to keep all components above freezing temperature (never heat the cement), but the mix itself below 80°F.

- Bench demonstration: Make some rock candy. Compare its need for sufficient moisture throughout crystallization, with the need for moisture in curing concrete.

An understanding of the function of these members is prerequisite to appreciating the need for care in building them.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Forms</td>
<td>Be aware of the need for forms to be clean, tight, and well braced, and of the ensuing problems should they not be.</td>
<td>As an oversimplification, reinforcing rods in concrete may be compared to wired glass.</td>
</tr>
<tr>
<td>1) Clean</td>
<td></td>
<td>A brief description of the duties of the iron worker may be valuable.</td>
</tr>
<tr>
<td>2) Ready</td>
<td></td>
<td>Reinforcing rods should be mentioned as dowels used in lieu of a keyway, as well as in use within a concrete member.</td>
</tr>
<tr>
<td>c. Reinforcement</td>
<td>Be aware of the function of iron in preventing shearing of concrete.</td>
<td>Be aware of the identical expansion coefficients of concrete and iron.</td>
</tr>
<tr>
<td>1) Function</td>
<td>Be acquainted with the form of reinforcing commonly used for this purpose.</td>
<td>Be aware of the rust-preventative nature of the inherently alkaline concrete.</td>
</tr>
<tr>
<td>2) Types</td>
<td></td>
<td>Be aware of the need for prevention of air pockets in a pour.</td>
</tr>
<tr>
<td>d. Vibrating</td>
<td></td>
<td>Bench demonstration: Build two exceedingly tight forms.</td>
</tr>
<tr>
<td>1) Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Methods</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**CONTENT**

e. Screeding
   1) Function
   2) Method

f. Curing

**OBJECTIVES**

The student should:

Be acquainted with the common methods of screeding.

**INFORMATION FOR THE TEACHER**

Mix sufficient stiff, lean concrete to fill both forms. Quickly pour the mix into one form, screeding the top. Carefully fill the second form tamping and vibrating as you pour. Screed the top. When concrete is sufficiently set remove the forms to show the presence and lack of "honeycomb."

2. Walls and columns
   a. Mixes
   b. Reinforcement
   c. Pouring and vibrating
d. Curing
e. Finishing
   1) Filling holes
   2) Removing form marks

Properly use an immersion-type vibrator.

Demonstrate proficiency in filling tie-rod holes and small honeycombs, using a wooden float and a stiff mixture of sand and cement.

Remove small projections by use of carborundum stones.

The student should be able to:

Discern any condition of form or reinforcing which would delay a pour.

Vibrate and screed to produce a smooth, dense concrete.

The student should use only shovel or board tamp to work the concrete at this point.

Stress the importance of vibrating while filling the form rather than after it is full, and of constantly moving the vibrator to avoid puddling the grout.

Where appearance is important, grey and white cements can be blended to match the pour.

Power grinders should not be introduced at this point.
3. Slabs
   a. Mixes
   b. Reinforcement
      1) Rod
      2) Net
   c. Expansion joints
      1) Function
      2) Methods and materials
   d. Pouring and vibrating
   e. Screeding
   f. Finishing
      1) Wood float
      2) Steel trowel
      3) Machines

The student should:

Be aware of the use of net reinforcement in place of rods in some slab pours.

Be aware of the need to provide for thermal expansion in long units of concrete.

Be acquainted with the methods and materials used to provide expansion joints in concrete.

Be acquainted with the support forms installed by the carpenter to set the grade and guide long screeds.

Be acquainted with the tools used to finish concrete, and the characteristics of the finish obtained.

The student should be able to:

Impart a commercially acceptable finish to concrete — float and trowel, hand tool and machine.

The student should be familiar with the "tar" joints in concrete paved highways.

The commoner materials — asphalt, asphalt-impregnated fiberboard, vinyl — should be introduced.

Both 2 x 4 and pipe supports should be introduced.

Stress the selection of float or trowel finish on the basis of slipperiness, ease of cleaning, and surface density.

The student should be familiar with the operation of concrete finishing machines, but emphasis should be on attaining proficiency with hand tools.
CONTENT

4. Damp-proofing
   a. Sealers
   b. Bituminous coatings
   c. Membrane
   d. Polyethylene spray

OBJECTIVES

The student should:

Be aware of the need for damp-proofing subterranean concrete structures in poorly drained soils.

Be acquainted with the common damp-proofing materials, the properties of each, and the methods of application.

The student should be able to:

Properly apply two coats of asphalt-asbestos damp-proofing to a section of foundation wall.

INFORMATION FOR THE TEACHER

The student should be judged on the neatness as well as the completeness of the application.

II. BLOCK CONSTRUCTION — Suggested Time: 10 Days

A. Types
   1. Heavyweight
   2. Lightweight

B. Shapes and sizes

State, in simple terms, the criteria regulating use of the two types of masonry blocks.

Correctly identify, among provided samples, the more common shapes of block.

State the dimensions of standard block shapes.

Emphasize the nonload-bearing nature of lightweight blocks.

At this point, samples should be limited to stretcher, corner, jamb, and partition (solid) block.
C. Mortar
   1. Proportions of mix
   2. Maintaining plasticity

D. Layout of the bond
   1. Running
   2. Stacking

E. Laying block
   1. Mortar bedding
      a. Full bedding
      b. Face shell bedding
      c. Buttering headjoints
   2. Applying mortar
      a. Spreading
      b. Swiping

The student should be able to:

The student should:

The student should be able to:

The student should:

The student should:

The student should:

The student should be able to:

The student should:

Only Type I cements should be used at this point.

The relationship between ambient temperature and time since mixing should be the basis for deciding whether stiff mortar can be retempered or has begun to "set" and should be discarded.

Emphasis should be on the running bond since this style is most often used.

Full bedding is normally used only at the footing where it serves as a substitute keyway, and in columns, piers, and pilasters.

The student must become adept in use of the trowel.
CONTENT

3. Running up corners
   a. Maintaining height
   b. Maintaining uniform joints
   c. Plumbing, leveling, straightening

4. Running stretcher courses
   a. Stringing lines
      1) Line pins
      2) Line clamps
   b. Plumbing and straightening
   c. Cutting and dressing
      1) Brick chisel
      2) Masonry saw
   d. Setting the closure block
      1) Maintaining joint size
      2) Maintaining mortar bond
   e. Setting brick ties

OBJECTIVES

The student should be able to:

Run up a corner six courses high; straight, level, and plumb, with uniform joints, whose total height shall be 48 inches, ± 1/4-inch.

INFORMATION FOR THE TEACHER

Evaluation should be based on the quality of the work, time being considered only in relation to set up of the mortar.

The student should be capable of stringing lines with commercial hardware or by improvising with nails or weights.

The student should become proficient in use of the mason's spirit level.

Proper safety procedures in use of the masonry saw must be emphasized.

Emphasize the necessity of lowering the block in as level a position as possible.

Bench demonstration:
Make a quantity of wooden "bricks" of about 1/4-inch = 1-inch scale. Position these...
The student should:
Be acquainted with the more common methods of tying the facing.

5. Patching and pointing
   a. Mortar consistency
   b. Using a backstop

   Be aware of the necessity of patching and pointing before the mortar sets, of using a backstop against which the mortar can be forced, and of using fresh mortar for such repairs.

   Be acquainted with the method of patching and pointing where the mortar has already set.

6. Tooling joints
   a. Function
   b. Shapes
      1) V
      2) Concave
      The student should be able to:
      Tool joints to field standards of density and appearance.
      c. Method

7. Pilasters and intersections
   a. Control joints
      1) Wire lath
      2) Tie bar
      3) Calking

   Demonstrate the proper method of tying intersections of nonbearing walls.

   Demonstrate the proper method of tying intersection of bearing walls.

so as to simulate a section of brick veneer. Place sufficient weight on the top to cause the "wall" to bulge and collapse.

Both header courses and galvanized iron ties should be introduced.

The teacher should be prepared to discuss the unsuitability of extruded and raked joints for all but decorative purposes.

The teacher should be prepared to explain why interior intersections should not be masonry bonded.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student should be able to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Properly rake-out and caulk the vertical joint of exposed wall intersections.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Masonry bond</td>
<td>Lay-up a pilaster, using a correct masonry bond.</td>
<td>The student should not be required to make the opening layout at this point, but merely to follow it accurately.</td>
</tr>
<tr>
<td>F. Wall openings</td>
<td>The student should:</td>
<td></td>
</tr>
<tr>
<td>1. Laying out openings</td>
<td>Be acquainted with the layout method of indicating openings in block walls.</td>
<td></td>
</tr>
<tr>
<td>2. Laying block</td>
<td>Be acquainted with the methods and materials used in preparing wall openings.</td>
<td></td>
</tr>
<tr>
<td>a. Working to set frames</td>
<td>Properly lay-up block against a preset frame.</td>
<td></td>
</tr>
<tr>
<td>b. Jamb block</td>
<td>Properly lay-up with jamb block to ± 1/8-inch of each side of a wall opening.</td>
<td></td>
</tr>
<tr>
<td>c. Lintels and sills</td>
<td>Properly emplace a provided lintel of each type.</td>
<td></td>
</tr>
<tr>
<td>1) Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Precast concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Anchor bolts</td>
<td>Set anchor bolts to within ± 1/16-inch of specifications.</td>
<td>Product quality, not labor time, should be the criterion for evaluating the student.</td>
</tr>
</tbody>
</table>
H. Damp-proofing

1. Parge coating

2. Sealers
   a. Bituminous
   b. Membrane
   c. Polyfilm
   d. Polyethylene spray

III. BRICK VENEER — Suggested Time: 17 Days

A. Brick:

1. Sizes and styles

2. Types
   a. High absorption
   b. Low absorption

The student should:

The student should be able to:

Properly apply two coats of concrete plaster to the block wall exterior.

Properly apply a sealer of a type indicated on provided blueprints/specifications.

Demonstrate a knowledge of the common sealers, their properties and the methods of applying each.

Be aware of the variety of sizes and face textures available.

Be aware of the different rate of absorption of common brick and face brick, the effects on mortar bond, and the procedures required by these effects.

Smoothness of the cove and adherence to grade specifications should be noted in evaluating work.

Only the locally common varieties should be introduced at this point.

Shop demonstration:

Burrow a lab scale and weights. Weight two dry common brick, a face brick, and a pre-wet common brick. Place one of the dry brick flat in 1/4-inch of water for 1 minute. Re-weigh this brick. If it has gained more than 20-grams (7/10-oz.) it was too dry to use. Lay the other three brick in fresh mortar on a well-set wall. After several minutes remove them to show mortar adhering to all except the other too-dry common brick.
**CONTENT**

**OBJECTIVES**

**INFORMATION FOR THE TEACHER**

B. Mortar

1. Mix
   a. Proportions
   b. Methods

2. Plasticity

3. Water retention

C. Laying out the bond

1. Corners and ends
2. Stretcher course

D. Laying brick

1. Mortar bedding
   a. Spreading
   b. Swiping
   c. Buttering

2. Laying-up corner and end
   a. Maintaining level and plumb

The student should:

Be acquainted with the properties of mortar required for good brick work, and the proper proportions of the correct mix.

The student should be able to:

Lay out an acceptable running bond for a specified section of brick veneer, said section including corner, end, a doorway, and a run of soldier course.

Prepare, or supervise the preparation of, masonry components needed for a specified section of brick veneer.

Lay up corner or end to field standards of level, plumb, and uniformity of joint size.

The teacher should emphasize the necessity of completely filling all joints with mortar.

The teacher should emphasize that the mortar must have a high water retention value to properly bond even wetted high-absorption brick.

Instruction in other than the running bond should, at this point, be limited to projecting photographs or drawings and discussing the variation.

Preparation should include wetting brick if necessary, and placing components conveniently, as well as properly mixing the mortar.
b. Maintaining joint size

3. Stringing a guideline

4. Laying stretcher courses
   a. Maintaining bond
   b. Tying in veneer
   c. Securing full mortar bond
   d. Cutting brick

The student should be able to:
Lay up stretcher courses to field standards of uniformity.

5. Laying window sills

6. Finishing joints
   a. Tooled
   b. Brushed
   c. Struck
   d. Raked

Identify by any specified means, the four common styles in which joints are finished.
Properly finish joints in each of the styles.

E. Washing the wall

1. Materials
   a. Brushes

Be aware of the need to clean new brickwork of cement dust, mortar drippage, and efflorescence.
Be acquainted with the materials used for washing brickwork.

Mortar shrinkage is so small that cracks between brick and mortar due to shrinkage must be magnified to be seen.

Emphasize necessity of removing excess mortar with upward cut of the trowel to avoid cracks in the mortar bond.

The teacher should emphasize the practical superiority of tooled joints; the esthetic value of the other styles.
b. Muriatic acid  
c. Water

2. Methods

3. Safety
   a. Personal
      1) Contact with acid
      2) Acid fumes
   b. General
      1) Other people
      2) Property

The student should:

Be fully aware of the nature of muriatic acid, its properties, and its effects on various common materials.

The student should be able to:

Properly dilute the acid to working concentration.

Demonstrate a knowledge of correct safety equipment and procedure.

Demonstrate a knowledge of correct first aid procedures.

Properly wash and rinse a section of brickwork, observing all precautions to insure the safety of his person, others in the vicinity, and nearby property.

CAUTION!

The teacher must be sure that the student recognizes "muriatic" as a commercial term for a certain concentration of powerful hydrochloric acid.

Demonstrating the effects of HCl on samples of cloth, wood, and metal should be effective.

To prevent spattering, always gently pour the acid into the correct amount of water.

The wisdom of unfailing use of hand and eye protection should be stressed.

The teacher should be prepared to explain, in the most simple terms, the relationship of acid and base.

While ventilation is necessary, wind may carry acid vapors. Drippage must be considered. Tools and other unprotected metal must not be exposed to acid droplets. Containers must be clearly labeled, safely closed, and properly stored.
PLUMBING

CONTENT

I. PREPARATION — Suggested Time: 1 Day

A. Blueprint reading

1. Roughing
   a. Water supply
      1) Municipal
      2) Well
   b. Waste disposal
      1) Municipal
      2) Septic system

2. Fixtures
   a. Water supply
      1) Cold
      2) Hot
   b. Sanitary
   c. Bath
   d. Laundry
      1) Washer
      2) Dryer
      3) Tubs

OBJECTIVES

The student should be able to:

- Demonstrate knowledge of what blueprints are, and why they are needed.
- Demonstrate proper care of the blueprint.

Locate on a supplied blueprint:

- The nature and correct position of supply and waste lines.
- The location and type of common plumbing fixtures.

INFORMATION FOR THE TEACHER

It is suggested that this topic be taught by repeated use of the blueprint in introducing each successive topic in this Plumbing section.

Bench demonstration:

Using contrasting ink, make a transparency of the plumbing data on a section of blueprint. Screen the section through an opaque projector so that the students may attempt to locate the plumbing. Position the transparency over the blueprint to locate the plumbing. An overhead projector may be used if a positive transparency is made of the blueprint.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Specifications</td>
<td></td>
<td>The student should know what information is contained in the specifications, and how to locate specific information. Proficiency in use of &quot;specs&quot; is not within the scope of the course.</td>
</tr>
<tr>
<td>1. Sizes</td>
<td>Be acquainted with the standard specifications format.</td>
<td>Commercically prepared texts containing sample blueprints and specifications are available.</td>
</tr>
<tr>
<td>2. Qualities</td>
<td>Be aware of the precedence of specifications over blueprints should they not agree.</td>
<td>The screening of this material in an opaque projector, preferably in conjunction with individual student copies, is an effective method.</td>
</tr>
<tr>
<td>3. Materials</td>
<td></td>
<td>The student should not be required to commit any part of a code to memory.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Codes and regulations</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. Local and State building codes</td>
<td>Be aware of the existence of plumbing codes.</td>
<td></td>
</tr>
<tr>
<td>2. Health Department regulations</td>
<td>Be acquainted with inspection procedures.</td>
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<tr>
<td></td>
<td>Be aware of problems ensuing from noncompliance.</td>
<td></td>
</tr>
</tbody>
</table>
II. ROUGHING IN — Suggested Time: 22 Days

A. Water supply

1. Mains
   a. Materials
      1) Copper
      2) Galvanized iron
      3) Plastic
   b. Fittings

2. Branch lines
   a. Risers
   b. Compression chambers

3. Installation
   a. Threaded joints
      1) Cutting iron pipe

The student should be able to:

- Recognize the common materials used for pipe and fittings.
- Demonstrate a basic knowledge of the properties of each material as used in plumbing.
- Ascertain the sizes of samples of standard pipe and fittings.
- Identify common fittings in a mixed sample.
- Describe a compression chamber, where it is located, and why it is needed.
- Cut iron pipe to length to an accuracy of ± 1/8-inch, using the vise and pipe cutter supplied.

Bench demonstration:

Show the effects of:
- Warm nitric acid (HNO₃) on copper
- Repeated bending of copper
- Temperature extremes on plastic
- Water-borne minerals in galvanized pipe
- Any strong acid on the zinc coating of galvanized pipe

Shop demonstration:

Perform the required joining operations, emphasizing the importance of:
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Cutting a thread</td>
<td><em>The student should be able to:</em></td>
<td>• Cutting pipe to well-squared ends</td>
</tr>
<tr>
<td>3) Method of joining</td>
<td>Properly cut threads using the vise and dies supplied.</td>
<td>• Reaming the ends of iron pipe</td>
</tr>
<tr>
<td>4) Tools and equipment</td>
<td>Make a watertight threaded joint, using personally selected tools and equipment.</td>
<td>• Using sufficient cutting oil on thread dies</td>
</tr>
<tr>
<td>b. Sweated joints</td>
<td></td>
<td>• Using a sealing compound on threaded joints</td>
</tr>
<tr>
<td>1) Cutting copper pipe</td>
<td>Cut copper tubing to length to an accuracy of ± 1/16-inch, using a wheel tubing-cutter.</td>
<td>• Using the correct type and size wrench</td>
</tr>
<tr>
<td>2) Preparing the parts</td>
<td>Expose the pure metal of tubing and fitting by use of emery paper and flux.</td>
<td>• Removing all sulfates and oxides from both copper surfaces to be joined</td>
</tr>
<tr>
<td>3) Sweating the joints</td>
<td>Make a watertight sweat joint, using wire solder and propane or butane torch.</td>
<td>• Protecting adjacent surfaces from heat and flame</td>
</tr>
<tr>
<td>c. Cemented joints</td>
<td>Fit and solvent-weld watertight joints in polyvinyl chloride and polyvinyl dichloride pipe.</td>
<td>Screening the components in an opaque projector between operations will provide close inspection to all students simultaneously.</td>
</tr>
<tr>
<td>d. Unions</td>
<td>State the purpose and use of ground-joint unions.</td>
<td></td>
</tr>
<tr>
<td>4. Pipe supports</td>
<td>Support a run of each type pipe, using personally selected pipe supports.</td>
<td>Shop demonstration: Support a run of each type pipe, demonstrating the proper type of support and spacing for each. Demonstrate safe use of hand and power boring tools.</td>
</tr>
<tr>
<td>a. Straps</td>
<td></td>
<td></td>
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<tr>
<td>b. Hangers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
c. Notched timbers
   1) Location
   2) Size limitations

   The student should:
   Have a basic understanding of the tension and compression forces in a horizontal timber, and of the effects of oversize or improperly located notches and holes.

   INFORMATION FOR THE TEACHER
   Bench demonstration:
   Make a scale simulation of installed floor joists. Bore pipe runs — some correct, some oversize or off center. Move a weight from one to another to show the effects of such holes on structural strength.

B. Waste lines

1. Soil pipe and vents
   a. Materials
      1) Cast iron
      2) Copper
      3) Composition

   Be acquainted with the common materials used for soil pipes, fittings, and drains.

   b. Fittings

   Be acquainted with the form, function, and particular uses of common fittings.
c. Traps

Be aware of the form, function, and proper location of traps.

The student should:

Be acquainted with the specific uses of the three types of trap.

Be acquainted with the purpose and function of basement drains and sump pumps.

Accurately cut iron soil pipe, using personally selected tools and equipment.

Calk a bell-and-spigot joint watertight, using supplied packing, lead and furnace, and personally selected tools.

Construct a sink drain of ordinary materials, except the trap which will be a laboratory type, clear glass unit. Pour water through the drain to show the function of the trap.

Demonstrate the use of the cold chisel in cutting iron soil pipe.

Emphasize safety in use of molten metals, including avoidance of inhaling lead vapors.
PLUMBING

CONTENT

b. Sweating copper

c. Slip joints

d. Sloping the drain

C. Septic systems

1. Septic tanks
   a. Construction
   b. Materials
      1) Steel
      2) Precast concrete

c. Function
d. Placement

2. Drain field
   a. Function
   b. Location
c. Construction
      1) Distribution box
      2) Absorption trench

OBJECTIVES

The student should be able to:

- Construct a watertight and unmarred sink drain and trap, using supplied components and personally selected tools and equipment.

- State the maximum and minimum pitch allowable in sloping drains.

- Demonstrate a basic understanding of why the pitch is limited.

- Be acquainted with the construction and function of septic tanks, dry wells, and leaching beds.

- Be aware of the health aspects involved in locating septic systems.

INFORMATION FOR THE TEACHER

The student should:

- Be acquainted with the construction and function of septic tanks, dry wells, and leaching beds.

- State the maximum and minimum pitch allowable in sloping drains.

- Demonstrate a basic understanding of why the pitch is limited.

- Be aware of the health aspects involved in locating septic systems.

- Require padded wrenches in assembly of bright-plated slip joints.

Shop demonstration:

- Construct a small sluice box. Securing it at several pitches, pour in a mixture of water and small pieces of putty to demonstrate how pitch affects the washing away of solids.

- The use of color overlays in an overhead projector to show the positioning of septic system components is an effective method.
D. Gas supply

1. Pipes
   a. Materials
   b. Sizes
   c. Line pressure
   d. Valves
      1) Type
      2) Location

2. Connection
   a. Meter
   b. Appliances
      1) Condensation traps
      2) Flexible tubing

3. Testing

---

**OBJECTIVES**

The student should:

- Be aware of the unsuitability of copper pipe for conducting some gases.
- Be aware of the effect of pipe size on gas flow.
- Be aware of the necessity of installing a shutoff valve before each appliance.
- Be acquainted with the form, function, and location of condensation traps.

The student should be able to:

- Assemble a gas-tight pipe system connecting a water heater, range, and clothes dryer to the gas meter, using supplied pipe, fittings, and flexible tubing, and personally selected tools and equipment.

- Demonstrate proper safety procedure in testing pipe lines and appliance connections.

---

**INFORMATION FOR THE TEACHER**

The student should not be expected to figure gas volume delivered, or gas pressure.

Demonstrate metal fatigue in aluminum, induced by repeated bending.

The quality of fitting, tightness, and general neatness of the system should be criteria for evaluation.
III. FINISHING — Suggested Time: 3 Days

A. Fixtures

1. Installation
   a. Sanitary
   b. Bath
   c. Sinks and lavatories
   d. Laundry

2. Connection
   a. Supply
   b. Drain

3. Testing

B. Water heaters

1. Types
   a. Gas
   b. Electric
   c. Domestic water jacket

2. Installation of gas heater
   a. Leveling in place
   b. Water connection
   c. Connection to meter
   d. Venting
   e. Testing

The student should:

* Be acquainted with the function of the hot water heater.

The student should be able to:

* Install provided plumbing fixtures to field standards of workmanship, using personally selected tools and equipment.

* Install and connect — watertight and with finish unmarred — showerheads, drains, pop-up wastes, supply pipes, valves, and controls.

* Set up, connect, and vent a gas water heater, all work being to field standards of workmanship.

* Demonstrate the accepted, safe method of testing the installation for gas and water tightness, and for proper functioning.

The necessity of installing fixtures level, plumb, and true, should be emphasized as should protecting the fixtures from damage by other workmen.

Emphasize protection of chrome, brass, and other visible finishes from damage by wrenches, screwdrivers, and other tools.

A description of function should be sufficient coverage of electric and water jacket heaters.

The student should have a basic understanding of the function of a thermocouple.

The student should not be expected to "troubleshoot" malfunction in the heater mechanism. His competency should be judged on securing leaking connections, positioning the thermocouple, and adjusting the pilot flame.
CONTENT

I. THEORY OF HEAT TRANSFER — Suggested Time: 1 Day

A. Conduction
   1. Function

   2. Relative conductivity of common materials

B. Convection

C. Radiation

II. HEATING SYSTEMS — Suggested Time: 12 Days

A. Hydronic
   1. Method of distribution
      a. Gravity flow
      b. Forced flow
      c. One-pipe system
      d. Two-pipe system

OBJECTIVES

The student should:

- Be acquainted with the means by which heat travel.

Be aware of the superiority of certain materials as either thermal conductors or insulators.

INFORMATION FOR THE TEACHER

The teacher should be prepared to reexplain (Carpentry, X, A.2) the molecular motion theory of heat transfer, if in his judgment, it would aid the students' understanding of this section.

Bench demonstrations of conduction/convection/radiation, and of the relative conductivity of such materials as copper, aluminum, woods, and textiles, are easily devised and quite effective.

Description of the obsolescent systems should be sufficient, that time may be devoted to fully understanding the current system.
# CONTENT

2. Means of distribution
   a. Cast iron
   b. Copper and aluminum

3. Characteristics
   a. Efficiency
   b. Expense

# OBJECTIVES

The student should:

Be aware of the relative values of cast iron and copper/aluminum as radiators.

Be aware of the effect which the system used may have on fuel consumption.

Be acquainted with the systems of warm air heat, and with the specific circumstances in which each system is used.

Be acquainted with the characteristics of forced warm air heat.

Be acquainted with the two common systems of radiant heat and the most common utilizations of each.

# INFORMATION FOR THE TEACHER

The student should view this system as expensive to install, not economically converted to air conditioning, slow to respond -- but delivering very even heat.

The student should know that the position of the plenum chamber determines the type furnace, and that the reverse flow (counterflow) is designed specifically for basementless homes.

The student should view this type system as inexpensive, rapid-acting, compatible to central air conditioning — and somewhat noisy, and prone to soil surfaces around registers.

The student should be aware of the use of hot water radiant heat, usually only in slab construction.
The student should:

2. Method of distribution
   a. Embedded coil
   b. Panels

3. Characteristics

The student should be acquainted with the construction materials compatible with specific distribution systems.

Be acquainted with single or interlocking electrical radiant panels.

Be acquainted with the characteristics of radiant heat.

III. ENERGY SOURCES — Suggested Time: 1 Day

A. Types
   1. Coal
   2. Oil
   3. Gas
   4. Electricity

B. Characteristics
   1. Efficiency
   2. Expense

Be acquainted with the standard sources of energy for heating.

Be acquainted with the characteristics of each energy source which make it more or less desirable for use in homes.

The student should be alerted to the unsuitability of lightweight plasters and acoustical materials as a base for electrical coil radiant heat.

The student should view this system as expensive to install and/or to operate, difficult to service or modify, completely incompatible to air conditioning — but supplying the most even, draft-free heat, and when electrical, nearly maintenance-free and completely clean.

As background or introductory information, this instruction should not be subject to testing.
IV. TEMPERATURE CONTROL — Suggested Time: 2 Days

A. Thermostatic function
   1. Bimetallic rod
   2. Mercury vial

   The student should:
   Be acquainted with the form and function of bimetallic and mercury thermostats.

B. Thermostat features
   1. Single setting
   2. Time change
   3. Combination controls

   Be acquainted with the various types of temperature control available.

   The student should be able to:
   Make an accurate sketch of the single-setting thermostat, mercury and bimetallic, and clearly describe its functioning.

V. SYSTEMS INSTALLATION — Suggested Time: 13 Days

A. Heater unit
   1. Unpacking and placing
      • Removing the components from the shipping containers without marring the cabinet.
   2. Connecting
      a. Transfer system
         1) Pipes
         2) Ducts
         3) Coils

   Set up a heater unit, to field standards of workmanship, including:

Bench demonstration:
Place the bimetallic element in an opaque projector. The class can watch as the projector lamp heat causes the element to bend and close the circuit. The demonstration can be repeated using a mercury thermostat, but due to the need to place it horizontally, the movement but not the contact will be seen.

At this point, the student should not be required to understand the functioning of any control except the single-setting mercury and bimetallic thermostats. It is sufficient that he know of the existence of the other types and what additional functions they perform.

Obtain a supply of installation instruction sheets from the manufacturer of the heater unit being used. Bring the opaque projector into the shop (modern opaque projectors work quite well in partially lighted rooms).
b. Fuel supply

c. Vents

d. Controls

- Checking the shipment for missing or damaged parts.

- Setting the heater unit in place, level, plumb, and true.

- Connecting the unit to the heat transfer system, energy supply, and vents.

- Installing and connecting control devices.

B. Transfer systems

1. Installation

   a. Pipes
      1) Cutting
      2) Preparing the joints
      3) Making connections

   b. Duct work
      1) Joining
      2) Hanging

   c. Resistance coils
      1) Joining sections
      2) Securing in place

   The student should be able to:

   Select, prepare, and sweat-fit the components of a copper hot water heating system, all work watertight and to field standards of workmanship.

   Select, install, and support the components of the duct work of a forced warm air system, maintaining field standards of workmanship.

   Cut, thread, and fit watertight, the components of a hot water radiant heat system.

   Install space strips and wire, and install interlocking grid panels to field standards of workmanship.

Plumbing, II, 3.b.

Instruction should be limited to assembly and joining of sheet metal duct components. The fabrication of the duct sections is not within the scope of this course.

Plumbing, II. 3.a.

Project the schematic/pictorial drawings of the installation instructions. Have the students follow on their copies, your instructions on a segment of the work. Completely illuminate the shop and demonstrate the actual work. Return to the projector for instructions on the next segment.
d. Radiators and registers
   1) Placement
   2) Connection

C. Testing

1. Valves
   Test all valves for proper functioning.

2. Combustion
   Check the resistance coils, or heater unit for proper functioning.

3. Controls
   a. Function
   Test all controls for proper functioning.
   b. Thermostat adjustment
   Adjust the thermostat to maintain the required temperature.

The student should be able to:

Install and properly connect radiators and registers, all surfaces true and unmarred.

Test all valves for proper functioning.

Check the resistance coils, or heater unit for proper functioning.

Test all controls for proper functioning.

Adjust the thermostat to maintain the required temperature.

The student should not be expected to troubleshoot faulty equipment. At this level, it is sufficient that the student to able to determine whether or not the system is functioning properly.
ELECTRICAL THEORY — Suggested Time: 1 Day

The student should:

A. Nature of electrical energy
   Be acquainted with the electron theory.

B. Production of electricity (AC)
   Be acquainted with the process of producing and transmitting electricity.

C. Transmission of electricity
   Categorize common materials as insulators or conductors.
   1. Conductors
   2. Insulators

D. Terminology
   Demonstrate by any teacher specified means, a correct understanding of the common electrical terms.
   1. Ampere
   2. Volt
   3. Watt

The teacher should be prepared to briefly review the electron theory if a need is indicated.

A brief description of a transmission system, from generator to building weatherhead should suffice.

The student should know which common solids and liquids will conduct, and which will insulate. He should know that Type A extinguishing agents must never be used on electrical fires.

It is imperative that the student become safety conscious.

It may be necessary to define the terms to aid the student’s recall. The combining of terms — kilowatt-hour, volt-ampere — should be explained.
II. HOUSE WIRING — Suggested Time: 36 Days

A. Regulatory Codes

1. Type
   a. Underwriters
   b. Local

2. Inspection procedure
   Be acquainted with the procedure involved in obtaining inspection and approval of the installed system.

3. Application of regulations
   a. Service entrance
      1) Entrance cable
      2) Meter connection
      3) Distribution panel
   b. Circuits
      1) Wire gage
      2) Distribution
   c. Switches and receptacles
      1) Type

The student should:

Be aware of the existence of codes specifying standards for electrical installations.

Be aware of the regulations for:
   - 220 v., single-phase entrance
   - Locating the meter
   - Locating, and minimum capacity of, the distribution panel

Be aware of the relationship between circuit wire gage and the circuit total amperage, and thus, the distribution of circuits.

Be acquainted with the common types of switches and receptacles, and with their current ratings.

The student should be aware of existence of such codes, and the necessity of compliance. He should not be required to memorize code content.

The student should not be required to memorize code requirements. He should know that installations are regulated, and how to determine the exact requirements.

The student should know the amperage rating of #18 through #6 wire.

The problems resulting from non-compliance should be presented.
## CONTENT

### 2) Distribution

<table>
<thead>
<tr>
<th>B. Blueprint reading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Symbols</strong></td>
</tr>
<tr>
<td><strong>2. Wiring</strong></td>
</tr>
</tbody>
</table>

### C. Service entrance

<table>
<thead>
<tr>
<th>1. Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Overhead</td>
</tr>
<tr>
<td>b. Underground</td>
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<thead>
<tr>
<th>2. Measuring and cutting cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Tools and equipment</td>
</tr>
<tr>
<td>b. Methods</td>
</tr>
</tbody>
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<thead>
<tr>
<th>3. Installing entrance cable</th>
</tr>
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<tbody>
<tr>
<td>a. Preparing cable ends</td>
</tr>
<tr>
<td>b. Running/supporting cable</td>
</tr>
</tbody>
</table>

## OBJECTIVES

### The student should:

Be aware of the code specifications for locating switches and receptacles.

### The student should be able to:

- Describe the wiring of a specific medium-size one-story house, using code manuals and a provided house plan.
- Measure and cut entrance cable to field standards of accuracy, using personally selected tools and equipment.
- "Skin" and clean the proper amount of cable ends.
- Correctly support exposed cable, or pull cable through a conduit mast.

## INFORMATION FOR THE TEACHER

- The student should know the maximum distance allowable between receptacles.
- The student should be aware that plan locations are not necessarily exact. Door swing, tile and panel heights should be verified.
- The many advantages and the disadvantages of underground service should be explained.
- The high cost of entrance cable should be stressed, but not overemphasized.
- The teacher should introduce the local utility company's booklet of recommended installations and mandated procedures.
<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Connecting</td>
</tr>
<tr>
<td>1) Weatherhead</td>
</tr>
<tr>
<td>2) Meter box</td>
</tr>
<tr>
<td>3) Main disconnect</td>
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<tr>
<td>4. Installing the distribution panel</td>
</tr>
<tr>
<td>a. Types</td>
</tr>
<tr>
<td>1) Fuses</td>
</tr>
<tr>
<td>2) Breakers</td>
</tr>
<tr>
<td>b. Grounding</td>
</tr>
<tr>
<td>c. Safety</td>
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<tr>
<td>5. Circuitry</td>
</tr>
<tr>
<td>a. Layout</td>
</tr>
<tr>
<td>1) Path</td>
</tr>
<tr>
<td>2) Load</td>
</tr>
<tr>
<td>3) Location</td>
</tr>
<tr>
<td>b. Boxes</td>
</tr>
<tr>
<td>1) Types</td>
</tr>
<tr>
<td>2) Sizes</td>
</tr>
<tr>
<td>3) Methods of installation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
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<tbody>
<tr>
<td>The student should be able to:</td>
</tr>
<tr>
<td>Properly connect the cable to its terminals at meter box and main disconnect.</td>
</tr>
<tr>
<td>Properly install a provided distribution panel.</td>
</tr>
<tr>
<td>The student should:</td>
</tr>
<tr>
<td>Be acquainted with the types of panels in use.</td>
</tr>
<tr>
<td>Be aware of the vital importance of using only the correct type extinguisher on electrical fires.</td>
</tr>
<tr>
<td>The student should be able to:</td>
</tr>
<tr>
<td>Lay out the circuitry for a five-room house, properly locating switches and outlets, as indicated on a supplied plan.</td>
</tr>
<tr>
<td>Install boxes as indicated on a supplied plan, by fastening directly to the structure and by use of hanger bars.</td>
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<thead>
<tr>
<th>INFORMATION FOR THE TEACHER</th>
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<tbody>
<tr>
<td>The strict observation of all regulations should be re-emphasized.</td>
</tr>
<tr>
<td>The advantages and disadvantages of each type should be explained.</td>
</tr>
<tr>
<td>The student should understand the need for proper grounding of the system.</td>
</tr>
<tr>
<td>The teacher should be prepared to explain why Type B/C extinguishers are safe for use on electrical fires.</td>
</tr>
<tr>
<td>Layout in a framed unit is, of course, preferable to a &quot;paper&quot; layout.</td>
</tr>
<tr>
<td>Recessed units, &quot;ganging&quot; of boxes, and code limitations on the number of wires per box should be included.</td>
</tr>
</tbody>
</table>
The student should be able to:

**c. Cable**
1) Tools and equipment
2) Armored
3) Nonmetallic

**d. Switches and receptacles**
1) Types
2) Installation

**e. Installing fixtures**

**f. Cover plates**

**6. Testing**

**CONTENT**

**OBJECTIVES**

The student should be able to:

Properly prepare the structure to receive cable.

Pull cable through the prepared path, properly securing ends in boxes, and preparing the ends for connection.

Properly install switches and receptacles as indicated on a supplied plan.

Properly connect and install lighting fixtures.

Properly install cover plates of the type and finish indicated on supplied specifications.

Test the installation for proper functioning.

**INFORMATION FOR THE TEACHER**

Good judgment in locating and boring the circuit path should be developed.

The student should be acquainted with armored cable, but emphasis should be on proficiency with nonmetallic cable.

The student should be capable of installing 220-v. range and clothes dryer connections, and 3-way switches as well as 110-v. receptacles and single-pole switches.

Emphasize protection of the fixture and adjacent surfaces, and the use of correct lamp sizes.

Stress care in not marring the plate or adjacent surfaces, and in keeping the plate plumb.

In case of malfunction, the student's "troubleshooting" should be limited to checking fixtures and boxes for loose or improper connections.
AIR CONDITIONER INSTALLATION

CONTENT

I. FUNCTION — Suggested Time: 2 Days

A. Heat transfer theory

1. Intensity
   a. Fahrenheit
   b. Celsius
   c. Absolute

   The student should be able to:
   - Demonstrate an understanding of intensity and the difference in the measuring scales in use.
   - Transpose intensity readings from one scale to another when provided the conversion formulas.

2. Quantity
   a. Btu
   b. Specific heats

   Demonstrate an understanding of quantity of heat, the British thermal unit as a measurement of heat quantity, and specific heat as an indication of heat content of a material.

   The student should:
   - Be acquainted with the specific heats of several common materials.

OBJECTIVES

The student should be able to:

INFORMATION FOR THE TEACHER

The teacher should be prepared to aid the student in recalling this information.

The student should not be required to memorize these formulas but only to perform the required arithmetic function as indication of his comprehension of intensity measurement.

Comparison:

Intensity — One quart of water and one pint of water are both at 180°F. If both amounts of water are cooled to 170°F., the quart will release 20.4 Btu's of heat; the pint will release 10.2 Btu's.
## CONTENT

### B. Refrigeration system

1. **Type**
   - a. Compression
   - b. Absorption

2. **Service**
   - a. Room
   - b. Central

### C. Controls

1. **Operation**
   - b. Semiautomatic
   - c. Automatic

2. **Type**
   - a. Bimetallic rod
   - b. Mercury vial

## OBJECTIVES

The student should:

1. Be aware of the existence of two refrigeration systems.
2. Be sufficiently acquainted with the compression system to understand how it produces cold air.
3. Be acquainted with the differences in room conditioners and central conditioners.
4. Be acquainted with the convenience features available in temperature controls.
5. Be acquainted with the function of the direct contact, bimetallic rod, and the mercury contact, bimetallic coil thermostats.

## INFORMATION FOR THE TEACHER

The objectives of the section are concerned with conditioner installation. The student should understand the basic functioning of conditioners needed for systems installation. Adjusting or repairing malfunctioning equipment is not within the scope of the course.

The absorption system should be clearly explained, but emphasis should be on the more common compression system.

It is necessary at this level, only that the student know of the existence of units providing certain convenience advantages. He should not be required to understand the functioning of any but the manual control.

Heating, IV. A.
II. INSTALLATION — Suggested Time: 7 Days

A. Room unit

1. Location
   a. Direct sunlight
   b. Airflow obstructions
   c. Electrical supply
      1) Ampacity
      2) Voltage

2. Placement
   a. Window frame
   b. Existing wall opening

3. Installing the mounting frame and brackets, or mounting sleeve.

4. Installing the unit

The student should:

- Be aware of the need to locate the unit where it will not be seriously affected by conditions which interfere with its functioning.
- Be acquainted with proper procedures in checking an existing electrical supply for sufficient capacity.
- Be aware of the advantages in placing the unit on its own separate circuit.
- Be aware of the two standard placements of room unit conditioners

The student should be able to:

- Properly install a mounting sleeve in an existing wall opening, using personally selected tools and equipment.
- Properly install a mounting frame and brackets in a double-hung window unit, using personally selected tools and equipment.
- Properly secure the unit housing in the mounting sleeve.

The student should be instructed in how these factors affect conditioner functioning.

It is sufficient that the student understand the necessity of checking electric power, and the manner in which it is done. Proficiency in such testing is not within the scope of the course.

Instruction should be limited to placement in double-hung windows and previously prepared wall openings, since this course is limited to new construction.

The student should be aware of the need to pitch the mounting components 1/8-inch on 1-foot to the outside, to allow condensation to drain away from the wall.

Emphasize:
- Move units by grasping the bottom pan — never by the tubing or coils.
The student should be able to:

Secure the unit housing to the mounting frame and brackets.

Properly install the unit in the housing.

Measure, cut to a sealable accuracy, and install filler boards, using provided fasteners and personally selected tools.

Neatly and correctly install sash locking brackets.

Neatly and correctly install seals at all possible air leakage points.

Test the installed unit for proper operation of the cooling, ventilating, and exhausting functions.

Check the clearance of refrigerant lines and wiring before placing the unit in the housing. NEVER force the unit into place.

The student should understand the necessity of eliminating air leaks around the installation.

Emphasize care in avoiding marring the exposed finished parts of the conditioner and surrounding surfaces, and in obtaining a pleasing appearance of seals and calking.

The student should be able to determine if air is being cooled and moved, and if it is being moved in the correct direction. Troubleshooting a unit malfunction should be limited to obstructing all air vents to determine whether or not the thermostat is functioning.
B. Central unit

1. Furnace combination
   a. Installing a combination unit
   b. Installing in existing unit
   c. Installing controls
      1) Combination thermostat
      2) Single function thermostat
   d. Connecting to power supply
   e. Installing diffuser grilles

2. Independent precharged unit
   a. Preparing the installation
      1) Packaged unit

The student should:

- Be aware of the increased capacity of water-cooled units.
- Be acquainted with the several advantages of packaged units.
- Properly unpack and assemble a climate control unit, observing all the manufacturer's instructions.
- Properly unpack and install in an existing forced warm air system, a precharged conditioning unit, all work to be in accordance with manufacturer's instructions.
- Install temperature controls as specified by the manufacturer.
- Connect the unit to the electrical power supply observing applicable codes and regulations, and the manufacturer's instructions.
- Connect the high electrical requirements of control units should be discussed.
- The student should understand that the 25 percent increase in efficiency is affected by the cost of cooling water.
- Seemingly evident advantages --- mechanism not exposed to weather, windows are not blocked, interior decor is not affected, thermostat is more efficiently located, noisy mechanisms are not in the room --- may not occur to the student without teacher direction.

Emphasize care in handling components to avoid damaging refrigerant lines and capillary tubes.
<table>
<thead>
<tr>
<th>CONTENT</th>
<th>OBJECTIVES</th>
<th>INFORMATION FOR THE TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Remote cooler unit</td>
<td>The student should: Be acquainted with the advantages and disadvantages of remote cooler units.</td>
<td>Expense of installation, maintenance of exterior parts, and effect on property appearance must be balanced against estimated savings in water costs.</td>
</tr>
<tr>
<td>b. Installing ducts</td>
<td>The student should be able to: Install ductwork as specified on a supplied detail, all workmanship conforming to field standards.</td>
<td>The student should not be expected to lay out the ductwork, nor to fabricate parts. His work should be evaluated on proficiency in selecting specified components, and on tightness and neatness of installation.</td>
</tr>
<tr>
<td>1) Rigid</td>
<td></td>
<td>Specifications for the concrete for mounting a remote cooling unit should be discussed. Masonry, I.E.3.</td>
</tr>
<tr>
<td>2) Flexible</td>
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<tr>
<td>3) Hangers</td>
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<tr>
<td>c. Installing the condenser</td>
<td>Install the condenser and evaporator units in their proper places without damaging the coils, fins, coolant lines, or cabinetry.</td>
<td></td>
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<tr>
<td>d. Installing the evaporator</td>
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<tr>
<td>e. Installing controls</td>
<td>Install temperature controls as directed by the manufacturer, properly leveling in place without marring the control or adjacent surfaces.</td>
<td></td>
</tr>
<tr>
<td>f. Connecting to supply lines</td>
<td>Connect the unit to power and water supply, and to water disposal if necessary, conforming to codes, regulations, and standards of workmanship.</td>
<td>Electricity, II, A.1. Plumbing II, A.3.6.</td>
</tr>
</tbody>
</table>
3. Testing

**OBJECTIVES**

_The student should be able to:_

Activate the unit, and check the movement of air and the proper functioning of temperature controls.

**INFORMATION FOR THE TEACHER**

Student troubleshooting should be limited to adjusting a properly operating thermostat, and eliminating faulty connections in water, electrical, and duct systems.
PAINTING AND DECORATING

CONTENT

I. PREPARING THE SURFACE — Suggested Time: 6 Days

A. Smoothing and cleaning

1. Tools and equipment

The student should:

Be aware that the finish cannot improve a poorly prepared surface.

Be aware that finishes will not adhere to wet, slippery, or loose surfaces.

The student should:

a. Hand tools

Be acquainted with the common hand tools used for preparing surfaces.

b. Power tools

Be acquainted with the common power tools used for preparing surfaces.

c. Coated abrasives

1) Shapes and sizes

Be acquainted with the variety of coated abrasives available for hand and machine use.

2) Grits

3) Manufacture

INFORMATION FOR THE TEACHER

Bench demonstration:

Select samples having rough spots and checks. Apply paint and clear finish. Show the results. Make opaque or transparent drawings of reflective/refractive surfaces. Project. Explain.

In the process of acquiring skill in use, the student should become capable of identifying and selecting such surface preparation tools as planes, scrapers, belt sanders, disc sanders, and orbital sanders.

Compare sandpaper samples representing the variety of grit sizes and materials, by use of the opaque projector. Discuss the information printed on the backing. Charts, booklets, and filmstrips are available from abrasives manufacturers and their associations.
The student should:
Be acquainted with the solvents available for cleaning pitch, wax, oils, and asphalt from surfaces to be finished.

2. Methods
a. Wood
b. Metal
c. Composition

The student should be able to:
Safely and properly prepare for finishing, supplied surfaces containing such representative imperfections as tool marks, pencil marks, rough spots, and lumber crayon marks.

B. Patching

1. Materials
a. Wood doughs
b. Paste wood fillers
c. Drywall cements
d. Putty
e. Fibraded epoxies

The student should:
Be acquainted with the various materials used to fill cracks, chips, pitch pockets, and nail holes in surfaces being prepared for finishing.

2. Tools and equipment

Be acquainted with the tools and equipment commonly used in patching defective surfaces.

Emphasize health and safety aspects. Explain Type B fire extinguishers. Paint and varnish removers should not be introduced in this course which is concerned with new work rather than repair and maintenance.

The student's work should be judged on safe and orderly procedures, and a degree of finish commensurate with the nature of the product.

The student should be instructed in the proper use of putty knives, trowels, chisels, and rough cloth.
II. APPLYING THE FINISH — Suggested Time: 11 Days

A. Stains

The student should:

1. Type
   a. Oil
   b. Water
   c. Spirit

   - Be aware of the availability of different types of stain, based on the nature of the pigment carrier.
   - Be acquainted with the relative advantages and disadvantages inherent to each type.
   - Be aware that species of wood vary in ability to "take" a stain.

Bench demonstration:
Stain one piece of pine or fir with each of the three types. Show results in an opaque projector. Apply stripes of the three types to each piece of a collection of woods of varying "stainability," to show effects of stain type on quality. Project.
## CONTENT

2. Application

<table>
<thead>
<tr>
<th>a. Brush</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Wipe-on</td>
</tr>
</tbody>
</table>

B. Clear finishes

1. Type
   | a. Surface |
   | b. Penetrating |

2. Materials
   | a. Shellac |
   | b. Lacquer |
   | c. Varnish |
   | d. Synthetic resins |
   | e. Sealers |

3. Means of application
   | a. Brush |
   | 1) Types |
   | 2) Methods |

## OBJECTIVES

**The student should be able to:**

- Apply oil and spirit stains to woods of medium to good stainability, achieving a finish quality commensurate with the nature and purpose of the surface.

## INFORMATION FOR THE TEACHER

- Proficiency in use of the less common water stains is not necessarily entry-level proficiency.

- The student should know such basic properties as the effects of alcoholic beverages on shellac, the nongloss finish of sealers, and the high weather-resistance of lacquer.

- Finishes should be applied with varnish/enamel, wall, and sash brushes, in sizes from 3/4-inch to 4 inches.

- Instruction and practice should show the false efficiency of attempted use of brushes of unsuitable size or type, and of finishing around installed hardware.
CONTENT  |  OBJECTIVES  | INFORMATION FOR THE TEACHER
---|---|---
3) Maintenance  | The student should: Be acquainted with the means of maintaining brush condition. | Emphasize the need to clean brushes after use. Acquaint with vapor-type brush conditioners. |
b. Spray  | Be aware of the existence of two types of spray equipment. | The students should be instructed in the properties of pressure-feed and suction-feed. |
  1) Types  | Be acquainted with the proper methods of spray finishing. | Instruction and practice should begin to develop judgment of proper distance for various finishes, and a "parallel wrist." |
  2) Methods  | Be acquainted with the means of routinely maintaining spray equipment. | Emphasize the need to solvent-clean spray equipment immediately after use. |
3) Maintenance  | | |
C. Paints  | The student should: | |
  1. Type  | | The student should realize that while using interior paints outdoors is merely uneconomical, use of lead-base exterior paints indoors can be injurious to health. |
    a. Exterior  | Be aware of the existence of specific paints for indoor and outdoor use, and of the general noninterchangeability of their natures. | |
    b. Interior  | | |
CONTENT

2. Surface finish
   a. Gloss enamel
   b. Semigloss
   c. Flat

5. Base material
   a. White lead
   b. Ti and TiL
   c. Latex
   d. Alkyd resins
   e. ZnO

4. Application
   a. Brush
      1) Types and uses
      2) Maintenance
   b. Roller
      1) Types and uses
      2) Maintenance

OBJECTIVES

The student should:

- Be aware of the existence of paints prepared to provide a specific amount of surface reflectivity.
- Be acquainted with the common paint bases, and with the outstanding properties of each.
- Demonstrate by any teacher-selected means, a basic knowledge of the variety of common paints available, their outstanding properties, and proper utilization.
- Apply paint to field standards of quality, personally selecting proper brushes and equipment.
- Properly clean and store brushes after use.
- Apply paint to field standards of quality using roller and pan, and using pressure-feed roller. Properly clean and store equipment after use.

INFORMATION FOR THE TEACHER

Instruction should be given on characteristics of surface finishes — glare, soil resistance, easy washability — which affect the choice of paint for a given use.

The properties of the common paint bases — resistance to sunlight, moisture resistance, resistance to chemical fumes, self cleaning or nonchalking — should be clearly explained.

The student should acquire this knowledge by repeated teacher-statement, and by use, not by memorization.

Emphasize removal of hardware, and the covering of surfaces not to be painted.

The relationship between roller cover material and paint type should be emphasized.
c. Spray

1) Types and uses

The student should be able to:

Apply paint to field standards of quality, using teacher-selected spray equipment.

2) Maintenance

Properly clean and store equipment immediately after use.

3) Safety

Demonstrate by use thereof, and by any other teacher-designated means, an appreciation of proper safety and health precautions.

D. Solvents

1. Common materials

   a. Alcohol
   b. Lacquer thinner
   c. Turpentine
   d. Mineral spirits

   The student should:

   Be acquainted with the commonly used solvents, and with their individual properties.

2. Uses

   a. Thinning
   b. Cleaning

   Be aware of the uses to which solvents are put.

3. Safety

   a. Inhalation
   b. Ingestion
   c. Eye and skin protection

   Be acquainted with general safety procedures for use of solvents.

The teacher's knowledge of local employment conditions will determine whether pressure-feed as well as suction-feed equipment will be used.

The student should know what to do, what not to do, and why.

The student should know the proper first-aid procedures for each solvent used in his course.

The teacher should not be required to memorize the finish/solvent relationships, since this information is given on the container. He should be encouraged to form a habit of reading this information before opening the container.

The teacher should know the proper first-aid procedures for each solvent used in his course.
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<tr>
<td>d. Type B fire</td>
<td>The student should: Be aware of the type extinguisher proper for use on volatile liquids. Be aware of the type extinguisher which must not be used on volatile liquids. The student should be able to: Demonstrate by use, and by any other teacher-designated means, an appreciation of and adherence to proper safety procedures.</td>
<td>The student should understand why the proper type should be used. He should be aware of any undesirable side effects.</td>
</tr>
</tbody>
</table>

III. MATERIALS ESTIMATION — Suggested Time: 2 Days

A. Area measurement

1. Rectangles
   - The student should: Be aware that most triangular shapes will contain a right angle.

2. Triangles
   - Be aware that most irregular shapes will be composites of several regular shapes.

The student should be able to:

B. Coverage

1. Prime coat
2. Two-coat system
3. Three-coat system

Demonstrate by any teacher-designated means, an ability to transpose area measurement to a correct number of units of finish materials.

Overhead projection of defined areas, with overlays lined as included square feet should be an effective method. Reuse of Carpentry, VIII, K., may be helpful.
CONTENT

The student should:

Be aware that the same amount of different finishes will provide different coverage.

Be aware that a finish will provide different coverage on different surfaces.

IV. MATERIALS STORAGE — Suggested Time: 2 Days

A. Fire prevention and control

1. Ignition combustion
   a. Proper containers
   b. Proper storage facilities

2. Spontaneous combustion
   a. Critical materials
   b. Proper disposal

3. Explosion
   a. Vapors control
   b. Eliminating sources of ignition

The student should be able to:

Demonstrate in use, and by any other teacher-designated means, a knowledge of proper storage conditions and procedures.

INFORMATION FOR THE TEACHER

Shop demonstration:

Gather samples of representative materials such as fiberboard, gypsum board, white pine, and plain-sawed red oak. Stripe each with various finishes. When dry, screen in the opaque projector, then pass among the students to show difference in coverage.

The shop facilities must include an amount of small storage spaces of approved construction, Emphasize immediate placing of used wiping cloths in metal safety cans which must be emptied at the end of each school day.

Violations of safety procedure should always be immediately discussed with the violator.
<table>
<thead>
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<th>CONTENT</th>
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<th>INFORMATION FOR THE TEACHER</th>
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</thead>
<tbody>
<tr>
<td>B. Maintaining stock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Stock rotation</td>
<td>The student should:</td>
<td>The student should understand why stock must be rotated — settling of solids, dropping of a color from the manufacturer's line, changes in shade of a color designation over long periods of time.</td>
</tr>
<tr>
<td></td>
<td>Be aware of the need to use older stock first.</td>
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<tr>
<td>2. Mixing devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Impellers</td>
<td>Be acquainted with stock rotation procedures.</td>
<td></td>
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<tr>
<td>b. Vibrators</td>
<td>Be acquainted with devices used to insure thorough preuse mixing of stored finishes.</td>
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<tr>
<td></td>
<td>The student should be able to:</td>
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<td></td>
<td>Demonstrate, by continuous use thereof, a knowledge of proper stock maintenance and preparation procedures.</td>
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</tr>
</tbody>
</table>
BOOKS

CARPENTRY


Concrete form construction. Albany.

Framing, sheathing, and insulation. Albany.

Hand tools and portable machinery. Albany.

Interior and exterior trim. Albany.


Woodworking for industry. Peoria, Ill. Chas. A. Bennett Co., Inc. 1963.


MASONRY


Louisville Cement Co., Inc. Specifications recommended to secure dry brick walls, AIA file no. 5-M. Louisville, Ky. 1952.

Type of workmanship recommended to secure dry brick walls, AIA file no. 5-A. Louisville, Ky. 1951.

Type of workmanship recommended for concrete block walls, AIA file no. 10. Louisville, Ky. 1953.


PLUMBING


HEATING/AIR CONDITIONING


ELECTRICITY


PAINTING/DECORATING

Forest Products Laboratory. Wood handbook. Washington. U.S. Department of Agriculture.


GENERAL


**OCCUPATIONAL DESCRIPTION**

These publications may be of value to the teacher of Building Industries Occupations who also is engaged in prevocational guidance or instruction.


KDI Instructional Systems, Inc. *Understanding the construction industry.* Columbus, Ohio. The Corporation.


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Residential electrical wiring. DCA Educational Products, Inc. Color.

Wood technology. DCA Educational Products, Inc. Color.
FILMSTRIPS - 35 MM.

Portable electric tools. Bailey Films. Series of five, 50-frame strips, color, records.

Portable power saws. Bailey Films. Two part series — 68 frames and 45 frames, color, records.

Safety and economy with the national electrical code. U.S. Department of Housing and Urban Development. 12 min., b & w, record.


SOUND FILMS - 16 MM.

Department of the Navy, Office of Information Catalog:

Basic Electricity Series —
The electron theory, MN-8016A, 5 min.
Current flow - what it is, MN-8016C, 3 min.
What causes current flow - EMF, MN-8016F, 3 min.
What causes current flow - resistance, MN-8016G, 3 min.
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AC parallel circuits, MN-8018D, 5 min.

Building Techniques Series —
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Framing, hip and valley rafters, MN-6719D, 25 min.
Interior and exterior trim, MN-6719E, 12 min.
Care and Use of Hand Tools Series —

Threading caps and dies, MN-7831G, 14 min.
The use of soldering coppers, MN-78311, 8 min.

State of New York, Department of Commerce Catalog:

At home with wood. U.S. Dept. of Agriculture, 1959, 12 min., color.
Baltimore plan. EBF, 1952, 20 min., b & w.
Blueprint for power. National Electric Manufacturers' Assoc., 1956, 18 min., color.
From trees to lumber. American Forest Products Industries, 1953, 14 min., b & w.
Power by which we live. General Electric Co., 23 min., color.
Wood, masterpiece of creation. SUNY College of Forestry, 1966, 28 min., color.

Miscellaneous Sources

A house in the sun. Jones & Laughlin, 40 min., color.
Basic electricity, TF1-4144. National Audiovisual Center, 19 min., color.
Cable surface wiring, OE 377. National Audiovisual Center, 17 min., b & w.
Knowing woods and their uses, code 401984. McGraw-Hill, 13 min., b & w.
Roughing-in nonmetallic sheathed cable, OE 373. National Audiovisual Center, 16 min., b & w.
Structural for modern building. Armco, 15 min., color.
Three-wire service entrance, OE 374. National Audiovisual Center, 24 min., b & w.
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