Chapter 11
Construction Drawings

Topics

1.0.0 Types of Construction Drawings
2.0.0 Project Drawing Preparation
3.0.0 Main Divisions of Project Drawing

To hear audio, click on the box.

Overview

Whenever a property’s cognizant authority intends to change the property by disturbing the natural soil or erecting a structure, they need to communicate their intentions to the constructors. They do this through a set of construction drawings.

The drawings describe the soil disturbance, structure, or facility with a set of related drawings that give a sequential graphic description of each phase of the construction process. For example, site drawings will show the location, boundaries, contours, and outstanding physical features of the construction project’s footprint and its adjoining areas.

Depending on the size and complexity of the project, succeeding drawings will provide further graphic and printed instructions for each phase of construction. They may include architectural for concept and finishes, structural for foundation and superstructure, mechanical for water distribution and waste removal, and electrical for power distribution. Others may include, although less frequently, heating, ventilating, and air-conditioning, fire sprinkler systems, alarm systems, and/or landscaping.

This chapter will cover the typical drawings used by most moderate sized construction projects. There may be more (or fewer) drawings for any given project, but the concept is the same for all drawings: convey the designer’s concept and intentions through drawings to the builder. As an EA, one of your tasks will be to provide accurate information through your drawings for your unit’s Seabees to get the job done.

Objectives

When you have completed this chapter, you will be able to do the following.

1. Describe the different types of construction drawings.
2. Describe the procedures for preparation of project drawings.
3. State the main divisions of project drawings.

Prerequisites

None
This course map shows all of the chapters in Engineering Aid Basic. The suggested training order begins at the bottom and proceeds up. Skill levels increase as you advance on the course map.

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<td></td>
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<tr>
<td>Drafting: Equipment</td>
<td></td>
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<tr>
<td>Mathematics and Units of Measurement</td>
<td></td>
</tr>
<tr>
<td>Engineering Aid Rating</td>
<td></td>
</tr>
</tbody>
</table>

**Features of this Manual**

This manual has several features which make it easy to use online.

- Figure and table numbers in the text are italicized. The figure or table is either next to or below the text that refers to it.
- The first time a glossary term appears in the text, it is bold and italicized. When your cursor crosses over that word or phrase, a popup box displays with the appropriate definition.
- Audio and video clips are included in the text, with an italicized instruction telling you where to click to activate it.
- Review questions that apply to a section are listed under the Test Your Knowledge banner at the end of the section. Select the answer you choose. If the
answer is correct, you will be taken to the next section heading. If the answer is incorrect, you will be taken to the area in the chapter where the information is for review. When you have completed your review, select anywhere in that area to return to the review question. Try to answer the question again.

- Review questions are included at the end of this chapter. Select the answer you choose. If the answer is correct, you will be taken to the next question. If the answer is incorrect, you will be taken to the area in the chapter where the information is for review. When you have completed your review, select anywhere in that area to return to the review question. Try to answer the question again.
1.0.0 TYPES OF CONSTRUCTION DRAWINGS

Construction drawings are categorized by intended purpose. Besides the type used in the field to do the on-site activities, other types are often needed in the larger scope of “Construction” from conceptual ideas to the finite details of a manufactured part. This chapter will cover some of the types commonly used in military construction.

1.1.0 Presentation Drawings

Presentation drawings (as the name implies) present the proposed building or facility in an attractive setting in its natural surrounding at the proposed site. They often consist of perspective views complete with colors and shading. (Figure 11-1) Presentation drawings are usually used to “sell” an idea or design concept, so as an EA assigned to the drafting section, you would rarely be tasked with developing them, but you need to be able to recognize them.

Figure 11-1 – Example of presentation drawing-Gulfport duplexes post Katrina.

1.2.0 Shop Drawings

Shop drawings can be more than just a drawing. They can also be schedules, diagrams, or other related data intended to illustrate materials, products, or systems for some portion of the work. (Figure 11-2) The construction contractor, subcontractor, manufacturer, distributor, or supplier can prepare them along with providing product data. Product data include brochures, illustrations, performance charts, and other
information by which the work will be judged. As an EA, you may be required to draft shop drawings for minor shop and field projects.

Figure 11-2 – Typical shop drawing — (Doorframe ordering options.)

You may need to draw shop items, such as doors, cabinets, and small portable structures from portions of the design drawings, specifications, material schedules, or from freehand sketches given by the design engineer.

1.3.0 Master Plan Drawings

Master plan drawings are commonly used in the architectural, topographical, and construction planning processes. They show sufficient features for use as guides in long-range area development. (Figure 11-3)

Figure 11-3 – Example of simple existing plan and proposed master plan.
They usually contain:

- North point indicator (arrow)
- Section boundary lines
- Horizontal and vertical control data
- Contour lines
- Acreage
- Streams
- Profiles
- Existing utilities
- Rights-of-way and appurtenances
- Locations and descriptions of existing and proposed structures
- Existing and proposed surfaced and unsurfaced roads and sidewalks

On existing and proposed Navy installations, the Resident Officer in Charge of Construction (ROICC) and the Public Works Center (PWC) constantly maintain and upgrade the master plan and general development drawings as well as the as-buils.

1.4.0 Working Drawings

A working drawing (project drawing) is any drawing that furnishes the information craftsmen require to manufacture a machine part (Figure 11-4) or builders and crew require to erect a structure.

Working drawings can be prepared from a freehand sketch or from a design drawing.

They present information complete enough that the user will require no further information.

A good set of project drawings includes all the drawings necessary for each Seabee rating to complete its stage of a project.

These drawings show the size, quantity, location, and relationships of a building’s components.

Figure 11-4 – Typical working drawing for a machine part.
A complete set of project drawings consists of general drawings, detail drawings, assembly drawings, and always a bill of materials.

- General drawings consist of “plan views” (from above) and “elevation views” (from side or front) drawn on a relatively small-defined scale, such as 1/8 in. = 1 ft or 1/4 in. = 1 ft. Most general drawings are in orthographic projections although sometimes details may appear in isometric or cavalier projections. (Figure 11-5)

Figure 11-5 – Typical views for general drawings.

- Detail drawings show a particular item on a scale larger than the general drawing’s scale. A detail drawing may include additional features not viewable from the perspective of the general drawing or items too small to appear on a general drawing. They may also be in a view other than the general drawing’s; for example, the detail may be in an isometric view to provide a three dimensional perspective for additional information. (Figure 11-6)

Figure 11-6 – Typical detail drawing.

- An assembly drawing can be either an exterior or a sectional view of an object. It may be drawn to a smaller or larger scale than the detail drawings, but its
The purpose in any scale is to show the proper relationship of elements to each other. This procedure provides a check on the accuracy of the design and detail drawings and often discloses errors. (Figure 11-7)

**Figure 11-7 – Typical assembly drawing.**

- A bill of materials may be incorporated on the drawing sheet if space is available, but if not, it must be listed on a separate sheet. It contains a list of the quantities, types, sizes, and units of materials required to construct the object presented in the drawing. (Figure 11-8)

<table>
<thead>
<tr>
<th>Item #</th>
<th>Quantity</th>
<th>Unit of meas. or x</th>
<th>Size/Description</th>
<th>Est. Price Each</th>
<th>Total Est. Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>x</td>
<td>2x12x16’ (Re-use for Accessories and scaffolding)</td>
<td>$20.00</td>
<td>$140.00</td>
</tr>
<tr>
<td>66</td>
<td></td>
<td>8d Duplex nails</td>
<td></td>
<td>$4.00</td>
<td>$40.00</td>
</tr>
<tr>
<td>36</td>
<td></td>
<td>1x2 Stakes and Angel braces (every 4’ excluding inside corners)</td>
<td>$0.10</td>
<td>$3.60</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>1/2 X 20’ Rebar</td>
<td></td>
<td>$5.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>1</td>
<td>100’ Roll</td>
<td>6x6 Welded Wire Mesh</td>
<td></td>
<td>$50.00</td>
<td>$50.00</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>1/2x12 Anchor Bolts with flat washer and nut</td>
<td>$2.00</td>
<td>$36.00</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>*Cu. yds</td>
<td>Clay dirt or Crushed Rock (*approx.)</td>
<td>$20.00</td>
<td>$100.00</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>*Cu. yds</td>
<td>Concrete (*approximate)</td>
<td>$55.00</td>
<td>$550.00</td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>Sq.ft</td>
<td>Grill poly ethylene</td>
<td>$0.05</td>
<td>$35.00</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 11-8 – Typical bill of materials.**

With the exception of expeditionary or expedient construction, in a typical military construction project, NAVFACENGCOM will review and evaluate working (project) drawings to ensure good quality, consistency, and cost effectiveness in a design. The drawings will go through stages during the review process. The following paragraphs
describe these stages, from the initial development of the project to the final phase of construction.

1.4.1 Preliminary Drawings
The designer or architects and engineers (A/E) firm prepares preliminary drawings in the early planning or promotional stage of a project’s development. They are strictly initial concepts and provide a means of communication between the designer and the customer. Preliminary drawings are NOT intended for construction. Their purpose is to explore design concepts, material selection, and preliminary cost estimates; solicit input and approval by the customer; and provide a basis for preparing working drawings.

By the time preliminary drawings reach the 35-percent stage of completion, they will contain the following information at a minimum:

- Site plans
- Architectural floor plans
- Elevations
- Building sections
- Preliminary finish schedule and furniture layout
- Interior and exterior mechanical and electrical data
- Civil and structural details

If the preliminary drawings are intended for use as Seabee project, the senior regional Seabee command will review them for construction methods or procedures. If the project is to be contracted to other sources, the local ROICC will provide the review.

1.4.2 Final Drawings
100% complete and used for bidding, the final drawings (Finals) are signed by the contracting officer and become the official contract drawings once the contract is awarded. However, with the concurrence of both the contractor and contracting officer, final drawings are often revised to show adjustments made by a scope change or a change order.

At this stage, no further functional input may be introduced into the final drawings because of time constraints or cost implications. In general, final drawings, together with project specifications, cost estimates, and all of the calculations, comprise the final stages of design requirements.

1.4.3 Red-Lined Drawings
Red-lined drawings get their name from the color used to indicate a minor design change or field adjustment. Using the official contract drawings, the mark-ups usually come from the field by the various trades involved in the project with the mark-ups reflecting the as-built conditions during construction.

1.4.4 As-Built Drawings
These are the original contract drawings (or copies) that are changed to incorporate the various as-built conditions from all the accumulated red-lined drawings. The construction contractor or military construction force (NMCB) must provide the ROICC with as-built drawings indicating any deviations from the contract drawings. The as-built marked-up prints must reflect exact as-built conditions and show all features of the
project as constructed. After completion of the project, the ROICC transmits the as-built marked-up prints to their cognizant Engineering Field Division (EFD).

1.4.5 Record Drawings
Record drawings are the original contract drawings (corrected according to the marked prints) that provide a permanent record of as-built conditions upon completion of a project. EFD may retain custody or transfer them to stations with a Public Works Center (PWC).

1.5.0 Conceptual Designs
Conceptual designs in the Navy include both definitive designs and standard designs for structures and facilities needed on a repetitive basis. Both are prepared designs or drawings defining various functional, engineering, and logistical requirements. They provide a uniform basis for planning and design.

1.5.1 Definitive Designs
Definitive designs are drawings of typical buildings and structures found in NAVFAC P-272, Definitive Designs for Naval Shore Facilities, Part 1. They provide general guidance to prepare project drawings and specifications. A/E contractors or in-house staff can refer to these definitive designs for floor plan arrangements, building sections and elevations, and utility requirements.

NAVFACP-272 Part 2 contains specific guidance in preparing project designs for more complex facilities. These may include equipment layouts, piping diagrams, electrical schematics, and other critical requirements.

NOTE
Valid technical information from P-272 has been included in the Unified Facilities Criteria (UFC) for the particular facility type; see the appropriate UFC for further information.

The facilities type of design includes additional information in the form of single-line schematics, bubble diagrams, or facility plates (Figure 11-9), graphics that show functional relationships or building layout such as individual rooms within the facility.

Facility plates may show:

- The location of equipment and furnishings within a room
- The location of utilities serving the room
- The location and size of doors and windows
- A ceiling plan reflecting the location of lighting fixtures
- Other technical design information about the room

Facility plates are used instead of definitive designs whenever the plates effectively convey the necessary design data, or whenever the definitive designs are scheduled for development, revision, or validation. Most of the facility plates can be found within the pages of criteria or design manuals (DMs).
Figure 11-9 – Example of a facility plate (based on Definitive Design 1404366).
1.5.2 Standard Designs

Standard designs are detailed working drawings of specialized, unique, naval facility structures, such as waterfronts and fleet moorings, aircraft operations and maintenance facilities, and ammunition storage facilities.

They form a part of the construction documents and require only supplemental drawings for adapting the facility to the specific site. These drawings (except for ammunition facilities) can be modified as necessary to meet on-site requirements.

⚠️ WARNING ⚠️

Ammunition and explosive design standards may NOT be modified without approval from Naval Facilities Engineering Command (NAVFACENGCOM).

⚠️ WARNING ⚠️

When using standard designs for a construction project, with or without modifications, the cognizant EFD must assign new title blocks and drawing numbers.

A third source of detailed construction drawings, although NOT definitive, is the NAVFAC P-437, Facilities Planning Guide, Vol. 1. The P-437 contains facility and assembly drawings of pre-engineered structures used to meet the Naval Construction Force (NCF) needs at advanced bases in peacetime and during contingency operations. Thus, if construction planners need a particular facility to meet tactical and/or strategic situational requirements, they can easily and readily identify the required facility and provide support.

Along with the detailed drawings, the P-437 also provides other useful information for Seabee planners such as the required land area, crew size and man-hours by skill, and the fuel necessary to make a component, facility, or assembly operational.

As an EA, you should realize the importance of becoming familiar with the contents of NAVFAC P-437.

**Test your Knowledge (Select the Correct Response)**

1. An EA assigned to the drafting section would rarely be tasked with developing a ______. drawing.
   
   A. shop  
   B. preliminary  
   C. working  
   D. presentation

2.0.0 PROJECT DRAWING PREPARATION

All NAVFACENGCOM project drawings are prepared according to ASME Y14.100. Military handbook UFC 1-300-09N provides policy and procedure for preparing and developing project drawings.

They must be complete, accurate, and explicit. For naval facility construction projects, the project drawings and the design specifications are the basis for both contract and construction. EAs and in-house planners also benefit from clear and consistent project drawings resulting from the policies and procedures in UFC 1-300-09N, especially when revising project drawings.
2.1.0 Policy and Standards

NAVFACENGCOM establishes the design criteria for project drawings. These criteria also apply to the definitive designs, standard designs, standard drawings, and project specifications. NAVFACENGCOM allows EFDs and A/E latitude in new concepts, creative thinking, and the use of new materials, but when they are considering deviations from mandatory criteria, they need to obtain prior clearance from NAVFACENGCOM headquarters.

Use customary U.S. dimensions on project drawings unless the project is in an area that normally uses System International (SI). The International System of Units is the internationally accepted “metric” system. However, use of the word “metric” is no longer an accepted practice. For details of the proper use of SI units, refer to IEEE/ASTM SI 10-1997, Standard for Use of International System of Units (SI): The Modern Metric System for generic conversions, and ASTM E621-79, Recommended Practice for the Use of Metric (SI) Units in Building Design and Construction, for conversions in engineering and design.

2.2.0 Order of Drawings

Arrangement of project drawings for buildings and structures follow a specific order:

1. Title Sheet and Index — specific project title and an index of drawings (for projects containing 60 or more drawings)
2. Plot or Vicinity Plans — plot or vicinity plans or both, as well as civil and utility service plans (for small projects, this sheet should include an index of drawings)
3. Landscape and Irrigation — (if applicable)
4. Architectural — (including interior design as applicable)
5. Structural
6. Mechanical — (heating, ventilation, and air conditioning)
7. Plumbing — (water service and waste removal)
8. Electrical — (interior service from utility service plan)
9. Fire Protection — (fireproofing and suppression)

For NAVFACENGCOM drawings, use the following drawing sheet sizes and format.

- Flat 17 x 22 (C size) - When small sheets are required
- Flat 22 x 34 (D size) - for project and other drawings
- Flat 28 x 40 (F size) - option to 22 x 34

For further information about drawing sizes and format, refer to chapter 4.

2.2.1 Title Blocks

The title block provides significant information about both the approval process and the development of the drawing. (Figure 11-10) It includes:

- Name and location of the activity preparing the drawing
- Drawing title and number
- Approval within the activity
- Approval by an activity other or different than the source preparing the drawing
• Information relative to preparation of the drawing
  o The predominant scale used
  o Drawing size letter designation
  o Sheet number for multiple sheet drawings

The code identification number or Federal Supply Code for Manufacturers (FSCM) “80091” is required in the title block of all NAVFACENGCOM drawings.

![Figure 11-10 – Example of NAVFACENGCOM title block.](image)

All 22- by 34-in. (D-size) drawings use vertical title block format (Figure 11-11); whereas, it is optional for 28- by 40-in. (F-size) drawings.

Chapter 4 of this course, and American National Standards Institute, ANSI Y14.1-1980 show the layout and format for title blocks.

![Figure 11-11 – Example of vertical title block.](image)
2.2.2 Drawing Numbers

NAVFACENGCOM drawing numbers issued to individual EFDs are within the following limits:

- **NORTHERN DIVISION** 2 000 000 to 2 999 999
- **CHESAPEAKE DIVISION** 3 000 000 to 3 999 999
- **ATLANTIC DIVISION** 4 000 000 to 4 999 999
- **SOUTHERN DIVISION** 5 000 000 to 5 999 999
- **WESTERN DIVISION** 6 000 000 to 6 999 999
- **PACIFIC DIVISION** 7 000 000 to 7 999 999

Reassignment of NAVFAC drawing numbers is required to accommodate the NAVFAC transformation and standup of new Facility Engineering Commands. The Business Management System (BMS) has been updated to reflect these new number assignments.

Until the ieFACMAN tool becomes functional, each command is responsible for issuing, assigning, and recording their assigned numbers.

The new series of drawing numbers assigned to each command can be accessed via the BMS or the following table. When the ieFACMAN tool becomes operational, the link to the current table in BMS will be replaced with a link to the new tool.

**Table 11-1- Drawing numbers assigned to each command.**

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DRAWING NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFESC</td>
<td>10 000 000 – 10 299 999</td>
</tr>
<tr>
<td>Exped. Logistics Center</td>
<td>10 300 000 – 10 599 999</td>
</tr>
<tr>
<td>NAVFAC Crane Center</td>
<td>10 600 000 – 10 999 999</td>
</tr>
<tr>
<td>NAVFAC Midwest</td>
<td>11 000 000 – 11 999 999</td>
</tr>
<tr>
<td>NAVFAC Mid-Atlantic</td>
<td>12 000 000 – 12 999 999</td>
</tr>
<tr>
<td>NAVFAC Washington</td>
<td>13 000 000 – 13 999 999</td>
</tr>
<tr>
<td>NAVFAC Atlantic</td>
<td>14 000 000 – 14 999 999</td>
</tr>
<tr>
<td>NAVFAC Southeast</td>
<td>15 000 000 – 15 999 999</td>
</tr>
<tr>
<td>NAVFAC Northwest</td>
<td>16 000 000 – 16 999 999</td>
</tr>
<tr>
<td>NAVFAC Pacific</td>
<td>17 000 000 – 17 999 999</td>
</tr>
<tr>
<td>NAVFAC Marianas</td>
<td>To be given by NAVFAC Pacific</td>
</tr>
<tr>
<td>NAVFAC Far East</td>
<td>To be given by NAVFAC Pacific</td>
</tr>
<tr>
<td>NAVFAC Southwest</td>
<td>18 000 000 – 18 999 999</td>
</tr>
<tr>
<td>NAVFAC Hawaii</td>
<td>19 000 000 – 19 999 999</td>
</tr>
<tr>
<td>NAVFAC Europe</td>
<td>To be given by NAVFAC Atlantic</td>
</tr>
</tbody>
</table>
**Figure 11-12** is an example of a drawing number assigned by NAVFAC Southwest to a local activity.

![Figure 11-12 - Example Drawing Number](image)

**Figure 11-12 – Number assigned by NAVFAC Southwest**

Do not use an assigned number for any other drawing even though the drawing to which it has been assigned is not being used. For example, extensive revisions may require a new drawing with a new assigned drawing number. The original drawing (and assigned number) is maintained for record purposes and development tracking. In such cases, place a cross-reference note directly above or adjacent to the title block.

<table>
<thead>
<tr>
<th>Old Drawing Note:</th>
<th>New Drawing Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td>THIS DRAWING SUPERSEDED</td>
<td>THIS DRAWING SUPERSEDES</td>
</tr>
<tr>
<td>BY DRAWING NO.</td>
<td>DRAWING NO.</td>
</tr>
</tbody>
</table>

### 2.2.3 Drawing Revisions

Revise NAVFACENGCOM project drawings according to ASME Y14.100. The revision block may include a separate “PREPARED BY” column to indicate the organization, such as an A/E firm, that prepared the revision. **Figure 11-13** shows the layout of the modified revision block.

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**NAVEDTRA 14069A**
Figure 11-13 – Example of revision blocks for NAVFACENGCOM drawings.

2.2.4 Graphic Scales

Graphic scales are located in the title block on the lower right-hand corner of each drawing sheet, with the words “Graphic Scales” directly over them. The correct graphic scales must be prominent on each drawing, since reproduced and reduced drawings do not always scale proportionately.

2.2.5 Line Conventions and Lettering

Pay close attention to the opaqueness and uniform weight of lines. (Figure 11-14)

Refer to Chapter 4 and ANSI Y14.2M, Line Conventions and Lettering, Engineering Drawing and Related Documentation Practices. Use uppercase lettering except for notes on maps and similar drawings, where you may use lowercase lettering. The
minimum allowable height of freehand letters is 5/32 (0.156) in. and of mechanical or computer graphics is 0.150 in. For abbreviations on drawings, use MIL-STD-12D.

2.3.0 Dimensioning and Tolerancing

Clearly define engineering intent by preparing all dimensions and tolerances according to ANSI Y14.5M, Dimensioning and Tolerancing for Engineering Drawings. Some of the fundamental rules are as follows:

1. A tolerated dimension may:
   - Have it applied directly to the dimension
   - Be indicated by a general note on the drawing sheet

2. Dimensions:
   - Should be arranged to provide optimum readability of required information
   - Should be selected to suit the function
   - Should not be subject to more than one interpretation

3. Dimensioning for size, form, and location of features are:
   - To be complete
   - To provide no more dimensions than those necessary for complete definition
   - Not to use “sealing” (measuring the size of a feature directly from an engineering drawing)
   - Not to use assumptions of a distance or size
   - To minimize the use of a reference dimension

Dimensioning format and standards to meet specific requirements will be discussed in this chapter. Notice that dimensioning construction or project drawings differs in some applications from dimensioning general technical drawings. This occurs primarily because of the materials and methods of construction.

2.3.1 Units of Measure

A drawing’s units of measurement should meet the criteria of the user and the geographical area in which the plans will be used. The U.S. commonly uses the inch as the linear unit on project drawings while the common SI (metric) linear unit is the millimeter.

Individual linear unit identification is NOT required on drawings where ALL dimensions are in either millimeters or inches. However, when this is the case, drawings should contain a note stating “Unless Otherwise Specified, All Dimensions Are in Inches” (or Millimeters,” as applicable).

Millimeter dimension values shown on an inch-dimensioned drawing must be followed by the symbol “mm”, while inch dimension values shown on a millimeter-dimensioned drawing must be followed by the abbreviation “in.”
Figure 11-15 provides examples of dimensioning angular units. Dimensions for angular units are expressed in one of two ways:

- Degrees, minutes, and seconds, Example A
- Degrees and decimal parts of a degree, Example B

Figure 11-15 – Examples of dimensioning angular units.

2.3.2 Application of Dimensions

Apply dimensions by using dimension lines, extension lines, or a leader from a dimension that includes a note or specification directed to the appropriate feature. Some of the standard rules are as follows:

1. Break dimension lines to insert numerals in one of two ways. (Figure 11-16)

The examples 40, 25, and 14, are the preferred method of drawing dimension lines in many forms of drafting.

However, examples 20 and 28 show an easier and time saving, in fact customary, method, for construction drawings. Draw unbroken dimension lines from one extension line to another and place the numerals above the dimension line parallel to the direction of measurement.

Figure 11-16 – Examples of breaking lines to insert numerals.

2. Align dimension lines and (if practical) group them for uniform appearance. (Figure 11-17)

Space the first dimension line no more than 10mm (3/8 in. U.S.) from the object line. Space succeeding parallel dimension lines not less than 6 mm (1/4 in. U.S.).
Where there are several parallel dimension lines, stagger the numerals for easier reading.

3. Dimension angles with an arc drawn so that its center is at the apex of the angle and the arrowheads terminate at the extension of the two sides. *(Figure 11-15)* If space is limited, place the arrows outside the extension line with the dimension between the extension lines. *(Figure 11-16)*

4. Avoid crossing dimension lines as much as possible. If crossing is unavoidable, do not break dimension lines. Refer again to *Figure 11-14* for line characteristics.

Extension lines (projection lines) indicate the extension of a surface or point to a location away from the object. Usually drawn perpendicular to dimension lines, they may be at an oblique angle where space is limited. *(Figure 11-18 A)*

Place the shortest dimension line as the closest to the object’ outline to minimize crossing extension lines over one another or over dimension lines. *(Figure 11-18 B)*

Break extension (not dimension) lines where they cross arrowheads or dimension lines close to arrowheads. *(Figure 11-18 C)*
Leaders (or leader lines) direct dimensions, notes, or symbols to the intended place on the drawing. (Figure 11-19)

**Figure 11-19 – Examples of leader lines.**

### 2.4.0 Drawing Symbols

Most construction drawings are drawn on a small scale, so standard graphic symbols are used to present information more complete about the construction items and materials. These symbols are used frequently in construction drawings so their meanings must be familiar to both preparer and user.

The primary sources for a particular symbol are the *Military (Drawing) Standards (MIL-STD)* and the *American National Standards Institute (ANSI)*. Refer to these standards before you use other references.

Some of the most commonly used military standards and the particular symbols are:

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-STD-14</td>
<td>Architectural Symbols (latest revision)</td>
</tr>
<tr>
<td>MIL-STD-17-1</td>
<td>Mechanical Symbols (latest revision)</td>
</tr>
<tr>
<td>MIL-STD-18</td>
<td>Structural Symbols (latest revision)</td>
</tr>
<tr>
<td>ANSI Y32.4-1977 (R1999)</td>
<td>Graphic Symbols for Plumbing Fixtures for Diagrams Used in Architecture and Building Construction</td>
</tr>
<tr>
<td>ANSI/AWS A2.4-2007</td>
<td>Symbols for Welding</td>
</tr>
</tbody>
</table>

Sometimes other symbols are not included in any of the standards mentioned. (Figure 11-20)
NAVACENGCOM provides guidance through one of their handbooks for using these symbols to develop project drawings.

They are in common use for both civilian and military project drawings.

As an EA, you will find that your knowledge of applicable symbols will greatly assist you in accomplishing the job correctly, promptly, and above all, with confidence.

**Figure 11-20** – Construction drawing symbols identifying sections, elevations, and details.

**Figures 11-21 through 11-23** show a few basic welding and architectural symbols.

**Figure 11-21** – Example of basic weld symbols.
Figure 11-22 – Example of extensive weld symbols and applications.
<table>
<thead>
<tr>
<th>Material</th>
<th>Elevation</th>
<th>Plan</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td>With notes indicating type of brick (common, fire, etc.)</td>
<td>Common or Face</td>
<td>Same as Plan Views</td>
</tr>
<tr>
<td>Concrete Block</td>
<td></td>
<td>Lightwight Lightweight</td>
<td>Same as Plan Views</td>
</tr>
<tr>
<td>Concrete</td>
<td></td>
<td>Structural</td>
<td></td>
</tr>
<tr>
<td>Stone</td>
<td>Cut Stone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood</td>
<td>Siding</td>
<td>Wood Stud</td>
<td></td>
</tr>
<tr>
<td>Plaster</td>
<td></td>
<td>Display</td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>Shingles</td>
<td></td>
<td>Same as Elevation View</td>
</tr>
<tr>
<td>Glass</td>
<td>Or Glass Block</td>
<td>Glass Block</td>
<td>Smell Scale</td>
</tr>
<tr>
<td>Facing Tile</td>
<td>Ceramic Tile</td>
<td></td>
<td>Large Scale</td>
</tr>
<tr>
<td>Structural Clay Tile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation</td>
<td></td>
<td></td>
<td>Same as Plan Views</td>
</tr>
<tr>
<td>Sheet Metal Flashing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metals Other Than Flashing</td>
<td>Indicated by Note or Drawn to Scale</td>
<td>Same as Elevation</td>
<td></td>
</tr>
<tr>
<td>Structural Steel</td>
<td>Indicated by Note or Drawn to Scale</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11-23 – Example of common architectural symbols for materials.
Obviously, there will be many symbols available for use in drawings to communicate the architect and engineers’ intentions for the building. As you may be tasked with developing additional drawings from a contract set of drawings, you need to remain aware of the many common symbols’ meanings and be able to research any uncommon symbol meaning within your department’s technical library.

2.5.0 Drawing Notes

Construction drawing notes are brief, clear, and explicit statements regarding construction methods, material use, and finish. Notes are either specific or general.

Specific notes are used either to reflect dimensioning information on the drawing or to be explanatory. As a means of saving space, many of the terms used in this type of notes are often expressed as abbreviations. (Figure 11-24)

![Figure 11-24 – Typical specific note.](image)

General notes refer to all of the notes on the drawing not accompanied by a leader and an arrowhead. Place general notes for a set of drawings covering one particular type of work on the first sheet of the set. (Figure 11-25)

When using the conventional horizontal block, place general notes a minimum of 3 in. below the space provided for the revision block.

When using the vertical title block, place them on the right side of the drawing.

![Figure 11-25 – Typical general note.](image)
General notes for architectural and structural drawings may include pertinent data used in the design such as:

- Roof, floor, wind, seismic and other loads
- Allowable soil pressure or pile-bearing capacity
- Allowable unit stresses of all the construction materials

General notes for civil, mechanical, electrical, sanitary, plumbing, or similar groupings may include references for vertical and horizontal control (including soundings) and basic specific design data.

General notes may also refer to a schedule that includes notes grouped together in a tabular form according to the specific construction material or process. Schedules for items like doors, windows, rooms, and footings are somewhat more detailed. Their formats will be presented later in this chapter.

**Test your Knowledge (Select the Correct Response)**

2. What organization establishes the design criteria for Seabee project drawings?

A. Local sponsoring command
B. Naval Facilities Engineering Command (NAVFACENGCOM)
C. Local Public Works Center
D. Regional Engineering Field Division (EFD)

**3.0.0 MAIN DIVISIONS of PROJECT DRAWING**

Project drawings (working drawings) are typically divided into the following major categories: civil, architectural, structural, mechanical, electrical, and fire protection. Seabee construction follows the same categories with the exception of fire protection, which is not a common tasking for the NCF.

Regardless of the category, working drawings:

- Provide a basis for making material, labor, and equipment estimates before construction begins
- Give instructions for construction, showing sizes and locations of various parts
- Provide a means of coordination between different ratings
- Complement specifications; one source of information is incomplete without the other

**3.1.0 Civil Drawings**

Civil drawings encompass a variety of plans and information including:

- Site preparation and site development
- Fencing
- Rigid and flexible pavements for roads and walkways
- Environmental pollution control
- Water supply units (that is, pumps and wells)

Civil drawings typically begin with a designating letter “C” in the title block. A set can vary from a bare minimum to several sheets depending on the size of the project.
average-size project, the first sheet will have a location map, soil boring log, legends, and occasionally, site plans and small civil drawing details. (Soil boring tests determine the water table of the construction site and classify the existing soil.)

A site plan furnishes the essential data for laying out the proposed building lines. Drawn from survey notes and sketches, it shows contours, boundaries, roads, utilities, trees, structures, references, and other significant physical features. Civil drawings showing both existing and finished contours enables the initial site crew (Equipment Operators) to estimate the amount of any soil displacement (cut and fill) and prepare the site for construction. It also allows them to plan for the site finishing (including landscaping) upon completion of building construction.

As an EA, you must be familiar with the methods and symbols used on civil site plans, maps, and topographic drawings. (Figure 11-26)

<table>
<thead>
<tr>
<th>Plot Plan Symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
</tr>
<tr>
<td>Point of Beginning (POB)</td>
</tr>
<tr>
<td>Utility Meter or Valve</td>
</tr>
<tr>
<td>Power Pole and Guy</td>
</tr>
<tr>
<td>Light Standard</td>
</tr>
<tr>
<td>Traffic Signal</td>
</tr>
<tr>
<td>Street Sign</td>
</tr>
<tr>
<td>Fire Hydrant</td>
</tr>
<tr>
<td>Mailbox</td>
</tr>
<tr>
<td>Manhole</td>
</tr>
<tr>
<td>Tree</td>
</tr>
<tr>
<td>Bush</td>
</tr>
<tr>
<td>Hedge Row</td>
</tr>
<tr>
<td>Fence</td>
</tr>
<tr>
<td>Walk</td>
</tr>
<tr>
<td>Improved Road</td>
</tr>
<tr>
<td>Unimproved Road</td>
</tr>
<tr>
<td>Building Line</td>
</tr>
<tr>
<td>Property Line</td>
</tr>
<tr>
<td>Property Line</td>
</tr>
<tr>
<td>Township Line</td>
</tr>
<tr>
<td>Electric Service</td>
</tr>
<tr>
<td>Natural Gas Line</td>
</tr>
<tr>
<td>Water Line</td>
</tr>
<tr>
<td>Telephone Line</td>
</tr>
<tr>
<td>Natural Grade</td>
</tr>
<tr>
<td>Finish Grade</td>
</tr>
<tr>
<td>Existing Elevation</td>
</tr>
</tbody>
</table>

Figure 11-26 – Example of common plot symbols for civil drawings.

Drawn to scale, most site plans use the engineer’s scale (divided into decimalized fractions of an inch) rather than the architect’s scale (divided into binary fractionalization of the inch). For buildings on small lots, the scales normally used are 1 in. = 10 ft or 1 in. = 20 ft. This means that 1 in. on the drawing is equal to 10 or 20 ft, whichever the case may be, on the ground. Since the engineer’s scale is the principal means of making scaled site plans, you need to be thoroughly familiar with its use.

On a set of project drawings prepared by an A/E firm, the physical information provided on the site plan is taken from surveyor-prepared field notes or sketches. (Figure 11-27)
Planners and estimators may also use information contained on the site plan when figuring areas available for staging of equipment and materials, quantities of soil for disturbance, the amount and types of equipment needed, quantities of materials required, and labor for each.

Figure 11-27 – Typical civil drawing site plan.
As an EA, you may be tasked with drawing a site plan or revising one. The following steps provide the basic procedure to develop a site plan.

1. Lay out the site plan from the surveyor’s drawing.
   - Show boundary lines or limits of construction.
   - Show existing trees and permanent structures.
   - Note any existing features that must be removed.

2. Draw contour lines with dashed lines. (Note: Place contour lines on the reverse side of the drafting sheet to make future changes or revisions easier).

3. Draw the proposed building and all surrounding construction, such as sidewalks and parking areas.
   - Show building wall outline with solid lines.
   - Show roof overhang outline with dashed lines.

4. Give the finished floor elevations of the building(s), garage(s), and desired finish elevations for any sidewalk and/or parking areas.

5. Review the existing contour lines. Surface water must run towards a storm drainage system and not towards the buildings or other structures.

6. Place the dimensions. Establish them from the property line to the exterior wall of the building, not the overhang. Locate the building and other constructions by a minimum of two location dimensions, more if the building is not positioned parallel with the property line. Include distances to road centerlines, utility lines, easements; and any restrictions or obstructions to the site, such as utility poles and hydrants.

7. Double-check your drawing. Take a second look at finish grade elevations, datum point, and other related information.

Keeping a site plan checklist handy is a good technique to make sure a site plan provides complete and accurate information.

### 3.2.0 Architectural Drawings

Architectural drawings typically begin with a designating letter “A” in the title block. They consist of all the drawings that describe the architectural design and composition of the building. A complete set of architectural drawings include:

- Floor plans
- Building sections
- Exterior and interior elevations
- Millwork
- Door and window details and schedules
- Interior and exterior finish schedules
- Any special architectural treatments

For small, uncomplicated buildings, architectural drawings may include foundation and framing plans, normally part of the structural drawings.
3.2.1 Floor Plan

Floor plans are considered the key drawings in a set of project drawings—the drawings that all of the construction personnel will look at and usually the first drawing an EA will work on.

A floor plan is a horizontal section through a building, showing the outline or arrangement of the floor. An offset cutting plane is often required to pass through low and high features on the wall in order to reveal features located in the building.

Its purpose is to show information about the:

- Footprint of the structure(s) relative to the property
- Type of construction
- Location and size of doors and windows
- Built-in fireplaces
- Stairs
- Rooms
- Exterior and interior features

Figure 11-28 shows a typical floor plan development. Imagine that after the building’s completion, a cutting plane passes through point WXYZ.

![Perspective View showing cutting plane WXY](image)

![Cutting Plane WXYZ (Top Removed)](image)

![Developed Floor Plan WXYZ](image)

Figure 11-28 – Typical simple floor plan development.
Note that the WXYZ plane passes through at an elevation that includes all the distinctive elements, the windows and doors. If the plane passed through the building above the door height, the floor plan would look like a solid box with closed interior cells.

With the upper portion of the cutting plane removed, you are now able to look down on a floor plan that includes all the doors and windows you were previously unable to see. *Figure 11-29* shows a floor plan of a concrete masonry unit building (mechanical shop).

*Figure 11-29 – Example of concrete masonry unit floor plan.*

It gives the lengths, thicknesses, and character of the outside walls and partitions at a height above floor level. It shows room arrangement and dimensions, location and width of doors and windows, and the location and character of rest rooms and other utility features. Concrete masonry units (CMUs) are a common construction material for Seabee projects, and the unit EAs may be tasked with developing the plans. You need to be familiar with drawing a floor plan for any given CMU project.

**3.2.1.1 Drawing a Floor Plan**

Select the proper scale and sheet layout to achieve the best results. Before doing the actual drawing, verify dimensions by drawing up preliminary sketches with approximate sizes for building, room dimensions, wall thicknesses, corridor widths, and so forth.

A scale of 1/4 in. = 1 ft is ideal for easy readability, but smaller scales such as 3/16 in. = 1 ft, or 1/8 in. = 1 ft, can be used for large buildings when sheet size is limited.

After selecting the scale and sheet layout, tape the sheet to the drafting board and follow the procedures outlined below:
1. Lay out the drawing construction lines for borders, title block, and exterior limits of the building at any one side.
   - Draw exterior wall thicknesses first and lay out the rooms and walls from left to right.
   - Use a “nominal” wall thickness dimension of 6 in. for a wall frame exterior wall that has no brick or stone veneer, or use the nominal wall thicknesses found in the Architectural Graphics Standards (AGS). (Note: Wall thickness varies with the materials used. It is impossible to draw actual dimensions of each material selected.)
   - Lay out the interior walls across the building, checking rooms, closets, bathrooms, corridors, and so on. Notice in Figure 11-29, between room 109 and the corridor, that a wider wall is necessary to allow room for plumbing pipe to service the wastewater and vents.

2. Locate and draw in all doors.
   - Use an architectural template to draw exterior and interior doors easily. Exterior doors in residential houses usually swing inward whereas building or fire codes often require commercial building doors to swing outward. (Note: A full or 90-degree door swing template can check that the door swing will not interfere with any equipment, walls, or appurtenances in the room).

3. Locate and draw in all windows, stairs, handrails, and other exterior and interior features, fixtures, equipments, appliances, and cabinets using the proper symbols and conventions.

4. Lay out the guidelines for dimensions and dimension lines.
   - Double-check and review the accuracy and completeness of the information drawn in. (The building’s basic floor plan should now appear lightly laid out.)
   - Darken in the plan if the information is accurate. Constructions lines do not need to be darkened or erased but all other lines must be drawn darkly and vary only in width.
   - Develop a systematic approach for a fast and orderly darkening of lines; common practice is left to right and top to bottom.
   - Keep the drawings clean. EAs often use a clean sheet of paper to cover their finished section of drawing while darkening the exposed section.

5. Draw in section markings on the floor plan and indicate where the wall sections have been taken. (If undecided, they may be placed on the plan later.)
   - Add all the material symbols, title, graphic scale, and other relative information to complete the drawing.
   - Go over your floor-plan checklist for completeness.

As an EA, one of your challenges (and a measure of your drafting competency) is to apply your dimensioning technique to various types of materials and construction methods. Although the principles of dimensioning and general locations of dimensions are the same for all types of materials and methods, a difference can exist in which dimensions are shown, and how the walls, openings, and partitions are dimensioned to provide accurate, easy, interpretation.
3.2.1.2 Dimensioning a Floor Plan

Lay out and verify dimensions on sketch paper before placing them on the drawing. Except for interior partition dimensions, place as many dimensions as possible outside the plan and far enough away from the plan to avoid interfering with roof overhangs, notes, porches, or other features. This helps prevent overcrowding.

In dimensioning floor plans, proceed as follows:

1. For wood-frame construction:

   **Figure 11-30 – Example of dimensioning exterior wall.**

   Interior wall partitions — measure from the outside face of the studs to the centerline of the partition. *(Figure 11-31)*

   Occasionally, partitions are measured from outside face of the studs to the face of the interior studs. The important thing is to be consistent. All partition measurements must reference from the same exterior wall.

   **Figure 11-31 – Example of dimensioning interior wall.**

   With veneer — dimension the same as a wood frame without veneer *(Figure 11-32).*

   The only difference will be in the overall dimension showing the total size of the house when the veneer is added.

   **Figure 11-32 – Example of dimensioning exterior wall with veneer.**

   In wood frame construction, dimension doors and windows to their centerlines.
2. For concrete-masonry construction:

Exterior and Interior walls — place extension lines on the outside face.

In concrete and masonry construction, all dimensions are all given to the face of the walls and not to the centerlines. *(Figure 11-33)*

![Concrete Wall (Dimensions to outside corner)](image)

![Solid Brick Wall (Dimensions to outside corner)](image)

*Figure 11-33 – Example of dimensioning concrete and masonry walls.*

In concrete and masonry construction, dimension doors and windows to rough openings.

![Figure 11-34 – Example of dimensioning concrete and masonry doors and windows.](image)

Take note again of the dimensioning for the concrete masonry unit mechanical shop. *(Figure 11-34)*

Dimension the rough openings of the doors and windows and the distance between the rough openings.

This is the correct procedure for dimensioning concrete or masonry construction.

3. For both wood frame and concrete masonry construction:
- Take enough time to check your dimensions for legibility and accuracy. Constantly recheck your work during the drawing’s development and again after you have finished. Inaccuracies found early can save you from a time consuming review looking for a dimensional error. Make sure the cumulative total of all short dimensions add up to their corresponding overall dimension.

### 3.2.2 Elevations

Elevations are orthographic projections that show the finished interior and exterior appearance of the structure. Interior elevations often provide details for important finish features such as built-in cabinets and shelves, but they may also be drawn for all interior walls in each room of a building.

Cabinet elevations *(Figure 11-35)* show cabinet lengths and heights, distance between base cabinets and wall cabinets, shelf arrangements, doors and direction of door swings, and materials used.

**Figure 11-35 – Typical elevation for interior cabinets.**

Interior elevations show wall lengths, finished floor-to-ceiling heights, doors, windows, other openings, and types of finish materials.

Exterior elevations show types of exterior materials and where they are used, finished grade around the structure, roof slope, basement or foundation walls, footings, and all of the vertical dimensions.

A complete set of drawings needs a minimum of four elevations to provide the exterior description: front, rear, and the two sides of a structure as they would appear projected on vertical planes.

Typically, an elevation is drawn at the same scale as the floor plan, (1/4 in. = 1 ft or 1/8 in. = 1 ft), but occasionally space limitations may require a smaller scale or a larger scale may be used to show more detail.

Several methods can be used to identify each elevation as it relates to the floor plan, but the most commonly used Seabee method is to label the elevations with the same terminology used in multi-view and orthographic projection; that is, front, rear, right-side, and left-side elevations *(Figure 11-36)*.
Figure 11-36 – Typical elevations for exterior views.
On irregular plans that would not clearly show an orthographic projection from one of the four views, elevations may be identified by a letter or a number. (Figure 11-37)

Figure 11-37 – Example of an elevation view for an irregular floor plan.

Use the following basic procedures as a guide to develop and draw elevations:

1. Use the same size sheet as the floor plan.
   - Determine overall height and length of elevations from floor plan and wall section (predetermined by prior computation or a sketch).
   - Use the same scale for elevations as for floor plan unless there is a specific benefit to a different scale.
   - Block in the views with construction lines placed in a logical order starting with the front view and working around the building. Front and right-side elevations are usually next to each other with (if necessary) the rear and the left-side elevations below.
   - Show all elevations on one sheet whenever possible.

2. Draw the exterior limits of the elevations.
   - Place the floor plan underneath the elevation-drafting sheet for a guide.
   - The vertical projection lines from the floor plan will define the length of exterior walls and any breaks or corners along the wall, windows, doors, roof overhang, and other elements, such as chimney location.
   - Horizontal projection lines on your elevation drawing will locate the height of doors and windows, eave line, bottom of fascia, top and bottom of the footing, and top of the roof.

3. Repeat until all elevations are lightly laid out with final changes incorporated into the exterior design.
   - Darken the drawing from left to right, top to bottom (same procedures used in the floor plan).
   - Remember, the grade line is the darkest line (disregarding the border lines), and all portions drawn below grade are shown with a dark hidden line.
4. Add dimensions.
   - Show vertical dimensions (include the following only): bottom of footing, finished grade, all finished floor lines, height of features, finished ceiling lines, chimney height, and freestanding walls. Refer to Chapter 4 for additional information.

5. Add all notes and pertinent information about exterior materials such as finishes, title, scale, window identification marks, and roof pitch.
   - Add section symbols to indicate where the sections have been taken. *(Figure 11-38, View A)*

6. Finish up by adding the material symbols. *(Figure 11-38, View B)*
   - Symbols do not take the place of the material notations; they just supplement them.
   - Go over your elevation checklist for completeness and accuracy of information.

**Figure 11-38 – Section symbols-View A, Material symbols-View B.**

### 3.3.0 Structural Drawings

Structural drawings typically begin with a designating letter “S” in the title block. A complete set contains all drawings relating to the building’s structural members and their interacting relationship. A set of structural drawings should include foundation plans and details, framing plans and details, wall sections, column and beam details, and all other plans, sections, details, and schedules necessary.

General notes in structural drawings should include, when applicable, all roof, floor, wind, seismic, and other loads, along with allowable soil pressure or pile bearing capacity and allowable stresses of all material used in the design.

### 3.3.1 Foundation Plan

A foundation plan is a top view of footings or foundation walls. Actually a horizontal section view cut through the walls of the foundation just below ground floor level, it shows beams, girders, piers or columns, openings, internal composition, and dimensions with centerlines and distances from reference or boundary lines.
A foundations plan’s primary user will be the building crew that constructs the proposed structure’s foundation. Most foundations in Seabee construction are built with concrete masonry units (CMU) and/or cast-in-place concrete.

*Figure 11-39* shows a plan view of a concrete/CMU foundation. The plan shows the main foundation will consist of 12 in. CMU walls measuring 28 ft by 22 ft. above a concrete spread footing that is 24 in. wide by 10 in. deep. In this plan, the standard symbol for concrete block identifies the CMU but a specific note should be added to call out the material.

![Typical foundation plan for CMU footing](image)

*Figure 11-39 – Typical foundation plan for CMU footing.*

A girder will run through the center of the building, supported on both ends by a 4 by 12 in. concrete pilaster abutting the foundation walls with intermediate support from two 12 by 12 in. concrete piers on 18 by 18 in. spread footings 10 in. deep.

Before you can draw the foundation plan, you will need to gather all relevant information about the concept of the structure. Observe the type of foundation intended, make a careful study of the materials and methods to be used, and analyze the relative position of the framing to the foundation wall or footing.

Before you start, refer to all of the applicable wall sections and typical sill details found in your texts and reference materials such as the *Architectural Graphics Standards*.

Note: Two sides of the footing in *Figure 11-39* show concrete sills to support the joists. Did you see that without the A-A elevation detail?
The ground floor plan serves as the basis for developing the foundation plan, (just as it did for the elevation views). The floor plan readily offers the information you need, such as the general shape of the building, openings, dimensions, and so forth.

Use the following basic procedures to develop a foundation plan properly:

1. Prepare and organize your drafting needs.
   - Draw the foundation plan at the same scale as the floor plan (1/4 in. = 1 ft), with the same sheet size and layout. Drawing the foundation plan by this method is easier because you can save time and effort by tracing the floor plan’s outline and other features.
   - Center the foundation plan to provide more space for notes and details about the footings. A smaller scale may be used when necessary to save space provided the amount of information given on this plan is limited.

2. Lay out the drafting sheet lightly, beginning with the borders and title block.
   - Tape a floor plan (original or preferably a print) under the foundation sheet if using the same scale.
   - Draw the exterior outline of the foundation wall (usually the outside, exterior line of the building), and locate any retaining walls, steps, porches, and fireplaces.
   - Carefully note the type of frame construction that will be used. Using the floor plan in laying out the foundation plan will vary among wood-frame, masonry, and steel-frame construction. Study these differences closely. Usually, a foundation plan’s dimensions are modified depending on the materials used.
   - If drawing to a different scale, determine the size of the desired foundation plan and lay it out on the sheet. Follow up by transferring all of the dimensions from the floor plan to the foundation plan. Be especially careful to locate other features accurately with the different scale.

3. Draw the inside wall of the foundation wall once the wall thickness is scaled from the established outside foundation line.
   - Locate other features such as access doors, vents, and pilasters. Also, draw the foundation for piers, columns, chimney, and any retaining wall, if required.

4. Lay out the footings.
   - Check the standards for typical details on different types of footings and the minimum allowable footing size for intended type of frame construction.
   - Draw and note any required additional structural information. For example, in wood-frame construction, the foundation plan commonly shows the structural information for the first floor as well. If so required, locate and lay in the supporting beam or girder and the size, spacing, and direction of floor joists.

5. Lay out the dimensions.
   - Double-check all dimensions to ensure they are correct, complete, and include all the features required in the drawing.
   - Add all of the notes, materials, appropriate plan symbols, and other pertinent information required to complete the plan.

6. Draw in the scale to the plan and the title of the drawing. Review your foundation-plan checklist, and make sure the entire drawing is darkened in and labeled.
3.3.2 Framing Plan

Framing plans show the size, number, and location of either steel or wood structural members. Separate framing plans may be drawn for the floors, the walls, and the roof.

![Framing Plan Diagram](image)

Floor framing plans must specify the sizes and spacing of joists, girders, and columns used to support the floor.

If necessary, add detail drawings to show the methods of anchoring joists and girders to the columns and foundation walls or footings. *(Figure 11-40)*

**Figure 11-40 – Typical detail for anchoring joist.**

The floor framing plan is a plan view of the layout of girders, beams, and joists. *Figure 11-41* shows a typical floor framing plan.
Figure 11-41 – Example of a structural upper floor, wood frame plan.

Joists and double framing are drawn in the position they will occupy in the completed building. Joists do not need dimensions at every location. Notes provide the necessary information, in this case “2” by 8” joists @ 16” O.C.” (on center).

Bridging is also drawn in position perpendicular to the joist but called out by note as “2-1” x 3” bridging”. The span of the joist controls the number of required rows of cross bridging. The rows should not be more than 7 or 8 ft apart. Hence, a 14-ft span may need only one row of bridging, but a 16-ft span needs two rows. Notes also identify floor openings, trimmers, plates, or doubles to support heavier floor loads.

Floor framing plans do not indicate length dimensions for individual pieces. The builder is able to determine those from overall building dimensions, dimensions for each bay, or distances between columns or posts.

Wall framing plans (Figure 11-42) show the location and method of framing openings and ceiling heights so that studs and posts can be cut.
Figure 11-42 – Example of a structural wall, wood frame plan.

Roof framing plans for wood frame construction are drawn in the same manner as the floor framing plan. The rafters are shown in the same manner as joists, with rafters shown spanning the building and supporting the roof. The size, spacing, roof slope, and all of the details are also shown in the plan. (Figure 11-43)

Roof framing plans for precast or cast-in-place concrete construction should indicate with symbols the location of:

- Bearing walls
- Beams and columns
- Direction and size of steel reinforcing bars
- The direction of the span
- Size and thickness of required structural members

Figure 11-44 shows an example of a cast-in-place structural roof framing plan with beams, joists, metal deck, welded wire fabric, schedule, and general notes.
Figure 11-43 – Example of a structural roof, wood frame plan.
Figure 11-44 – Example of a structural roof, cast-in-place framing plan.

Roof Framing Plan
Scale: 1/8" = 1'-0"

Roof Beam Reinforced Schedule
Not to Scale
General Reinforcing Notes:
1. All top bars to lap at midspan. All laps to be 24 diameters of smaller bar being lapped.
2. All top and/or bottom bars to be in one layer except as otherwise indicated.
3. Where lengths are indicated for top bars, bars are to be centered on column centerlines.
4. Stirrup spacing indicated starts at face of column.
5. See sections for additional beam reinforcing not shown in beam reinforcing schedule.
Use the following procedures when preparing framing plans:

1. For roof wood-frame plans:
   - Trace or transfer the dimensions and location of exterior stud wall.
   - Lay out the limits of roof overhang.
   - Lay out roof framing by locating the ridgeboard.
   - Lay out all of the required intersecting pieces.

2. For floor wood-frame plans:
   - Transfer dimensions of the foundation walls or footings.
   - Lay out supporting girders and joists in their proper spacing.
   - Notice any bearing walls, stairwells, and other openings when developing an elevated-floor framing plan.

3. For concrete framing plans:
   - Lay out the dimensions of the bearing walls below the floor (or roof) being framed, for example, a foundation plan to draw the first-floor framing or first-floor plan to draw the second-floor framing.
   - Add the location of beams, columns, direction of the span, size of precast concrete, or reinforcing steel for cast-in-place concrete.

4. For steel framing plans:
   - Trace off or transfer the dimensions of all of the bearing walls, columns, and beams below the floor (or roof) being framed.
   - Lay out the steel framing, using the grid system, a common setup used in steel framing.

5. For all framing plans whether wood, concrete, or steel, to finish:
   - Lay out guidelines for dimensions, notes, and labels.
   - Darken in all of the framing and fill in the notes and dimensions
   - Draw in the section and detail marks.
   - Go over your structural plans checklist and check the dimensions against those traced from the floor plan.

3.4.0 Mechanical Drawings

Chapter 9 provides symbols for components associated with mechanical systems and describes methods used to develop a mechanical plan. This section will focus on applicable procedures for drawing residential or commercial building plumbing plans.

A separate mechanical plan is drawn for some residences and commercial structures. They show water supply and fixtures, waste disposal lines, equipment such as hot water tank or recirculation hot water loop, and other supply and disposal sources.

Apply the following procedures to draw a plumbing plan:

1. Trace the floor plan, showing all exterior and interior walls, major appliances, and plumbing fixtures.
   - Draw the outline of the building in thin but visible lines.
3.5.0 Electrical Drawings

Chapter 10 provides symbols for components associated with electrical distribution systems and interior wiring, and describes methods used to develop an electrical plan.

Drawing sheets in the electrical division are frequently identified by the letter E in their title blocks.
When working with electricity, a simple Operational Risk Management (ORM) process will conclude that it is important for EAs not only to understand electrical symbols and drafting methods, but also to learn a great deal about how the system works. EAs must also recognize the need for the safety requirements of the system and the minimum requirements of the National Electrical Code (NEC) and any local codes that apply to the drawing.

Use the same procedures to draw an electrical plan as were applied to the mechanical plan; for example, use correct line thickness and orientation and employ standard symbols as much as possible.

1. **After the floor plan is traced (see mechanical):**
   - Draw the meter and service panel noting voltage rating and amperage.
   - Draw convenience outlets, ceiling and wall fixtures, and other electrical devices.

2. **Draw switches.**
   - Connect switches to fixtures or convenience outlets using a template or a french curve (curved lines may be solid or dashed and included in symbols list).
   - Add circuits, circuit numbers, and circuit notations.

3. **Add symbol legend and fixture legend (if required), drawing title, scale, fill in the title block, and as usual, go over the drawing for completeness and accuracy.**

### 3.6.0 Sections

Sections most commonly apply to the architectural and structural divisions but they can be used in any division to amplify information as necessary. Sections show the type of construction required, types of materials, locations, and method of assembling the building parts.

Although they may be used in each of the divisions and are important to those responsible for that division, perhaps the most important of all are wall sections found in the structural drawings.

Wall sections, commonly drawn at a scale of 3/4 in. = 1 ft, provide a wealth of information necessary to understand the structural arrangement, construction methods, and material composition of the walls of the building. *(Figure 11-46)* They are used extensively to visualize both the engineered requirements of the wall support system and architectural requirements of the building’s finish.
When a cutting plane passes through the narrow width of a building, as shown in Figure 11-47, it displays a transverse or cross section.
When a cutting plane passes through the length of a building, it displays a longitudinal section. (Figure 11-48)

Figure 11-48 – Typical longitudinal section cut view.

Usually located in the architectural division, full building sections are used to clarify the building design and construction process. Transverse and longitudinal sections are usually drawn at the same scale as the floor plan, and staggered (offset) cutting planes are often used as well to show as much construction information as possible with the fewest drawings.

Drawing a separate section for every wall and part of a building would soon become time consuming since many sections are identical. To simplify construction drawings and save time and effort, common practice is to use typical sections where exact duplications occur. (Figure 11-49)

Figure 11-49 – Example of typical section view.
Make a sketch of the section before beginning the actual drawing and have it checked by the leading petty officer or another experienced EA. This should give the best results and save time by ensuring that your work is compatible with their concept of the building’s design.

If placing more than one section of similar view on a sheet, give the users a “tour” through the building by arranging the sections in a progressive sequence from the front of the building to the rear.

Use the following procedures to develop sections:

1. Select the appropriate scale and lay out the first section lightly.
   - Lay out all other sections; allow enough space between for notes and dimensions.
   - Align multiple sections to the same elevation so they relate to one another.
   - Maintain enough clearance for subtitles, scale, and title block.

2. Lay out the guidelines for the material labels, leaders, and vertical dimensions.

3. Darken the section drawings using the top-down, left to right system.
   - Put in all of the labels, notes, and dimensions.
   - Add any detail markings.

4. Add material symbols (Note: For neatness and fast erasure for a minor change or revision, some EAs prefer to place symbols at the back of the sheet).
   - Place the title and scale below to complete the section drawing.
   - Review the section checklist for accuracy and completeness.

### 3.7.0 Details

Details are large-scale drawings of construction assemblies and installations that cannot be clearly shown in the sections. These enlarged drawings show the various parts in more detail and how they will be connected and placed.

Scale depends on how large the drawing needs to be magnified to explain the required information clearly. Details are usually drawn at a larger scale than the sections, generally 1 in., 1 1/2 in., or 3 in. = 1 ft.

*Graphic Standards* and *Sweet’s Catalogs* contain details commonly used for installation of items such as doorframes, window frames, fireproofing, and material connections; they do, however, need to be adapted to the particular building being drawn.

When different conditions actually exist, avoid the use of “typical” details; they will be misleading and cause confusion. An EA needs to understand construction well enough to make accurate detail drawings for each unique situation.

Details are commonly used for some specific phases and elements of construction such as foundations, doors, windows, cornices, and so forth. Show their details with the applicable main division of construction drawings and group them so that references can be made easily from the general drawing. *(Figure 11-50)*
Figure 11-50 – Example of detail grouping.
It is important to select the appropriate sheet to draw the detail on. Place details relating to a drawing on the same sheet if possible. If space is limited, place details with related section drawings, schedules, or on a separate sheet set aside for details.

For example, door details should be placed on the sheet with the floor plans, on a sheet with sections including doors, on the sheet with the door schedule, or on a sheet set aside for details.

Use the following procedures to develop detail drawings:

1. Lay out the details on the particular sheet.
   - Lightly draw extension lines, dimensions lines, and guidelines for all dimensions.

2. Darken in the details, one at a time, using a system similar to that used in drawing sections, the top-down, left to right system.
   - Add labels, notes, dimensions; show all sizes and thicknesses of materials.

3. Add material symbols.
   - Place title and scale below the detail to complete the detail drawing.
   - Review detail for accuracy and completeness.

3.8.0 Schedules

Schedules are tabular or graphic arrangements of extensive information or notes related to construction materials. They provide planners, estimators, contractors, and suppliers a quick and easy way to share similar data, save time, and reduce construction errors.

In the Seabees, various elements of the construction team depend greatly upon the accuracy and efficiency of information conveyed on the drawing (plan) schedules.

- Planners and estimators (P&E) in accurately preparing takeoffs
- Supply department (S-4) in properly ordering construction materials
- Construction crew (line companies and detachments) in installing the materials in their proper locations

Most schedules relate to doors, windows, and room finishes. A door schedule can vary from a bare minimum to extensive. (Figure 11-51)

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>QTY</th>
<th>FLR</th>
<th>SIZE</th>
<th>DIMENSIONS</th>
<th>WIDTH</th>
<th>HEIGHT</th>
<th>R/O</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO1</td>
<td>2</td>
<td>1</td>
<td>3070</td>
<td>36X84X1 3/4&quot;</td>
<td>36&quot;</td>
<td>84&quot;</td>
<td>37X85 1/2</td>
<td>EXT. HINGED PANEL</td>
</tr>
<tr>
<td>DO2</td>
<td>2</td>
<td>1</td>
<td>3070</td>
<td>36X84X1 3/4&quot;</td>
<td>36&quot;</td>
<td>84&quot;</td>
<td>37X85 1/2</td>
<td>4-PANEL</td>
</tr>
<tr>
<td>DO3</td>
<td>3</td>
<td>1</td>
<td>3070</td>
<td>36X84X1 3/4&quot;</td>
<td>36&quot;</td>
<td>84&quot;</td>
<td>37X85 1/2</td>
<td>HINGED-GLASS</td>
</tr>
<tr>
<td>DO4</td>
<td>4</td>
<td>1</td>
<td>6070</td>
<td>36X84X1 3/4&quot;</td>
<td>36&quot;</td>
<td>84&quot;</td>
<td>37X85 1/2</td>
<td>HINGED-PANEL</td>
</tr>
<tr>
<td>DO5</td>
<td>1</td>
<td>1</td>
<td>6068</td>
<td>72X80&quot;</td>
<td>72&quot;</td>
<td>80&quot;</td>
<td>73X81 1/2</td>
<td>SLIDER-GLASS</td>
</tr>
<tr>
<td>DO6</td>
<td>8</td>
<td>1</td>
<td>19080</td>
<td>228X96&quot;</td>
<td>228&quot;</td>
<td>96&quot;</td>
<td>229X97 1/2</td>
<td>GARAGE 4-PANEL</td>
</tr>
<tr>
<td>DO7</td>
<td>4</td>
<td>1</td>
<td>3670</td>
<td>42X84X1 3/4&quot;</td>
<td>42&quot;</td>
<td>84&quot;</td>
<td>43X85 1/2</td>
<td>HINGED-GLASS</td>
</tr>
</tbody>
</table>
Figure 11-51 – Example of a door schedule.

A door schedule may include door number, quantity, mark or code number, type, size, material description, lintel, and remarks.

Doors are commonly marked with a number or numbers and letters; the letter “D” is a common designation used for doors (sometimes enclosed in a circle or other shape).

A window schedule (Figure 11-52) provides an organized presentation of the significant window characteristics. Information often includes mark, window type, size, required opening size, material type, lintels, and remarks.

### WINDOW SCHEDULE

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>QTY</th>
<th>FLR</th>
<th>SIZE</th>
<th>DIMENSIONS</th>
<th>WIDTH</th>
<th>HEIGHT</th>
<th>R/O</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>WO1</td>
<td>2</td>
<td>3</td>
<td>3036</td>
<td>36X42&quot;</td>
<td>36&quot;</td>
<td>42&quot;</td>
<td>37X43 1/2</td>
<td>SNGL CASEMENT</td>
</tr>
<tr>
<td>WO2</td>
<td>4</td>
<td>3</td>
<td>4050</td>
<td>48X60&quot;</td>
<td>48&quot;</td>
<td>60&quot;</td>
<td>49X61 1/2</td>
<td>SNGL CASEMENT</td>
</tr>
<tr>
<td>WO3</td>
<td>3</td>
<td>2</td>
<td>3052</td>
<td>36X62&quot;</td>
<td>36&quot;</td>
<td>62&quot;</td>
<td>37X63 1/2</td>
<td>FIXED GLASS</td>
</tr>
<tr>
<td>WO4</td>
<td>4</td>
<td>2</td>
<td>2014</td>
<td>24X16&quot;</td>
<td>24&quot;</td>
<td>16&quot;</td>
<td>25X17 1/2</td>
<td>FIXED GLASS</td>
</tr>
<tr>
<td>WO5</td>
<td>1</td>
<td>3</td>
<td>1070</td>
<td>12X84&quot;</td>
<td>12&quot;</td>
<td>84&quot;</td>
<td>13X85 1/2</td>
<td>FIXED GLASS</td>
</tr>
<tr>
<td>WO6</td>
<td>3</td>
<td>1</td>
<td>7040</td>
<td>84X48&quot;</td>
<td>84&quot;</td>
<td>48&quot;</td>
<td>85X491/2</td>
<td>FIXED GLASS</td>
</tr>
<tr>
<td>WO7</td>
<td>4</td>
<td>1</td>
<td>80174</td>
<td>96X207 1/2&quot;</td>
<td>96&quot;</td>
<td>208&quot;</td>
<td>97X209</td>
<td>MULLED UNIT</td>
</tr>
</tbody>
</table>
Figure 11-52 – Example of a window schedule.

Like doors, windows are often marked with letters or letters with numbers and sometimes enclosed in a circle or other shape; letter “W” is most commonly used for window schedules.

A material finish schedule (Figure 11-53) may include room number, material finish for floors, walls, base, and remarks. Where several rooms in a row have identical finish, common practice is to use the ditto mark (’’) or initials DO to repeat the above entry.

### Material Finish Schedule

<table>
<thead>
<tr>
<th>Room Description</th>
<th>Flooring</th>
<th>Walls</th>
<th>Ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carpet</td>
<td>Resilient</td>
<td>Ceramic, Quarry Tile</td>
</tr>
<tr>
<td>Public</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Entrance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry Gallery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concourse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patron Toilets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lockers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Bowling               |         |          |                 |                  |             |                         |              |             |                   |                 |              |
| Lanes and Approaches  |         |          |                 |                  |             |                         |              |             |                   |                 |              |
| Bowler Seating and Spectator Seating |         |          |                 |                  |             |                         |              |             |                   |                 |              |

NAVEDTRA 14069A 11-55
### 3.9.0 Bill of Materials

A bill of materials (BM) is a tabular statement of material requirements for a given project. It contains information, such as stock numbers, unit of issue, quantity, line item number, description, vendor, and cost. Sometimes the bill of materials will be submitted on material estimate sheets or material takeoff sheets, but all will contain similar information.

The bill of materials is actually a grouped compilation based on all of the takeoffs and estimates of material needed to complete a structure. The takeoff sheet is usually an actual tally and check of the items shown, noted, or specified on the construction drawings and specifications.

In most cases, each NAVFACENGCOM drawing will contain a separate BM. However, sometimes an in-house project prepared by a local command will contain a BM incorporated within the set of drawings. *Figure 11-54* shows an example of a completed Bill of Materials.
Figure 11-54 – Example of a bill of material on standard form.

Summary

A complete set of construction drawings for a project can range from only a few sheets for a simple project with no requirements for mechanical service or electrical to hundreds of sheets with multiple divisions to accommodate the requirements of each of the construction trades’ areas of responsibility. As an EA tasked with developing drawings, to be able to communicate clearly the intentions of the designer, you need to have a general knowledge and appreciation of the materials, assembly, and working practices of each rating’s trade. If you couple your general knowledge of each rating’s work with your specific knowledge of how to communicate on paper with drawings and symbols, you can be a successful EA while assigned to the drafting division. Clear, concise, accurate, and timely drawings are always appreciated by the “hands-on” crews.
Review Questions (Select the Correct Response)

1. Which drawings present a proposed building or facility in an attractive setting?
   A. Presentation
   B. Master Plan
   C. Preliminary
   D. Record

2. Which drawings can actually be a schedule or diagram?
   A. Red-Lined
   B. Working
   C. Shop
   D. Preliminary

3. Which drawings are commonly used in architectural, topographical, and construction planning?
   A. Final
   B. Preliminary
   C. Presentation
   D. Master Plan

4. Which drawings can be prepared by the construction contractor, subcontractor, manufacturer, distributor, or supplier?
   A. Red-Lined
   B. Shop
   C. Preliminary
   D. Working

5. Which organization(s) maintains and upgrades the master plan on existing and proposed Navy installations?
   A. Naval Facilities Engineering Command (NAVFACENGCOM)
   B. Regional Engineering Field Division (EFD)
   C. Local Base Command
   D. Resident Officer in Charge of Construction (ROICC) and Public Works Center (PWC)

6. Working drawings are also known as _____ drawings.
   A. project
   B. preliminary
   C. red-lined
   D. shop
7. What does a complete set of project drawings always contain?
   A. An electrical division
   B. Preliminary Drawings
   C. As-Builts
   D. Bill of Materials

8. General drawings are drawn on a relatively small-defined scale, such as _____.
   A. 1/16 in. = 1 ft or 1/8 in. = 1 ft.
   B. 1/4 in. = 1 ft or 1/2 in. = 1 ft.
   C. 1/8 in. = 1 ft or 1/4 in. = 1 ft.
   D. 1/2 in. = 1 ft or 1 in. = 1 ft.

9. In what projection are most general drawings presented?
   A. Elevation
   B. Cavalier
   C. Isometric
   D. Orthographic

10. (True or False) Detail drawings must be presented in the same view as the general drawing to prevent confusion.
    A. True
    B. False

11. Which drawings provide a check on the accuracy of the design and detail drawings and often disclose errors?
    A. Assembly
    B. Working
    C. Final
    D. Red-Lined

12. (True or False) A bill of materials must always be listed on a separate sheet.
    A. True
    B. False

13. Except for expeditionary or expedient construction, in a typical military construction project, _____ will review and evaluate working drawings?
    A. Public Works Center (PWC)
    B. Regional Engineering Field Division (EFD)
    C. Naval Facilities Engineering Command (NAVFACENGCOM)
    D. Resident Officer in Charge of Construction (ROICC)
14. What organization reviews preliminary drawings if a project is not a Seabee project but will be contracted to other sources?

A. Local ROICC
B. Local PWC
C. Regional EFD
D. NAVFACENGCOM

15. Which drawings become the official contract drawings once the contract is awarded?

A. Final
B. General
C. Working
D. Master Plan

16. The construction contractor or the military construction force (NMCB) must provide ______ with as-built drawings indicating any deviations from the contract drawings.

A. PWC
B. EFD
C. the ROICC
D. the base command

17. Conceptual designs in the Navy include both definitive designs and standard designs for structures and facilities needed on a(n) ______ basis.

A. repetitive
B. expeditionary
C. emergency
D. humanitarian

18. What term describes the detailed working drawings of specialized, unique, naval facility structures?

A. Facilities Planning
B. Facilities Design
C. Definitive Designs
D. Standard Designs

19. (True or False) Ammunition and explosive design standards may be modified to accommodate local terrain.

A. True
B. False
20. What organization assigns new title blocks and drawing numbers when using standard designs for a construction project?

A. EFD  
B. PWC  
C. NAVFACENGCOM  
D. Local command

21. What source provides useful information for Seabee planners such as the required land area, crew size, man-hours by skill, and the fuel to build a contingency structure?

A. NAVFAC P-34, Engineering and Design Criteria for Navy Facilities  
B. NAVFAC P-437, Facilities Planning Guide  
C. NAVFAC P-272, Definitive Designs for Naval Shore Facilities, Part 1  
D. NAVFAC P-272, Definitive Designs for Naval Shore Facilities, Part 2

22. What resource provides policy and procedure for preparing and developing project drawings?

A. NAVFAC P-437, Facilities Planning Guide  
B. NAVFAC P-34, Engineering and Design Criteria for Navy Facilities  
C. MIL-HDBK-1006/1  
D. NAVFAC P-272, Definitive Designs for Naval Shore Facilities, Part 2

23. What Federal Supply Code for Manufacturers (FSCM) number is required in the title block of all NAVFACENGCOM drawings?

A. 00891  
B. 80091  
C. 91008  
D. 90081

24. (True or False) If an EFD issued drawing number is no longer being used, it can be reused on a current project.

A. True  
B. False

25. What resource provides guidance on revising NAVFACENGCON project drawings?

A. DOD-STD-100  
B. MIL-HDBK-1006/1  
C. NAVFAC P-437, Facilities Planning Guide  
D. NAVFAC P-34, Engineering and Design Criteria for Navy Facilities
26. What is the minimum allowable height of freehand letters?
   A. 5/32 in.
   B. 3/16 in.
   C. 1/4 in.
   D. 5/16 in.

27. As an EA developing drawing for use OUTCONUS, what common linear unit of measurement should be used?
   A. Mils
   B. Inch
   C. Millimeter
   D. As meets the user and geographical area criteria

28. What notes are used either to reflect dimensioning information on the drawing or to be explanatory?
   A. Primary
   B. Secondary
   C. Specific
   D. General

29. What notes refer to all of the notes on the drawing not accompanied by a leader and an arrowhead?
   A. Primary
   B. Secondary
   C. Specific
   D. General

30. When using the conventional horizontal block, general notes must be placed a minimum of _____ below the revision block space.
   A. 2 in.
   B. 3 in.
   C. 4 in.
   D. 5 in.

31. Into what major categories are project drawings divided?
   A. Site, architectural, structural, mechanical, electrical, and fire protection
   B. Civil, architectural, skeletal, mechanical, power, and fire protection
   C. Civil, architectural, structural, plumbing, power, and fire protection
   D. Civil, architectural, structural, mechanical, electrical, and fire protection
32. The _____ drawings allow the Equipment Operators to estimate the amount of any soil displacement (cut and fill) and prepare the site for construction.

A. architectural  
B. civil  
C. soil boring log  
D. delta

33. What type of scale is typically used for site plans on civil drawings?

A. 1/8 = 1 in.  
B. 1/4 = 1 in.  
C. Architect’s scale  
D. Engineer’s scale

34. What drawings are considered the key drawings in a set of project drawings?

A. Building sections  
B. Floor plans  
C. Elevations  
D. Details

35. What should be done before placing dimensions on a drawing?

A. Convert them to inches.  
B. Rescale them.  
C. Convert them from engineer’s scale to architect’s scale.  
D. Lay out and verify them on sketch paper.

36. In concrete and masonry construction, all dimensions are all given to the _____ of the walls.

A. centerline  
B. face  
C. veneer  
D. lintel

37. (True or False) Elevations are typically drawn at the same scale as the floor plan.

A. True  
B. False

38. What drawing should contain all roof, floor, wind, seismic, and other loads?

A. Civil  
B. Architectural  
C. Structural  
D. Schedule
39. What serves as the basis for developing the foundation plan?
   A. Architectural drawings
   B. Civil drawings
   C. Site plan
   D. Ground floor plan

40. The floor framing plan is a(n) _____ view of the layout of girders, beams, and joists.
   A. elevation
   B. plan
   C. isometric
   D. cut away

41. (True or False) Roof framing plans for wood frame construction are drawn in the same manner as the floor framing plan.
   A. True
   B. False

42. What additional drawings are commonly provided for plumbing (mechanical) plans that are difficult to read?
   A. Riser diagrams
   B. Large scale details
   C. Sectional cuts
   D. Orthographic

43. What is the next step in creating an electrical drawing after tracing the floor plan?
   A. Add circuits, circuit numbers, and circuit notations.
   B. Draw switches.
   C. Draw convenience outlets.
   D. Draw the meter and service panel noting voltage rating and amperage.

44. Sections most commonly apply to the _____ and _____ divisions.
   A. architectural, structural
   B. civil, architectural
   C. civil, structural
   D. architectural, mechanical

45. Full building sections are usually located in the _____ division.
   A. mechanical
   B. structural
   C. architectural
   D. electrical
46. What scale should be used to draw details?
   A. 1 in. = 1 ft.
   B. 1 1/2 in. = 1 ft.
   C. 3 in. = 1 ft.
   D. Large enough to explain required information

47. Most schedules relate to doors, windows, and ______.
   A. room finishes
   B. concrete pours
   C. material deliveries
   D. contract phases

48. (True or False) A bill of material can be submitted on a material estimate sheet or material takeoff sheet as well as on a bill of material form.
   A. True
   B. False
Trade Terms Introduced in This Chapter

Cavalier projections  Also called cavalier perspective or high view point; a way to represent a three-dimensional object on a flat drawing, and more specifically, a type of oblique projection.

Isometric projections  A form of graphical projection, more specifically, a form of axonometric projection; a method of visually representing three-dimensional objects in two dimensions, in which the three coordinate axes appear equally foreshortened and the angles between any two of them are 120°.

Lintel  A horizontal beam used in the construction of buildings and a major architectural contribution of ancient Greece. It usually supports the masonry above a window or door opening. Also known as a header.

Orthographic projections  A means of representing a three-dimensional object in two dimensions; with multiview orthographic projections, up to six pictures of an object are produced, with each projection plane parallel to one of the coordinate axes of the object.

Veneer  A thin covering of material, such as brick, placed over a backing material of wood frame or block.
Additional Resources and References

This chapter is intended to present thorough resources for task training. The following reference works are suggested for further study. This is optional material for continued education rather than for task training.


CSFE Nonresident Training Course – User Update

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