**GADSDEN TECHNICAL INSTITUTE**
**CONTINUAL EDUCATION**
**COVID-19 EMERGENCY LESSONS**

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|---|---|
| Teacher Name: | Mr. Alfred Suber |
| Dates of Instruction: | March 30 – April 13, 2020 |
| Lesson Title: | Introduction to Construction Drawings |
| Grade Levels: | 10 – 12; Adult |
| Subject Area: | Carpentry |

***Assignment:*** After reading the material on introduction to basic construction drawings and sketches, the student will be able to: recognize and identify basic construction drawing terms, components and symbols; relate information on construction drawings to actual locations on the print; recognize different classifications of construction drawings; interpret and use drawing dimensions and architectural scales; draw or sketch basic floor plans and/or shop drawings.

***Lesson Instructions:***
Week of March 30 – April 3, 2020, read pages 2 - 20. Study and Learn Trade Terms Definitions on pages 49 and 50.

Week of April 6 – 15, 2020, read pages 21 - 44. Study and Learn Trade Terms Definitions on pages 49 and 50.

***Practice Activities:***
Week of March 30 – April 3, 2020, answer review questions on page 45.

Week of April 6 – 15, 2020, answer trade terms quiz questions on pages 46 and 47.

***Instructional Materials:***
1. Carpentry Introduction to Construction Drawings Module 5 reading packet
2. Carpentry Introduction to Construction Drawings Module 5 questions packet.

***Special Notes from Instructor:***
ALL paper work should be kept in your folder, signed and dated to reflect completion date(s) prior to bringing them to class with you on April 16, 2020. If there are any questions, I can be reached at (850) 875-8324; ext. 5121 or email suberj@gcpsmail.com.

# SECTION ONE

## 1.0.0 CONSTRUCTION DRAWINGS AND THEIR COMPONENTS

### Objective

Identify and describe various types of construction drawings, including their fundamental components and features.

a. Identify various types of construction drawings.
b. Identify and describe the purpose of the five basic construction drawing components.
c. Identify and explain the significance of various drawing elements, such as lines of construction, symbols, and grid lines.
d. Identify and explain the use of dimensions and various drawing scales.
e. Identify and describe how to use engineer's and architect's scales.

### Performance Task

1. Using the floor plan supplied with this module:
   - Locate the wall common to both interview rooms.
   - Determine the overall width of the structure studio.
   - Determine the distance from the outside east wall to the center of the beam in the structure studio.
   - Determine the elevation of the slab.

### Trade Terms

**Architect**: A qualified, licensed person who creates and designs drawings for a construction project.

**Architect's scale**: A specialized ruler used in making or measuring reduced scale drawings. The ruler is marked with a range of calibrated ratios for laying out distances, with scales indicating feet, inches, and fractions of inches. Used on drawings other than site plans.

**Architectural plans**: Drawings that show the design of the project. Also called architectural drawings.

**Beam**: A large, horizontal structural member made of concrete, steel, stone, wood, or other structural material to provide support above a large opening.

**Blueprints**: The traditional name used to describe construction drawings.

**Civil plans**: Drawings that show the location of the building on the site from an aerial view, including contours, trees, construction features, and dimensions.

**Computer-aided drafting (CAD)**: The making of a set of construction drawings with the aid of a computer.

**Contour lines**: Solid or dashed lines showing the elevation of the earth on a civil drawing.

**Detail drawings**: Enlarged views of part of a drawing used to show an area more clearly.

**Dimension line**: A line on a drawing with a measurement indicating length.

**Electrical plans**: Engineered drawings that show all electrical supply and distribution.

**Elevation (EL)**: Height above sea level, or other defined surface, usually expressed in feet or meters.

**Elevation drawing**: Side view of a building or object, showing height and width.

**Engineer**: A person who applies scientific principles in design and construction.

**Engineer's scale**: A straightedge measuring device divided uniformly into multiples of 10 divisions per inch so that drawings can be made with decimal values. Used mainly for land measurements on site plans.

**Fire protection plan**: A drawing that shows the details of the building's sprinkler system.

**Floor plan**: A drawing that provides an aerial view of the layout of each room.

**Foundation plan**: A drawing that shows the layout and elevation of the building foundation.

**Hidden line**: A dashed line showing an object obstructed from view by another object.

**HVAC**: Heating, ventilating, and air conditioning.

**Leader**: In drafting, the line on which an arrowhead is placed and used to identify a component.

**Legend**: A description of the symbols and abbreviations used in a set of drawings.

**Mechanical plans**: Engineered drawings that show the mechanical systems, such as motors and piping.

**Metric scale**: A straightedge measuring device divided into centimeters, with each centimeter divided into 10 millimeters. Usually used for architectural drawings and sometimes referred to as a metric architect's scale.

**Not to scale (NTS)**: Describes drawings that show relative positions and sizes only, without scale.

**Piping and instrumentation drawings (P&IDs)**: Schematic diagrams of a complete piping system.

**Plumbing isometric drawing**: A type of three-dimensional drawing that depicts a plumbing system.

**Plumbing plans**: Engineered drawings that show the layout for the plumbing system.

**Roof plan**: A drawing of the view of the roof from above the building.

**Scale**: The ratio between the size of a drawing of an object and the size of the actual object.

**Schematic**: A one-line drawing showing the flow path for electrical circuitry or the relationship of all parts of a system.

**Section drawing**: A cross-sectional view of a specific location, showing the inside of an object or building.

**Specifications**: Precise written presentation of the details of a plan.

**Structural plans**: A set of engineered drawings used to support the architectural design.

**Symbol**: A drawing that represents a material or component on a plan.

**Title block**: A part of a drawing sheet that includes some general information about the project.

Construction drawings are architectural or working drawings used to represent a structure or system. These were traditionally referred to as **blueprints**, because years ago the lines on a blueprint were white and the background was blue. Construction drawings are also called prints. Today, most prints are created by **computer-aided drafting (CAD)**, and they have blue or black lines on a white background.

Various kinds of construction drawings, including residential drawings, commercial drawings, landscaping plans, shop drawings, and industrial drawings, are used in construction. In this module, several of the most common types of drawings will be introduced.

Construction drawings, together with the set of **specifications** (often abbreviated as *specs*), detail what is to be built and what materials are to be used. Specifications are written statements that the architectural and engineering firm provides to the general contractors. The specs define the quality of work to be done and describe the materials to be used.

**Did You Know?**

## How Blueprints Started

The process for making blueprints was developed in 1842 by an English astronomer named Sir John F. Herschel. The method involved coating a paper with a special chemical. After the coating dried, an original hand drawing was placed on top of the paper. Both papers were then covered with a piece of glass and set in the sunlight for about an hour. The coated paper was developed much like a photograph. After a cold-water wash, the coated paper turned blue, and the lines of the drawing remained white.

The set of construction drawings forms the basis of agreement and understanding that a building will be built as detailed in the drawings. Therefore, everyone involved in planning, supplying, and building any structure should be able to read construction drawings. For any building project, also consult the civil engineering plans for that location, including sewer, highway, and water installation plans.

### 1.1.0 Six Types of Construction Drawings

A set of building construction drawing plans almost always includes six major types of drawings (*Figure 1*). They include the following:

- Civil
- Architectural
- Structural
- Mechanical
- Plumbing
- Electrical
- Fire protection

This section will examine the various characteristics of each type of drawing.

#### *1.1.1 Civil Plans*

**Civil plans** are also called site plans, survey plans, or plot plans. They show the location of the building on the site from an aerial view (*Figure 2*). A civil plan also shows the natural contours of the earth, represented on the plan by **contour lines**. The civil plans can also include a landscape plan (*Figure 3*) that shows any trees on the property; construction features such as walks, driveways, or utilities; the dimensions of the property; and possibly a legal description of the property.

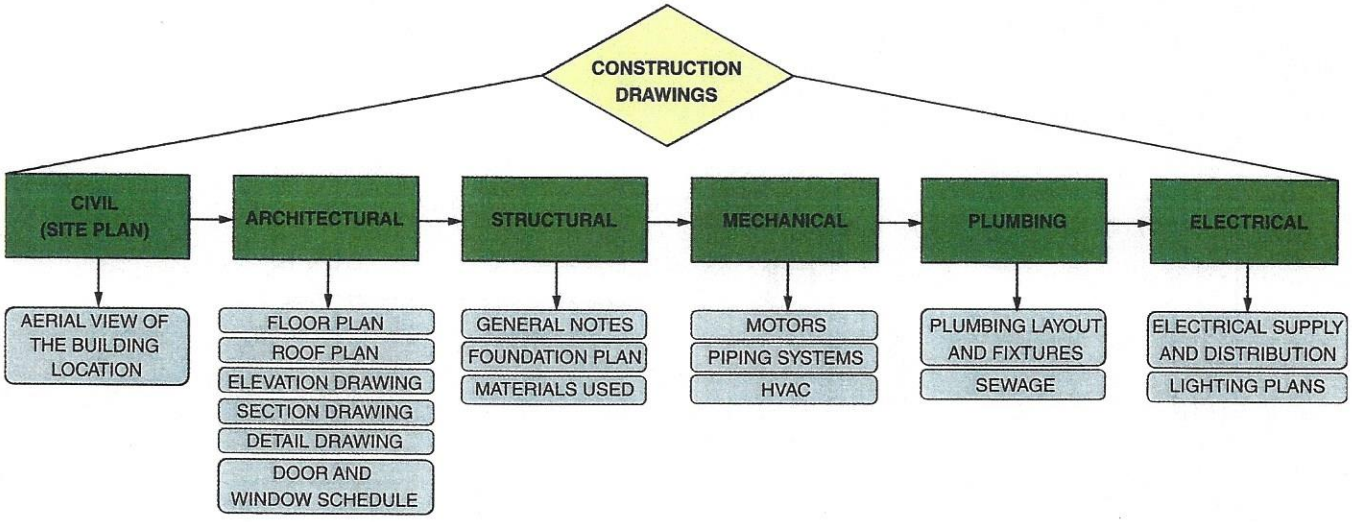



*Figure 1* Types of construction drawings.

### 1.1.2 Architectural Plans

**Architectural plans** (also called architectural drawings) show the design of the project. One part of an architectural plan is a **floor plan**, also known as a plan view (refer to *Drawing 1*, First Floor Plan, in the *Appendix*). Any drawing made looking down on an object is commonly called a plan view. The floor plan is an aerial view of the layout of each room. It provides the most information about the project. It shows exterior and interior walls, doors, stairways, and mechanical equipment. The floor plan shows the floor as someone would see it from above if the upper part of the building were removed.

An architectural plan also includes a **roof plan** (*Figure 4*), which is a view of the roof from above the building. It shows the shape of the roof and the materials that will be used to finish it.

**Elevation (EL)** is another element of architectural drawings. **Elevation drawings** are side views that show height. On a building drawing, there are standard names for different elevations. For example, the side of a building that faces south is called the south elevation. Exterior elevations (*Figure 5*) show the size of the building; the style of the building; and the placement of doors, windows, chimneys, and decorative trim.

## Building Information Modeling (BIM)

Traditionally, Building Information Modeling (BIM) was a system of paper-based documents and construction drawings designed to monitor and track specific information about a building.

In the last decade, BIM has increasingly moved toward computer technology, which allows the various trades and the building owner to track the lifecycle of the building from the start of planning, through construction, to completion. BIM allows building owners and trades to easily track and identify the various components and assemblies of individual systems (such as electrical, HVAC, and plumbing) and building materials within a specific location or locations of a building.

BIM also has the capabilities of simulating the lifecycles of various systems within the building in order to provide information on determining the wear on, and lifespan of, individual components. Additionally, BIM software allows the trades and the building owner to input and save information on the building as repairs, updates, or renovations are made to the building. Information such as part sizes, manufacturers, part numbers, and related drawings, or any other information ever researched in the past can be stored in a BIM system.

Another advantage of BIM lies in its capabilities of allowing documentation and information on a building to be easily transferred and communicated between all the members of a project.

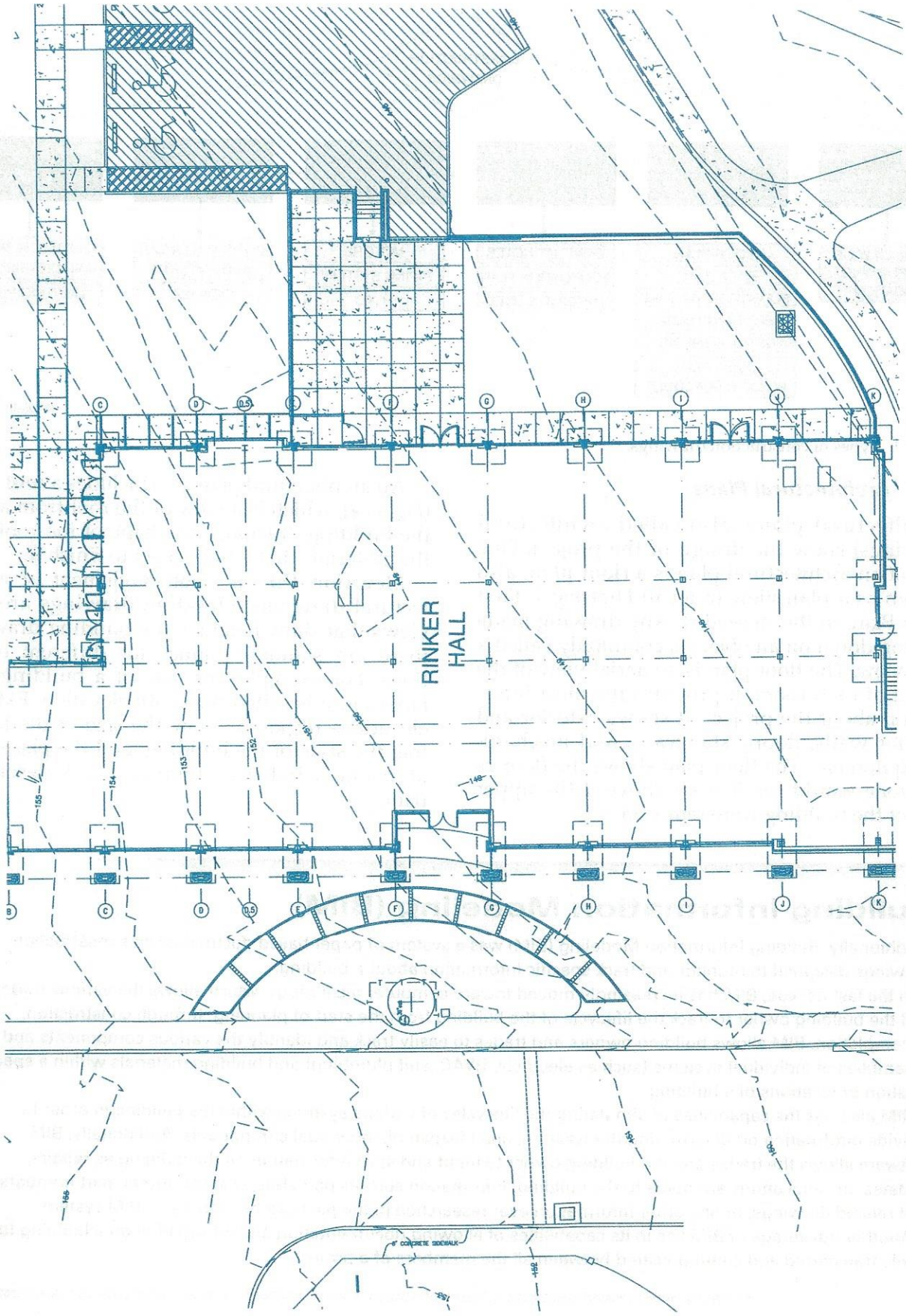
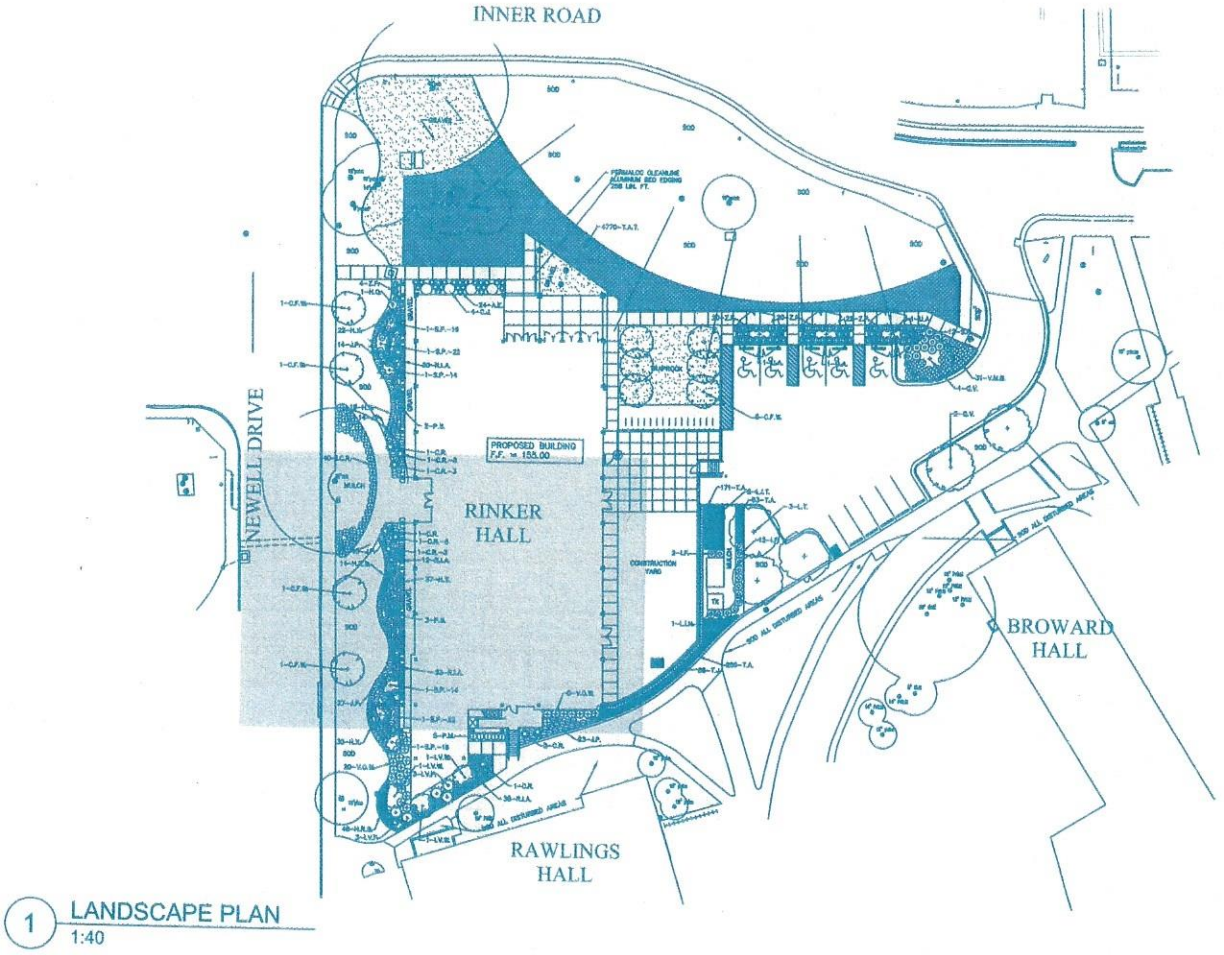



*Figure 2* Civil plan, aerial view.



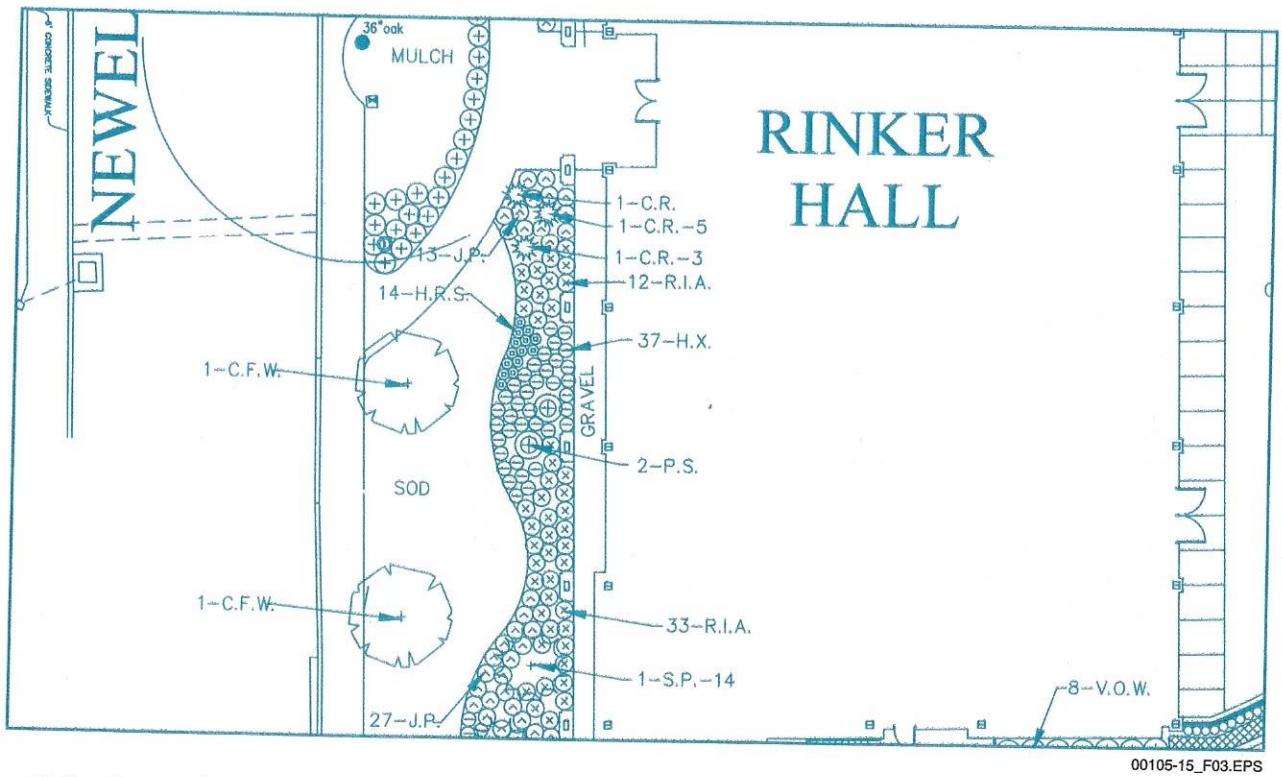




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*Figure 3* Landscape plan.

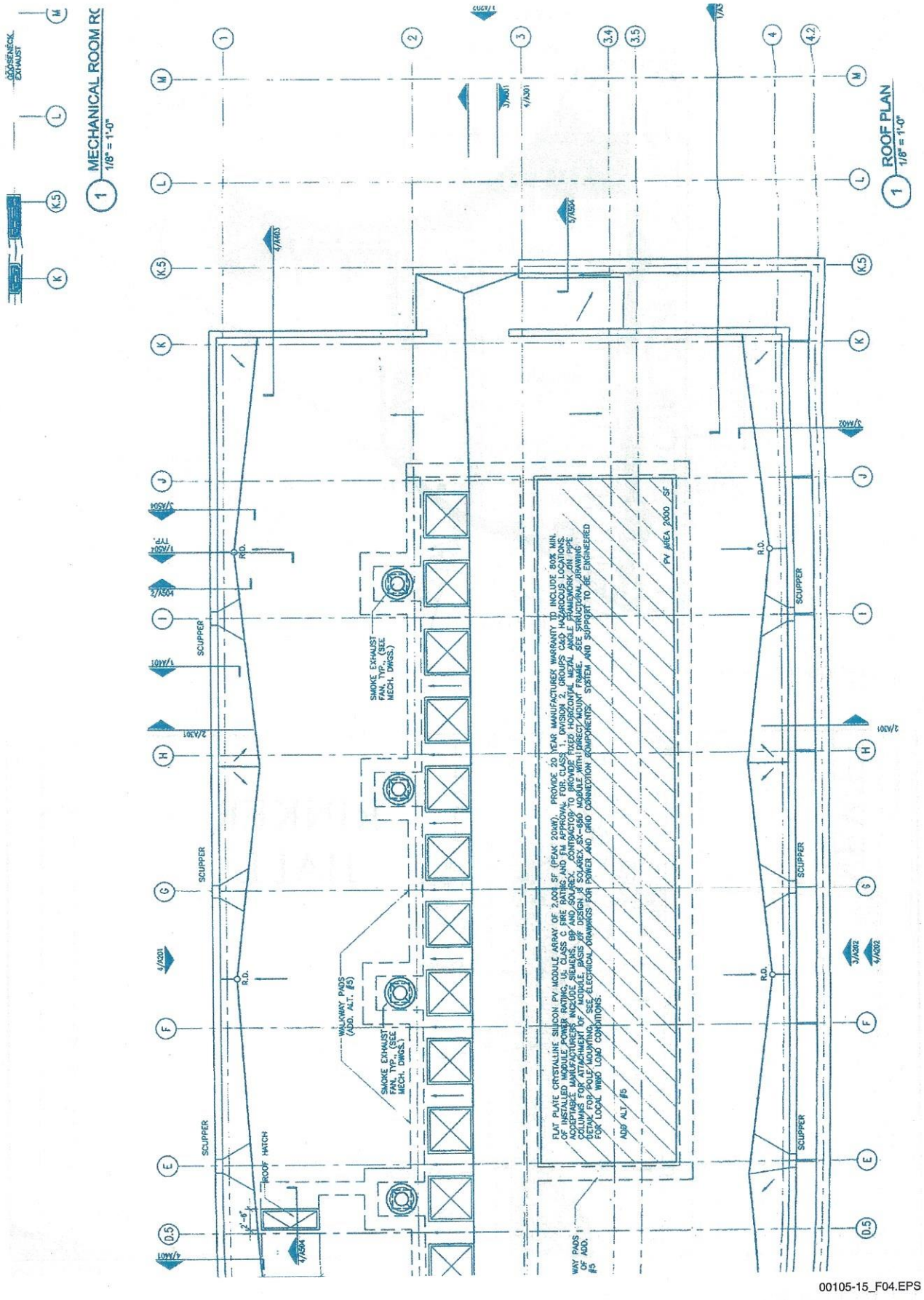


*Figure 4* Roof plan.

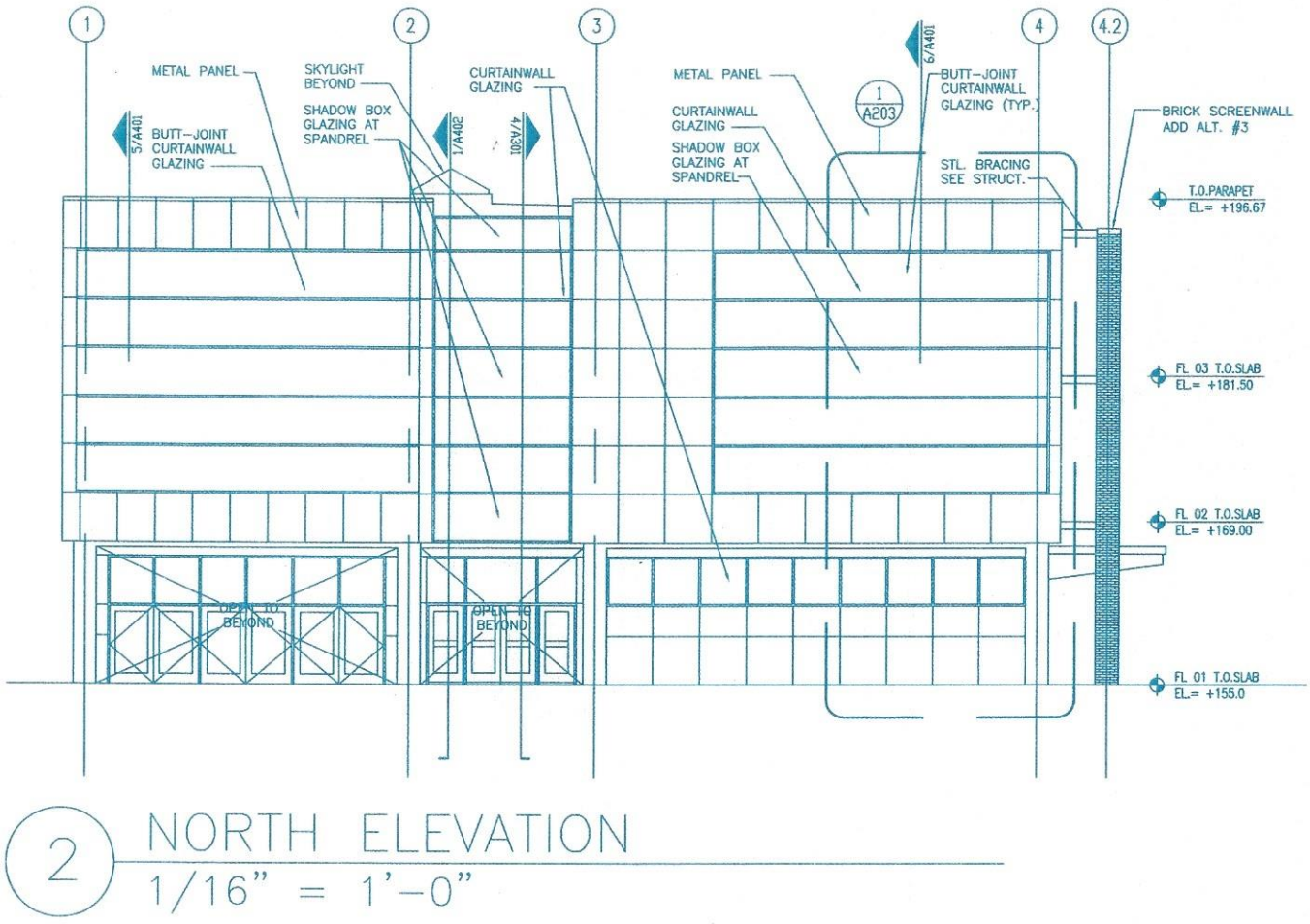


*Figure 5* Exterior elevation.

Another element of the architectural plan is **section drawings**, which show how the structure is to be built. Section drawings (*Figure 6*) are cross-sectional views that show the inside of an object or building. They show what construction materials to use and how the parts of the object or building fit together. They normally show more detail than plan views. Compare the information on the drawing in *Figure 6* with the information on the drawing in *Figure 5*.

Even more detail is shown in **detail drawings** (*Figure 7*), which are enlarged views of some special features of a building, such as floors and walls. They are enlarged to make the details clearer. Often the detail drawings are placed on the same sheet where the feature appears in the plan, but sometimes they are placed on separate sheets and referred to by a number on the plan view.

The architectural plan also shows the finish schedules to be used for the doors and windows of the building. Door and window schedules, for example, are tables that list the sizes and other information about the various types of doors and windows used in the project. *Figure 8* shows an example of a window schedule and a detail drawing for the Type D1 window. Be aware that in some sets of drawings the window schedule and elevation drawings for each type of window may appear on the same sheet. Schedules may also be included for finish hardware and fixtures. These schedules are not drawings, but they are usually included in a set of working drawings.

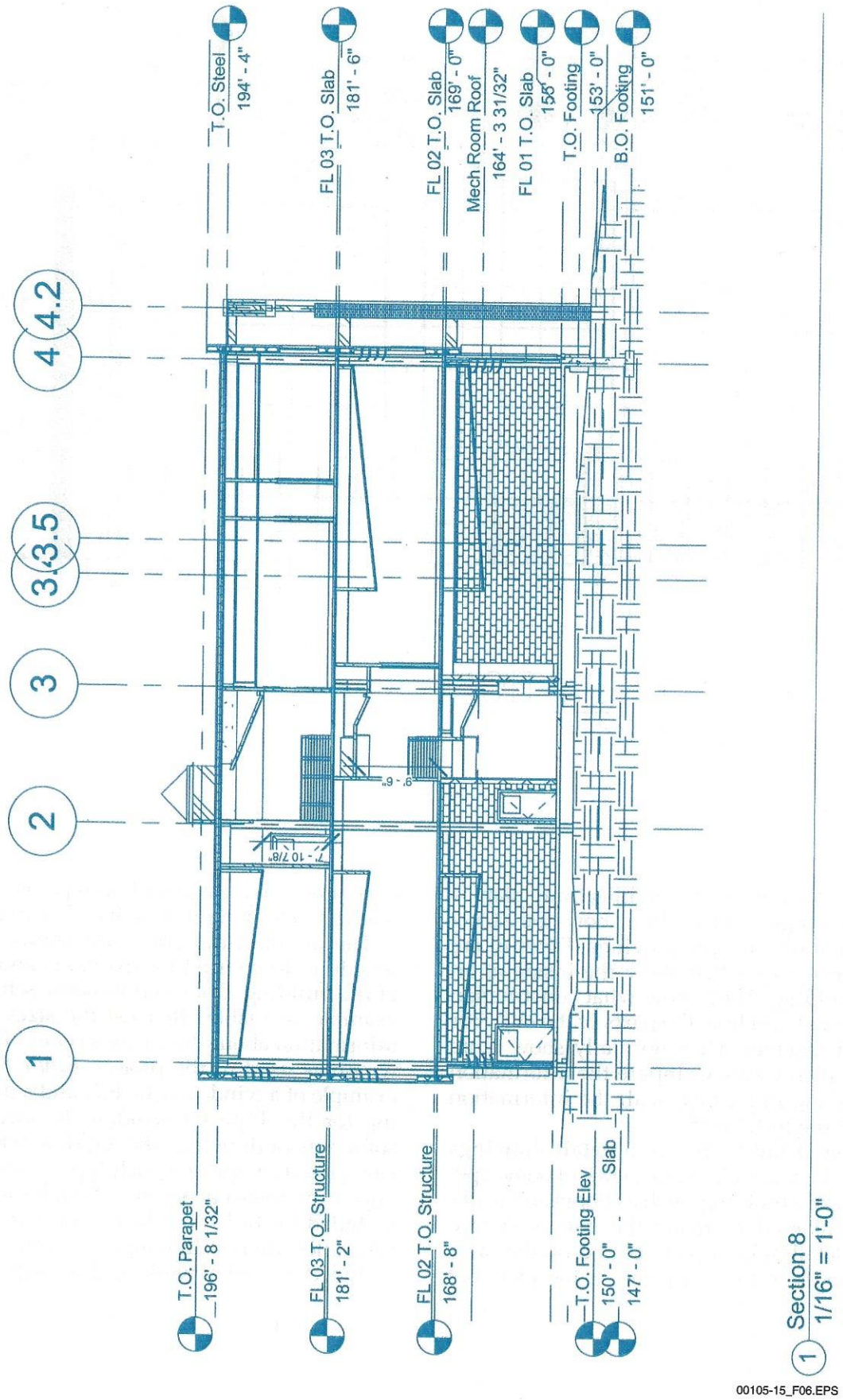


*Figure 6* Section drawing (wall section).

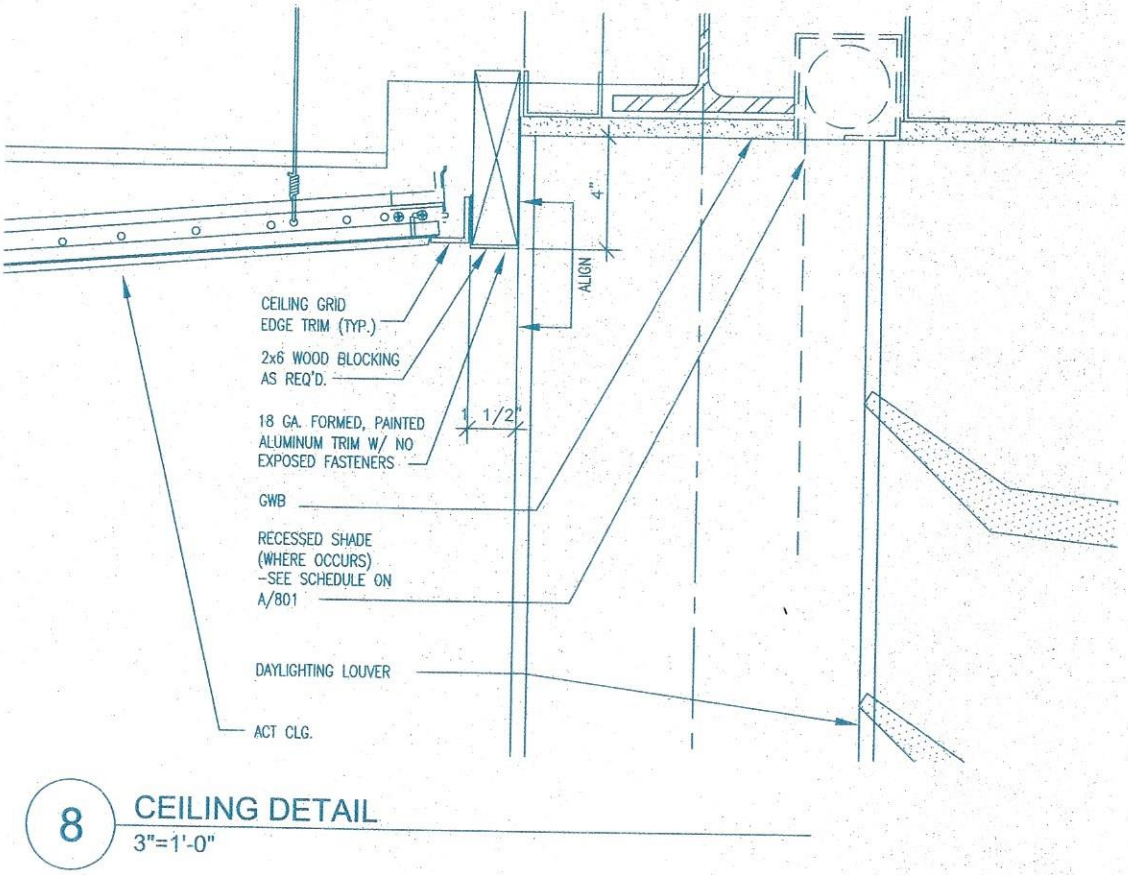


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*Figure 7* Detail drawing (ceiling detail).

### 1.1.3 Structural Plans

The **structural plans** are a set of engineered drawings used to support the architectural design. The first part of the structural plans is the general notes (*Figure 9*). These notes give details of the materials to be used and the requirements to be followed in order to build the structure that the architectural plan depicts. The notes, for instance, might specify the type and strength of concrete required for the foundation, the loads that the roof and stairs must be built to accommodate, and codes that contractors must follow. General notes may be on a separate general notes sheet or may be part of individual plan sheets.

The structural plans also include a **foundation plan** (*Figure 10*), which shows the lowest level of the building, including concrete footings, slabs, and foundation walls. They also may show steel girders, columns, or **beams**, as well as detail drawings to show where and how the foundation must be reinforced. Column and spread footing schedules, and foundation notes may be included on the foundation plan. A related element is the structural floor plan, which depicts a wood or metal joist framing and the underlayment of each floor of the structure.

## Importance of Architectural Drawings

Look at architectural plans first, because all other drawings follow from them. Architectural plans are the most general; they show how all the parts of the project fit together.

## WINDOW SCHEDULE

| TYPE | FRAME SIZE | FRAME FINISH | GLAZING | REMARKS |
|---|---|---|---|---|
| A | 4' 2" x 4' 2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| B | 24' 2-1/2" x 11' 0" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| B-1 | 12' 10" x 11' 0" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| C | 15'-11-1/2" x 8' 3-1/2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| C-1 | 15'-11-1/2" x 4' 1-1/2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| D | 15 11-1/2'-0" x 11' 1-1/2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| D-1 | 15 11-1/2'-0" x 11' 1-1/2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| D-2 | 31' 11-1/2" x 4' 4" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| E | 14' 4" x 7' 8" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| F | 15'-11-1/2" x 4' 4 " | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| H | 11' 11-1/2" x 8' 1/4" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| H-1 | 11' 11-1/2" x 10' 1-3/4" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| I | 15'-11-1/2" x 4' 1-1/2 " | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| | | | | |
| CW - 1 | 12' 0" x 27' 11-1/4" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| | | | | |
| CW - 3 | 15' 11 1/2" x 37' 3 1/4" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| CW - 4 | 36' 10" x 20' 9 1/2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |
| CW - 5 | 28' 11-7/8" x 20' 9-1/2" | CLEAR ANODIZED ALUMINUM | VIRACON VE-7-2M | |

NOTES

1. FRAME SIZES HAVE BEEN INDICATED ASSUMING 1/2" JOINT ADJACENT TO METAL PANEL SYSTEM. ALIGNMENT OF JOINTS W/ METAL PANEL MODULE IS REQUIRED. INTERMEDIATE MULLIONS TO BE CENTERED ON ADJACENT METAL PANEL JOINTS
2. "SG" INDICATES SAFETY GLAZING (TEMPERED GLASS REQUIRED)

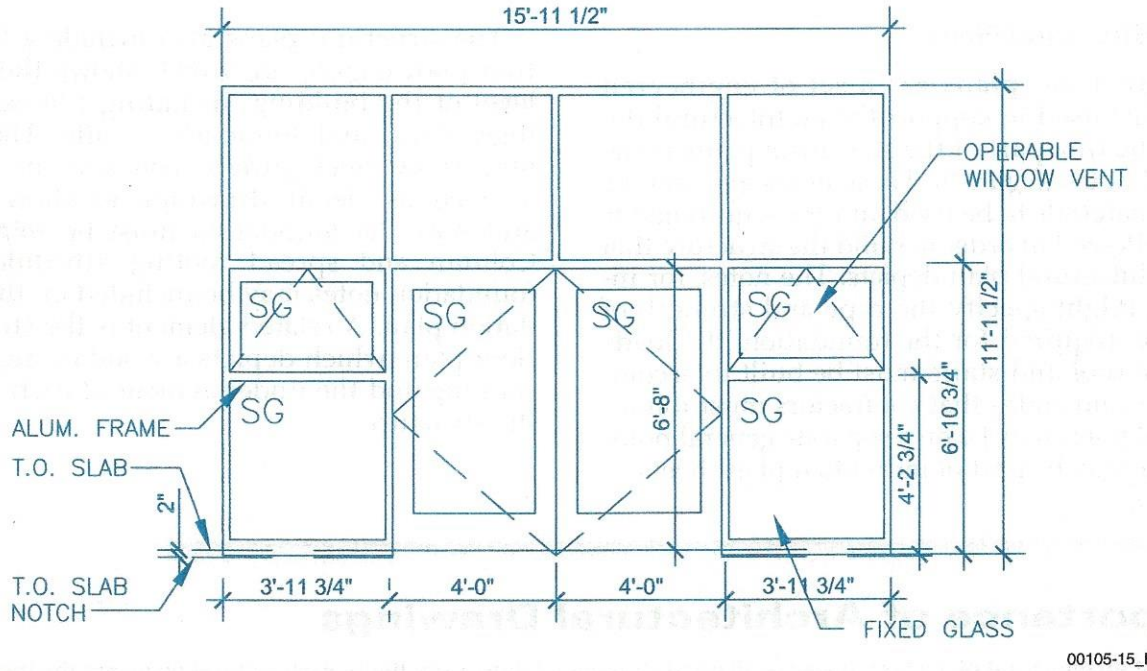


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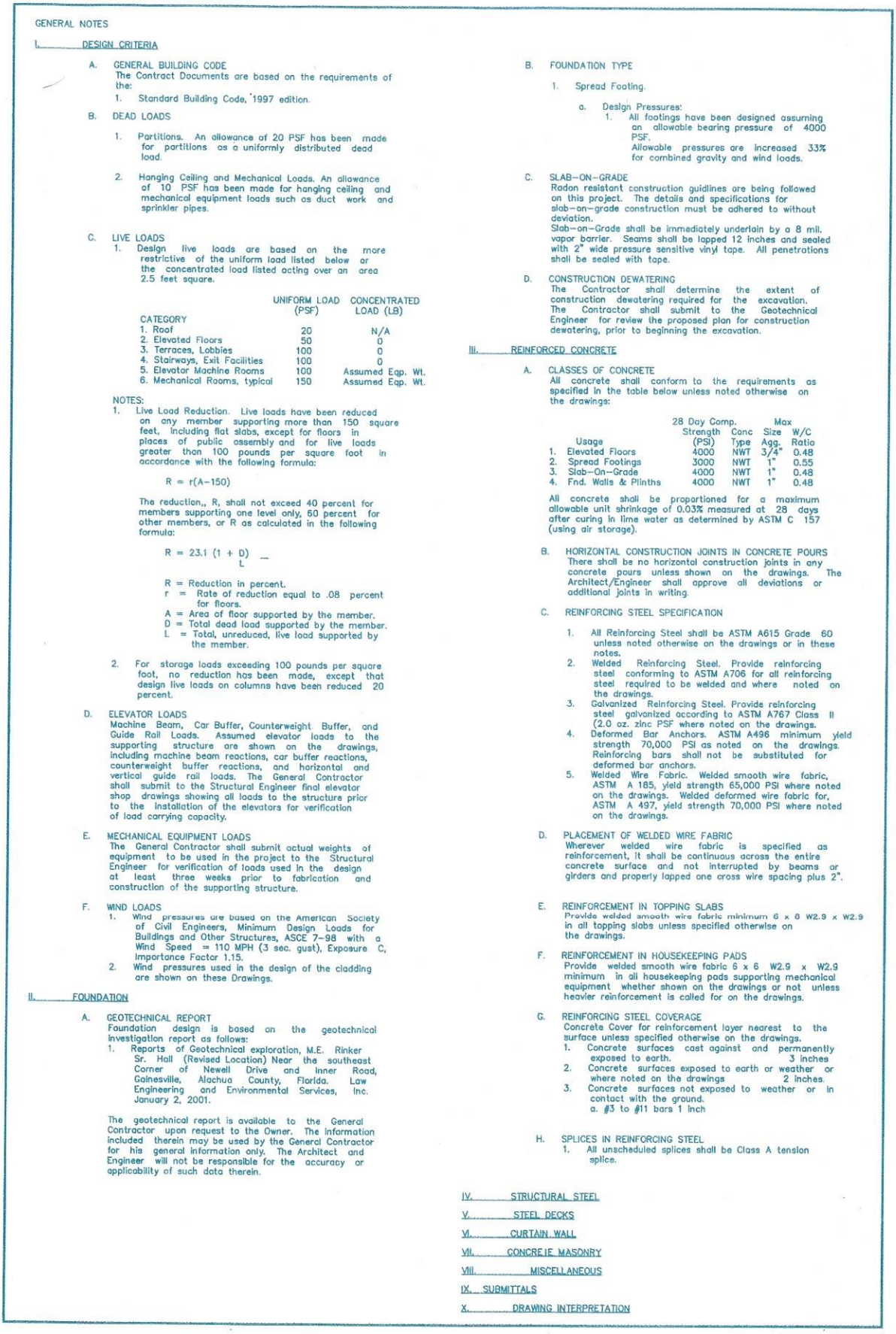
*Figure 8* Window schedule and window detail.



GENERAL NOTES

I. DESIGN CRITERIA

A. GENERAL BUILDING CODE
The Contract Documents are based on the requirements of the:
1. Standard Building Code, 1997 edition.

B. DEAD LOADS
1. Partitions. An allowance of 20 PSF has been made for partitions as a uniformly distributed dead load.
2. Hanging Ceiling and Mechanical Loads. An allowance of 10 PSF has been made for hanging ceiling and mechanical equipment loads such as duct work and sprinkler pipes.

C. LIVE LOADS
1. Design live loads are based on the more restrictive of the uniform load listed below or the concentrated load listed acting over an area 2.5 feet square.

| CATEGORY | UNIFORM LOAD (PSF) | CONCENTRATED LOAD (LB) |
|---|---|---|
| 1. Roof | 20 | N/A |
| 2. Elevated Floors | 50 | 0 |
| 3. Terraces, Lobbies | 100 | 0 |
| 4. Stairways, Exit Facilities | 100 | 0 |
| 5. Elevator Machine Rooms | 100 | Assumed Eqp. Wt. |
| 6. Mechanical Rooms, typical | 150 | Assumed Eqp. Wt. |

NOTES:
1. Live Load Reduction. Live loads have been reduced on any member supporting more than 150 square feet, including flat slabs, except for floors in places of public assembly and for live loads greater than 100 pounds per square foot in accordance with the following formula:

$$R = r(A-150)$$

The reduction,, R, shall not exceed 40 percent for members supporting one level only, 60 percent for other members, or R as calculated in the following formula:

$$R = 23.1\ (1 + \frac{D}{L})$$

R = Reduction in percent.
r = Rate of reduction equal to .08 percent for floors.
A = Area of floor supported by the member.
D = Total dead load supported by the member.
L = Total, unreduced, live load supported by the member.

2. For storage loads exceeding 100 pounds per square foot, no reduction has been made, except that design live loads on columns have been reduced 20 percent.

D. ELEVATOR LOADS
Machine Beam, Car Buffer, Counterweight Buffer, and Guide Rail Loads. Assumed elevator loads to the supporting structure are shown on the drawings, including machine beam reactions, car buffer reactions, counterweight buffer reactions, and horizontal and vertical guide rail loads. The General Contractor shall submit to the Structural Engineer final elevator shop drawings showing all loads to the structure prior to the installation of the elevators for verification of load carrying capacity.

E. MECHANICAL EQUIPMENT LOADS
The General Contractor shall submit actual weights of equipment to be used in the project to the Structural Engineer for verification of loads used in the design at least three weeks prior to fabrication and construction of the supporting structure.

F. WIND LOADS
1. Wind pressures are based on the American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures, ASCE 7-98 with a Wind Speed = 110 MPH (3 sec. gust), Exposure C, Importance Factor 1.15.
2. Wind pressures used in the design of the cladding are shown on these Drawings.

II. FOUNDATION

A. GEOTECHNICAL REPORT
Foundation design is based on the geotechnical investigation report as follows:
1. Reports of Geotechnical exploration, M.E. Rinker Sr. Hall (Revised Location) Near the southeast Corner of Newell Drive and Inner Road, Gainesville, Alachua County, Florida. Law Engineering and Environmental Services, Inc. January 2, 2001.

The geotechnical report is available to the General Contractor upon request to the Owner. The information included therein may be used by the General Contractor for his general information only. The Architect and Engineer will not be responsible for the accuracy or applicability of such data therein.

B. FOUNDATION TYPE
1. Spread Footing.
a. Design Pressures:
1. All footings have been designed assuming an allowable bearing pressure of 4000 PSF.
Allowable pressures are increased 33% for combined gravity and wind loads.

C. SLAB-ON-GRADE
Radon resistant construction guidlines are being followed on this project. The details and specifications for slab-on-grade construction must be adhered to without deviation.
Slab-on-Grade shall be immediately underlain by a 8 mil. vapor barrier. Seams shall be lapped 12 inches and sealed with 2" wide pressure sensitive vinyl tape. All penetrations shall be sealed with tape.

D. CONSTRUCTION DEWATERING
The Contractor shall determine the extent of construction dewatering required for the excavation. The Contractor shall submit to the Geotechnical Engineer for review the proposed plan for construction dewatering, prior to beginning the excavation.

III. REINFORCED CONCRETE

A. CLASSES OF CONCRETE
All concrete shall conform to the requirements as specified in the table below unless noted otherwise on the drawings:

| Usage | 28 Day Comp. Strength (PSI) | Conc Type | Max Size Agg. | W/C Ratio |
|---|---|---|---|---|
| 1. Elevated Floors | 4000 | NWT | 3/4" | 0.48 |
| 2. Spread Footings | 3000 | NWT | 1" | 0.55 |
| 3. Slab-On-Grade | 4000 | NWT | 1" | 0.48 |
| 4. Fnd. Walls & Plinths | 4000 | NWT | 1" | 0.48 |

All concrete shall be proportioned for a maximum allowable unit shrinkage of 0.03% measured at 28 days after curing in lime water as determined by ASTM C 157 (using air storage).

B. HORIZONTAL CONSTRUCTION JOINTS IN CONCRETE POURS
There shall be no horizontal construction joints in any concrete pours unless shown on the drawings. The Architect/Engineer shall approve all deviations or additional joints in writing.

C. REINFORCING STEEL SPECIFICATION
1. All Reinforcing Steel shall be ASTM A615 Grade 60 unless noted otherwise on the drawings or in these notes.
2. Welded Reinforcing Steel. Provide reinforcing steel conforming to ASTM A706 for all reinforcing steel required to be welded and where noted on the drawings.
3. Galvanized Reinforcing Steel. Provide reinforcing steel galvanized according to ASTM A767 Class II (2.0 oz. zinc PSF where noted on the drawings.
4. Deformed Bar Anchors. ASTM A496 minimum yield strength 70,000 PSI as noted on the drawings. Reinforcing bars shall not be substituted for deformed bar anchors.
5. Welded Wire Fabric. Welded smooth wire fabric, ASTM A 185, yield strength 65,000 PSI where noted on the drawings. Welded deformed wire fabric for, ASTM A 497, yield strength 70,000 PSI where noted on the drawings.

D. PLACEMENT OF WELDED WIRE FABRIC
Wherever welded wire fabric is specified as reinforcement, it shall be continuous across the entire concrete surface and not interrupted by beams or girders and properly lapped one cross wire spacing plus 2".

E. REINFORCEMENT IN TOPPING SLABS
Provide welded smooth wire fabric minimum 6 x 6 W2.9 x W2.9 in all topping slabs unless specified otherwise on the drawings.

F. REINFORCEMENT IN HOUSEKEEPING PADS
Provide welded smooth wire fabric 6 x 6 W2.9 x W2.9 minimum in all housekeeping pads supporting mechanical equipment whether shown on the drawings or not unless heavier reinforcement is called for on the drawings.

G. REINFORCING STEEL COVERAGE
Concrete Cover for reinforcement layer nearest to the surface unless specified otherwise on the drawings.
1. Concrete surfaces cast against and permanently exposed to earth. 3 inches
2. Concrete surfaces exposed to earth or weather or where noted on the drawings 2 inches.
3. Concrete surfaces not exposed to weather or in contact with the ground.
a. #3 to #11 bars 1 inch

H. SPLICES IN REINFORCING STEEL
1. All unscheduled splices shall be Class A tension splice.

IV. STRUCTURAL STEEL

V. STEEL DECKS

VI. CURTAIN WALL

VII. CONCRETE MASONRY

VIII. MISCELLANEOUS

IX. SUBMITTALS

X. DRAWING INTERPRETATION

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*Figure 9* General notes for structural plans.

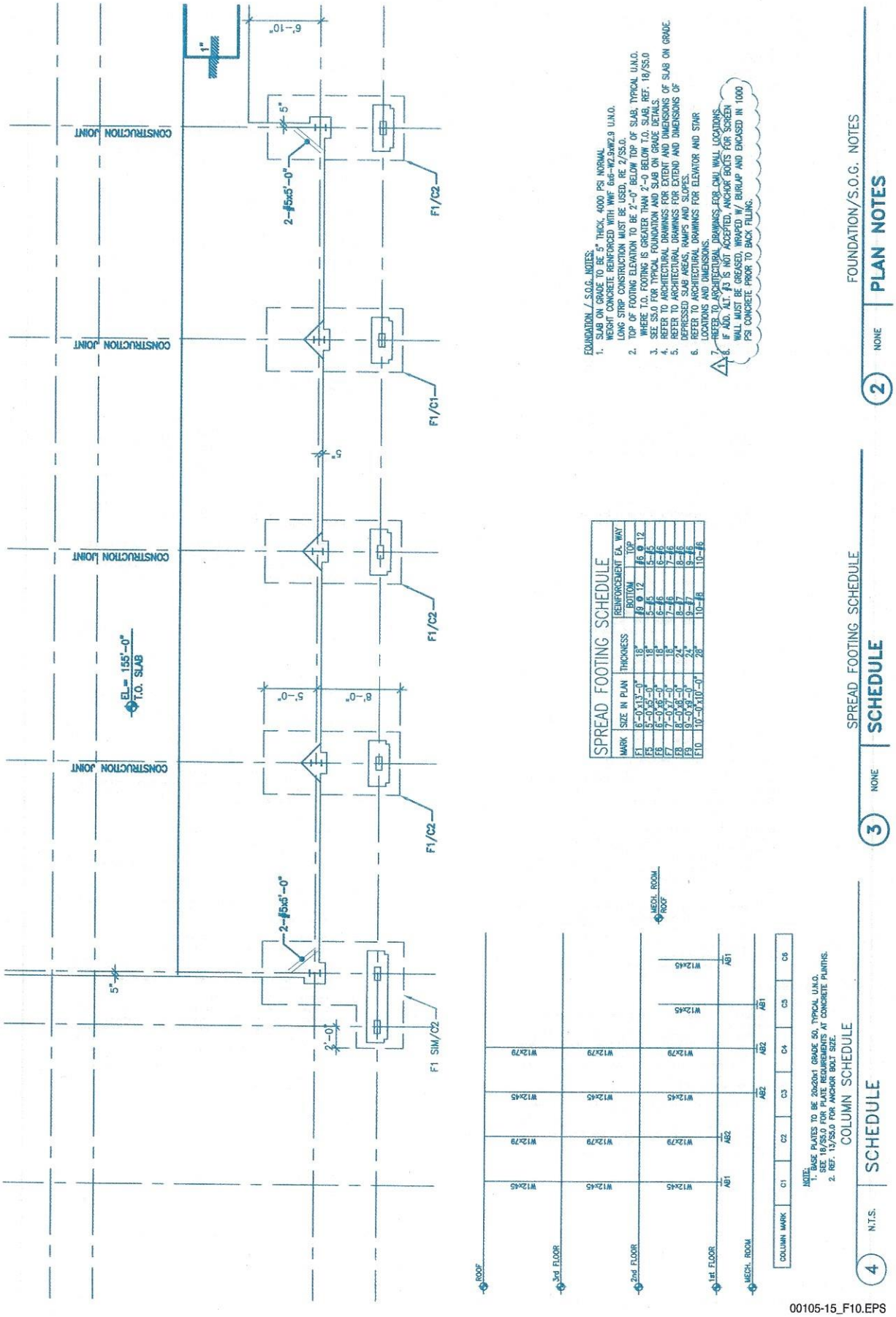



*Figure 10* Foundation plan (foundation/slab-on-grade plan).

The structural plans show the materials to be used for the walls, whether concrete or masonry, and whether the framing is wood or steel. Structural plans also include a roof-framing plan, showing what kinds of ceiling joists and roof rafters are to be used and where trusses are to be placed (refer to *Drawing 2*, Roof Framing Plan, in the *Appendix*). Notes for the framing plan are usually found on the same sheet as the drawing.

The structural plans include structural section drawings (*Figure 11*), which are similar to the architectural section drawings but show only the structural requirements. Miscellaneous structural details may also be shown in these sections to provide a better understanding of such things as connections and attachments of accessories.

### 1.1.4 Mechanical Plans

**Mechanical plans** are engineered plans for motors, pumps, piping systems, and piping equipment. These plans incorporate general notes (*Figure 12*) containing specifications ranging from what the contractor is to provide to how the contractor determines the location of grilles and registers. A mechanical **legend** (*Figure 13*) defines the **symbols** used on the mechanical plans. A list of abbreviations (*Figure 14*) spells out abbreviations found on the plans.

**Piping and instrumentation drawings (P&IDs)** (*Figure 15*) are **schematic** diagrams of a complete piping system that show the process flow. They also show all the equipment, pipelines, valves, instruments, and controls needed to operate the system.

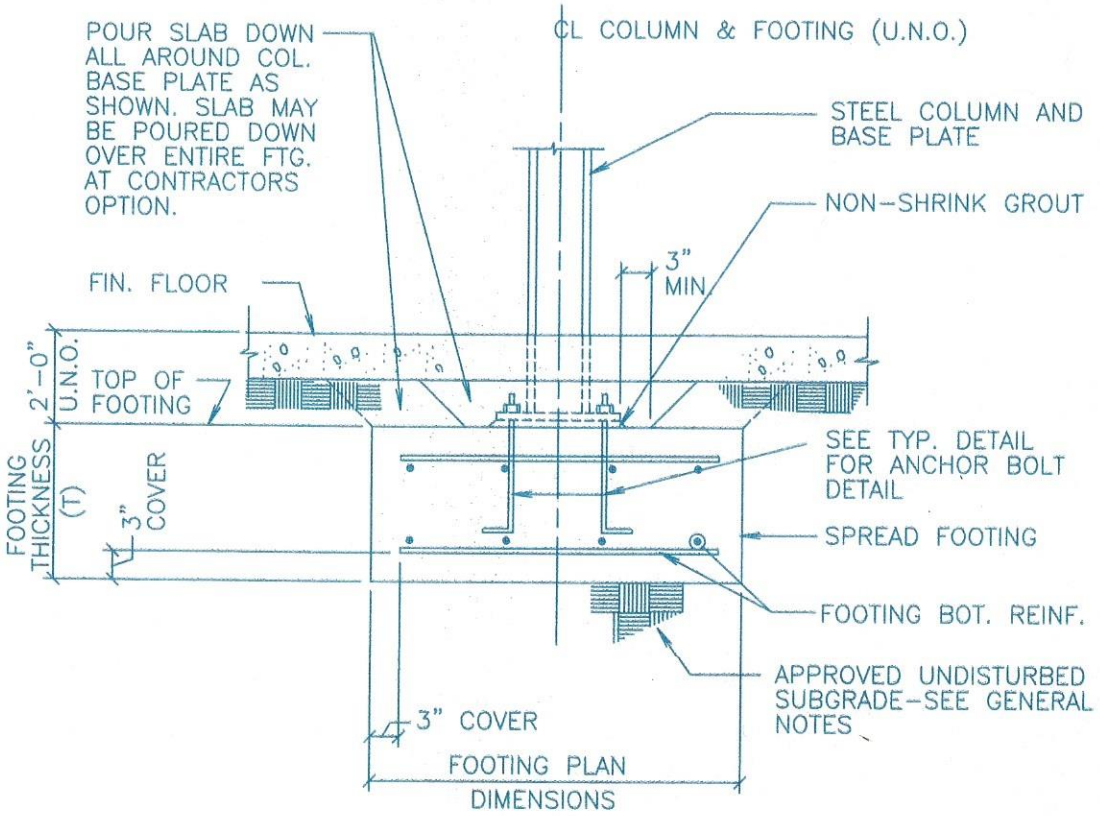



*Figure 11* Structural section drawing (foundation details).

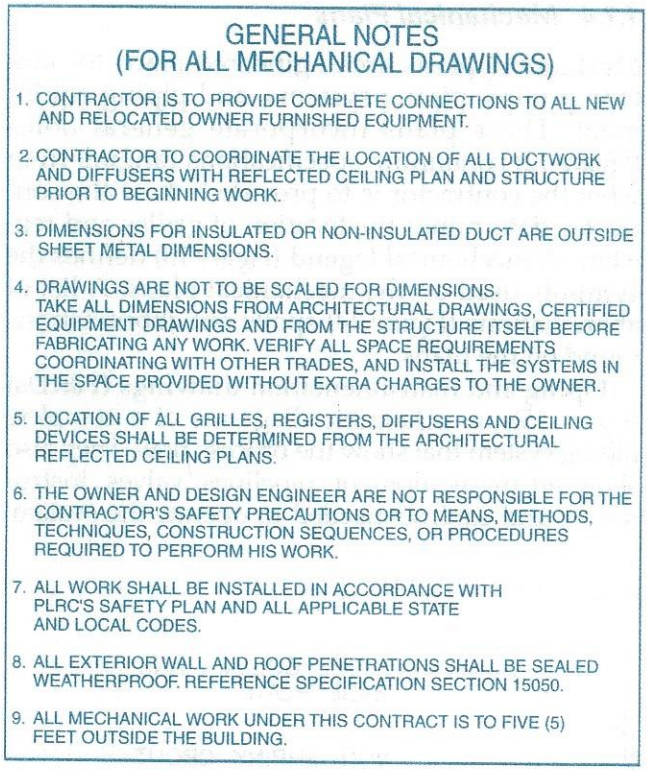


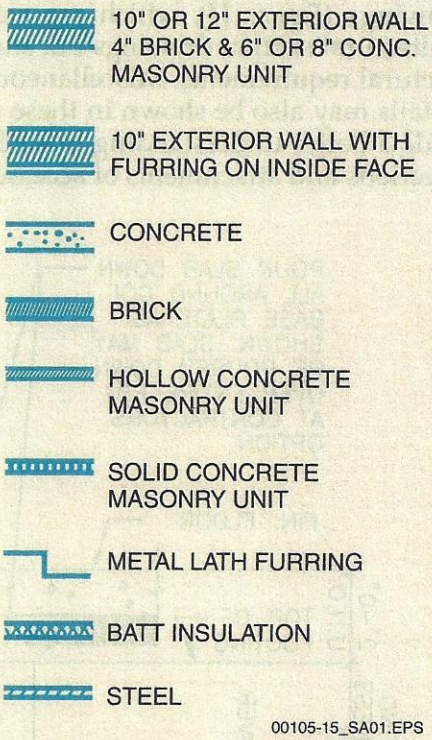

*Figure 12* Mechanical plan general notes.

P&IDs are not drawn to **scale** because they are meant only to give a representation, or a general idea, of the work to be done. Additionally, P&IDs do not indicate north, south, east, and west directions.

For more complex jobs, a separate heating, ventilating, and air conditioning **(HVAC)** plan is added to the set of plans. Piping system plans for gas, oil, or steam heat may be included in the HVAC plan. The mechanical plans include the layout of the HVAC system, showing specific requirements and elements for that system, including a floor, a reflected ceiling, or a roof. HVAC drawings (*Figure 16*) include an electrical schematic that shows the electrical circuitry for the HVAC system. HVAC plans are both mechanical and electrical drawings in one plan.

## Importance of Architectural Symbols

When looking at a section drawing, pay close attention to the way different parts are drawn. Each part of the drawing represents a method of construction or a type of material. These symbols are covered in more detail later in this module.

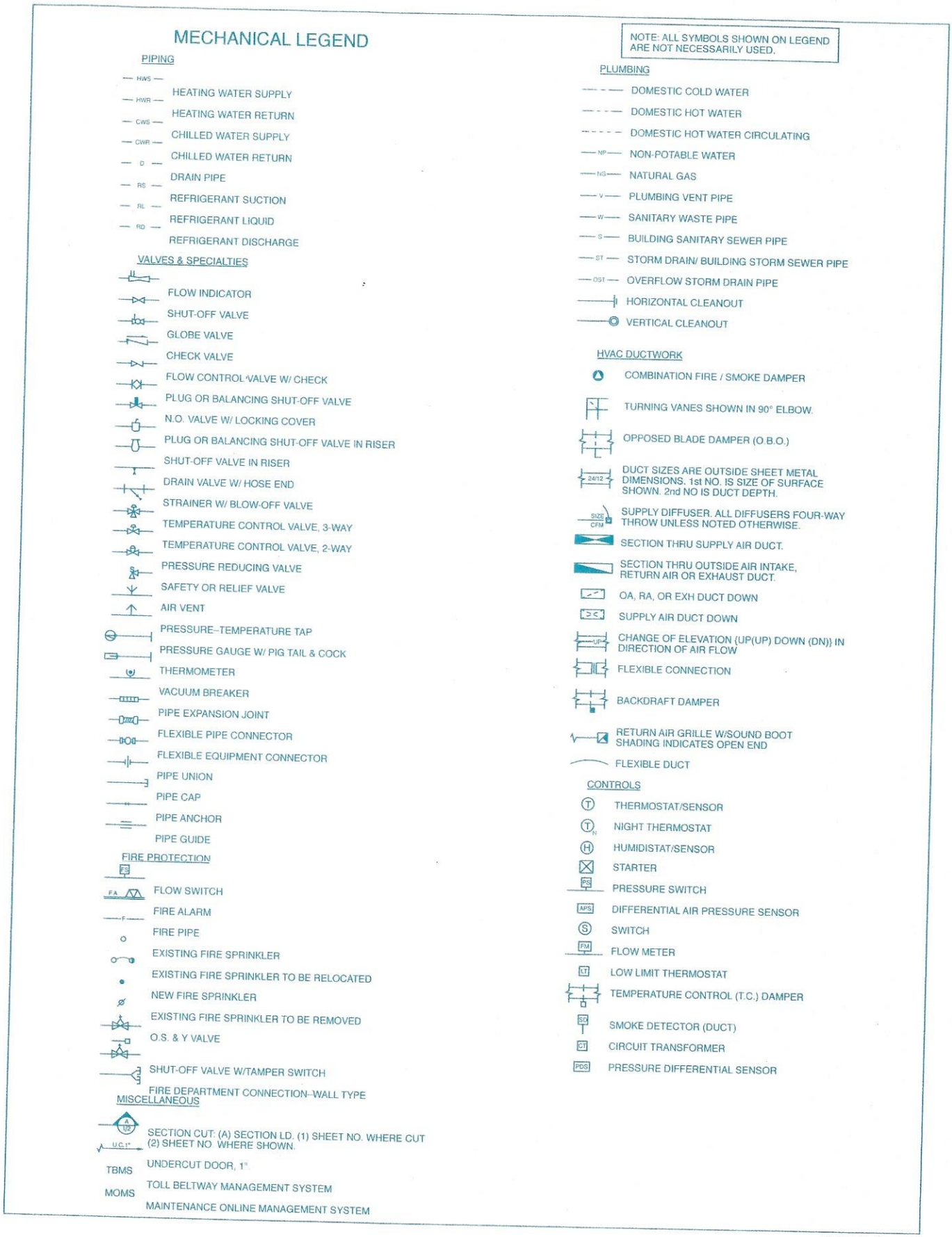



Be aware that a page with a series of mechanical detail drawings may be included in the mechanical plans. These drawings show specific details of certain components within the mechanical system. *Figure 17* is an example of a mechanical detail drawing.

**Around the World**

## Green Buildings

Many countries around the world are pursuing sustainable building construction and design. In Brazil, for example, a Green Building Council (GBC) operates independent of the government. The efforts of the group have resulted in Brazil being ranked fourth in the world in the number of green buildings. This places Brazil behind only the United States, the United Arab Emirates, and China. Over 100 countries now have an active Green Building Council. A World Green Building Council (WGBC) has also been created; established in 2002, the WGBC helps form a network that supports all GBCs worldwide.




00105-15_F13.EPS

*Figure 13* Mechanical plan legend.

## ABBREVIATIONS

| | |
|---|---|
| AFF | ABOVE FINISHED FLOOR |
| ALT | ALTITUDE |
| BHP | BRAKE HORSEPOWER |
| BTU | BRITISH THERMAL UNIT |
| Cv | COEFFICIENT, VALVE FLOW |
| CU FT | CUBIC FEET |
| CU IN | CUBIC INCH |
| CFM | CUBIC FEET PER MINUTE |
| SCFM | CFM, STANDARD CONDITIONS |
| dB | DECIBEL |
| DCW | DOMESTIC COLD WATER |
| DEG OR ° | DEGREE |
| DHW | DOMESTIC HOT WATER |
| DIA | DIAMETER |
| DB | DRY-BULB |
| EAT | ENTERING AIR TEMPERATURE |
| EFF | EFFICIENCY |
| ELEV or EL | ELEVATION |
| ESP | EXTERNAL STATIC PRESSURE |
| EWT | ENTERING WATER TEMPERATURE |
| EXH | EXHAUST |
| F | FAHRENHEIT |
| FLA | FULL LOAD AMPS |
| FPM | FEET PER MINUTE |
| FPS | FEET PER SECOND |
| FT | FOOT OR FEET |
| FU | FIXTURE UNITS |
| GA | GAUGE |
| GAL | GALLONS |
| GPH | GALLONS PER HOUR |
| GPM | GALLONS PER MINUTE |
| HD | HEAD |
| HG | MERCURY |
| HGT | HEIGHT |
| HORZ | HORIZONTAL |
| HP | HORSEPOWER |
| HR | HOUR(S) |
| HWC | HOT WATER CIRCULATING (DOMESTIC) |
| HZ | HERTZ |
| ID | INSIDE DIAMETER |
| IE | INVERT ELEVATION |
| IN | INCHES |
| IN W.C. | INCHES WATER COLUMN |
| KW | KILOWATT |
| KWH | KILOWATT HOUR |
| LAT | LEAVING AIR TEMPERATURE |
| LBS OR # | POUNDS |
| LF | LINEAR FEET |
| LRA | LOCKED ROTOR AMPS |
| LWT | LEAVING WATER TEMPERATURE |
| MAX | MAXIMUM |
| MCA | MINIMUM CIRCUIT AMPS |
| MBH | BTU PER HOUR (THOUSAND) |
| MIN | MINIMUM |
| NC | NOISE CRITERIA |
| N.O. | NORMALLY OPEN |
| N.C. | NORMALLY CLOSED |
| N/A | NOT APPLICABLE |
| NIC | NOT IN CONTRACT |
| NTS | NOT TO SCALE |
| NO | NUMBER |
| OA | OUTSIDE AIR |
| OD | OUTSIDE DIAMETER |
| PPM | PARTS PER MILLION |
| % | PERCENT |
| PH OR f | PHASE (ELECTRICAL) |
| PSF | POUNDS PER SQUARE FOOT |
| PSI | POUNDS PER SQUARE INCH |
| PSIA | PSI ABSOLUTE |
| PSIG | PSI GAUGE |
| PRESS | PRESSURE |
| RA | RETURN AIR |
| RECIRC | RECIRCULATE |
| RH | RELATIVE HUMIDITY |
| RLA | RUNNING LOAD AMPS |
| RPM | REVOLUTIONS PER MINUTE |
| SL | SEA LEVEL |
| SENS | SENSIBLE |
| SPEC | SPECIFICATION |
| SQ | SQUARE |
| STD | STANDARD |
| SP | STATIC PRESSURE |
| SA | SUPPLY AIR |
| TEMP | TEMPERATURE |
| TD | TEMPERATURE DIFFERENCE |
| TSP | TOTAL STATIC PRESSURE |
| TSTAT | THERMOSTAT |
| TONS | TONS OF REFRIGERATION |
| VAV | VARIABLE AIR VOLUME |
| VEL | VELOCITY |
| VERT | VERTICAL |
| V | VOLT |
| VOL | VOLUME |
| W | WATT |
| WT | WEIGHT |
| WB | WET-BULB |

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***Figure 14*** Mechanical plan list of abbreviations.

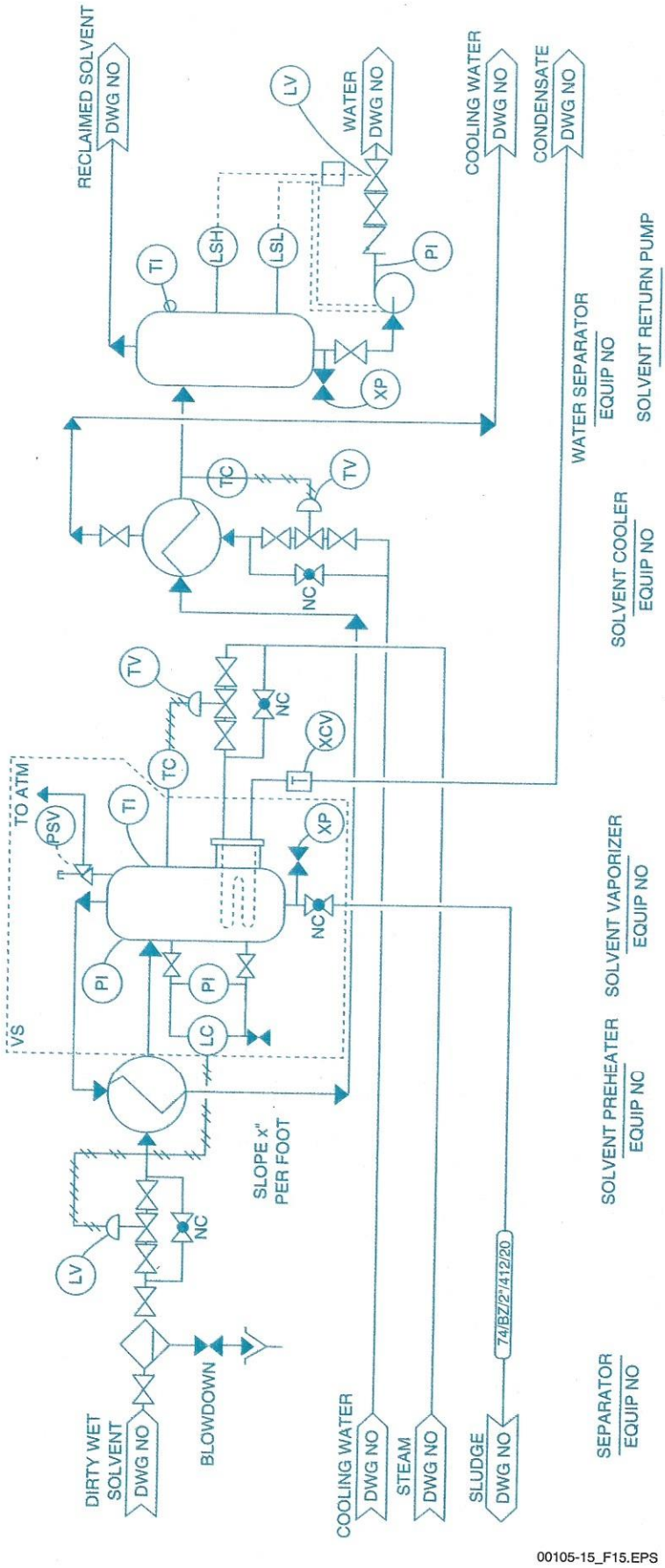


*Figure 15* P&ID drawing.

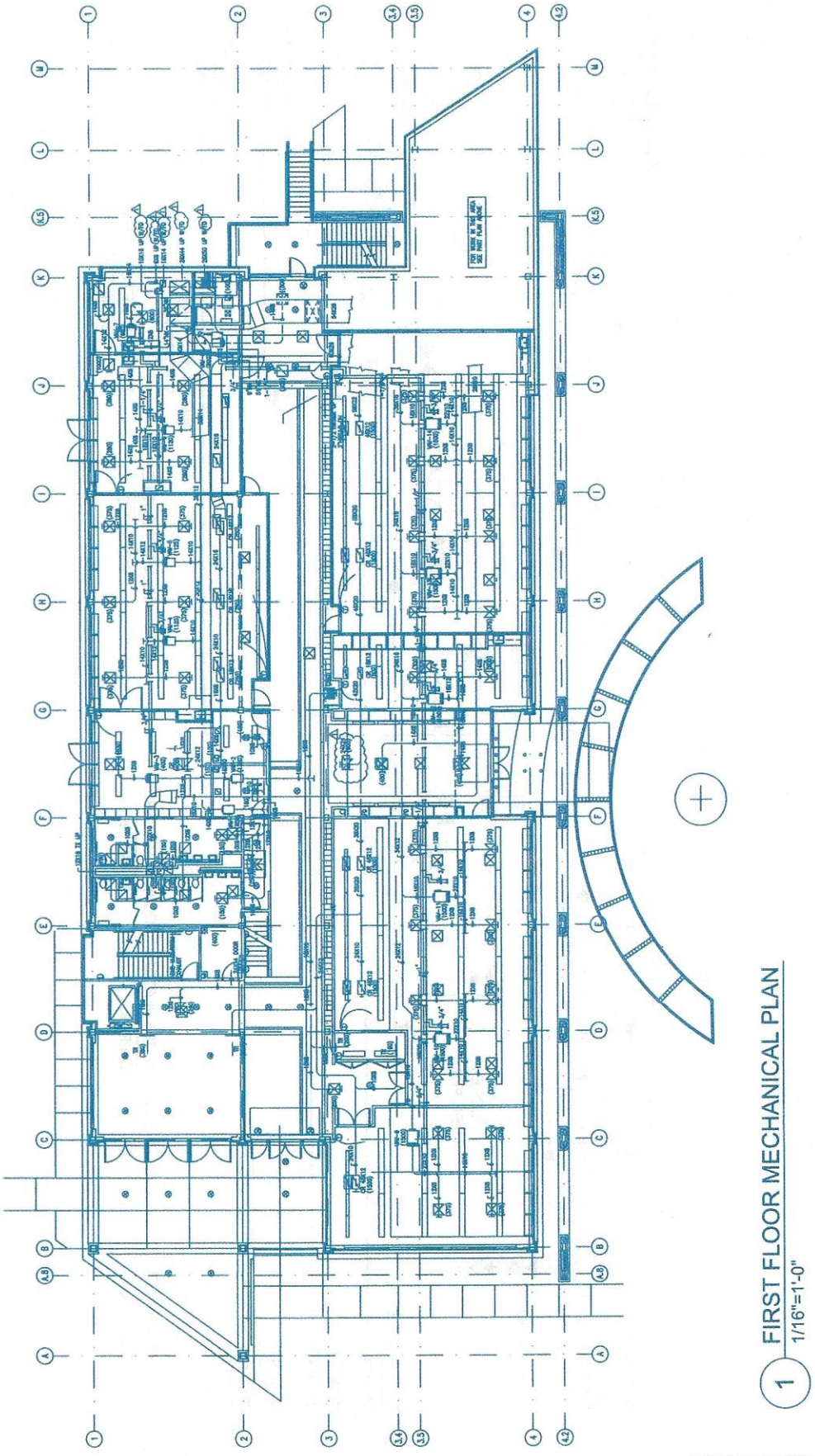


*Figure 16A* HVAC drawing. (1 of 2)

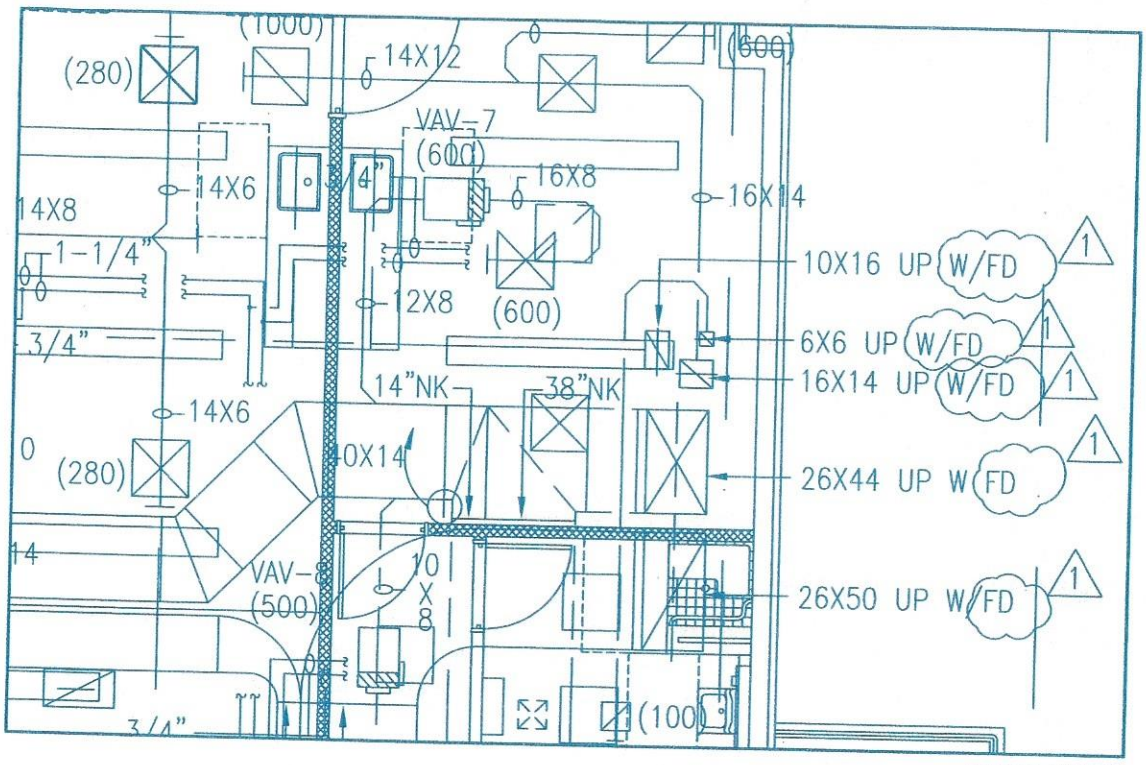


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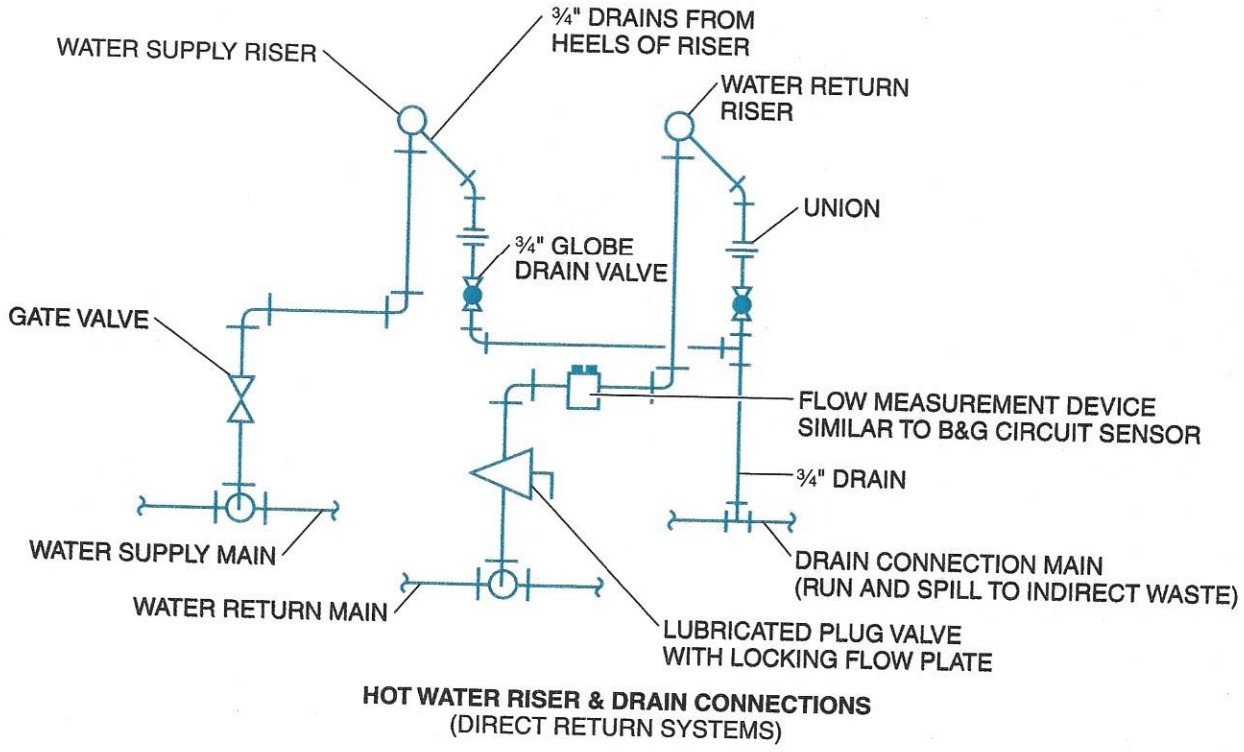
*Figure 16B* HVAC drawing. (2 of2)




00105-15_F17.EPS

*Figure 17* Mechanical detail drawing for hot water riser and drain connections.

### 1.1.5 Plumbing/Piping Plans

**Plumbing plans** (*Figure 18*) are engineered plans showing the layout for the plumbing system that supplies the hot and cold water, for the sewage disposal system, and for the location of plumbing fixtures. For commercial projects, each system may be on a separate plan.

A **plumbing isometric drawing** is part of the plumbing plan. It is a type of three-dimensional drawing that depicts the plumbing system. *Figure 19* shows a plumbing isometric drawing for a sanitary riser system.

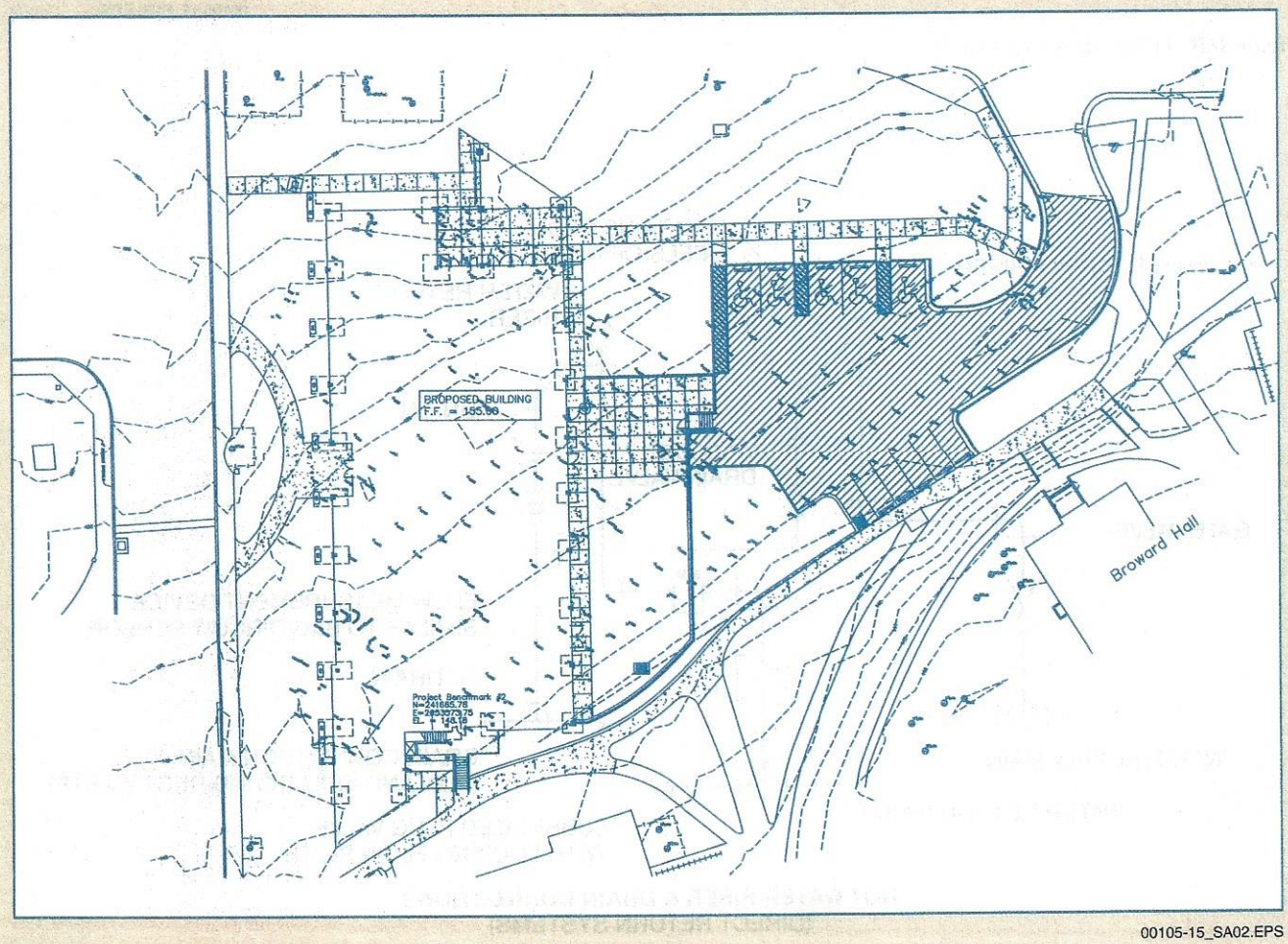
### 1.1.6 Electrical Plans

**Electrical plans** are engineered drawings for electrical supply and distribution. These plans may appear on the floor plan itself for simple construction projects. Electrical plans include locations of the electric meter, distribution panel, switchgear, convenience outlets, and special outlets.

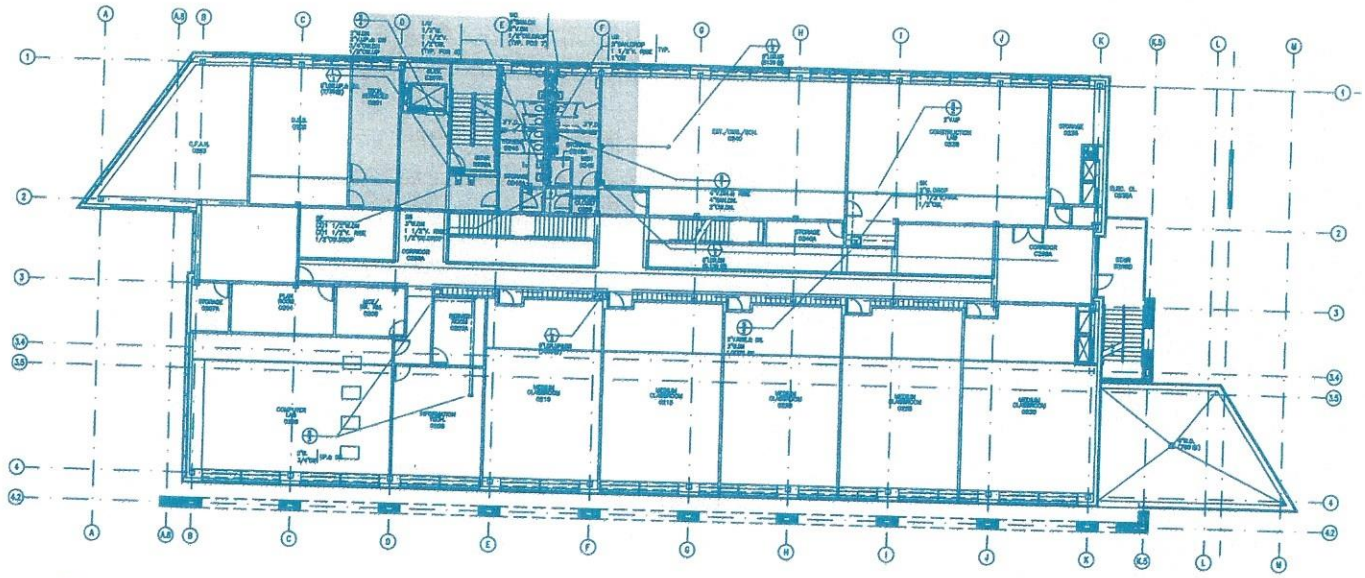
For more complex projects, the information may be on a separate plan added to the set of plans. This separate plan leaves out construction-related details and shows just the electrical layout.

## Topographic Maps

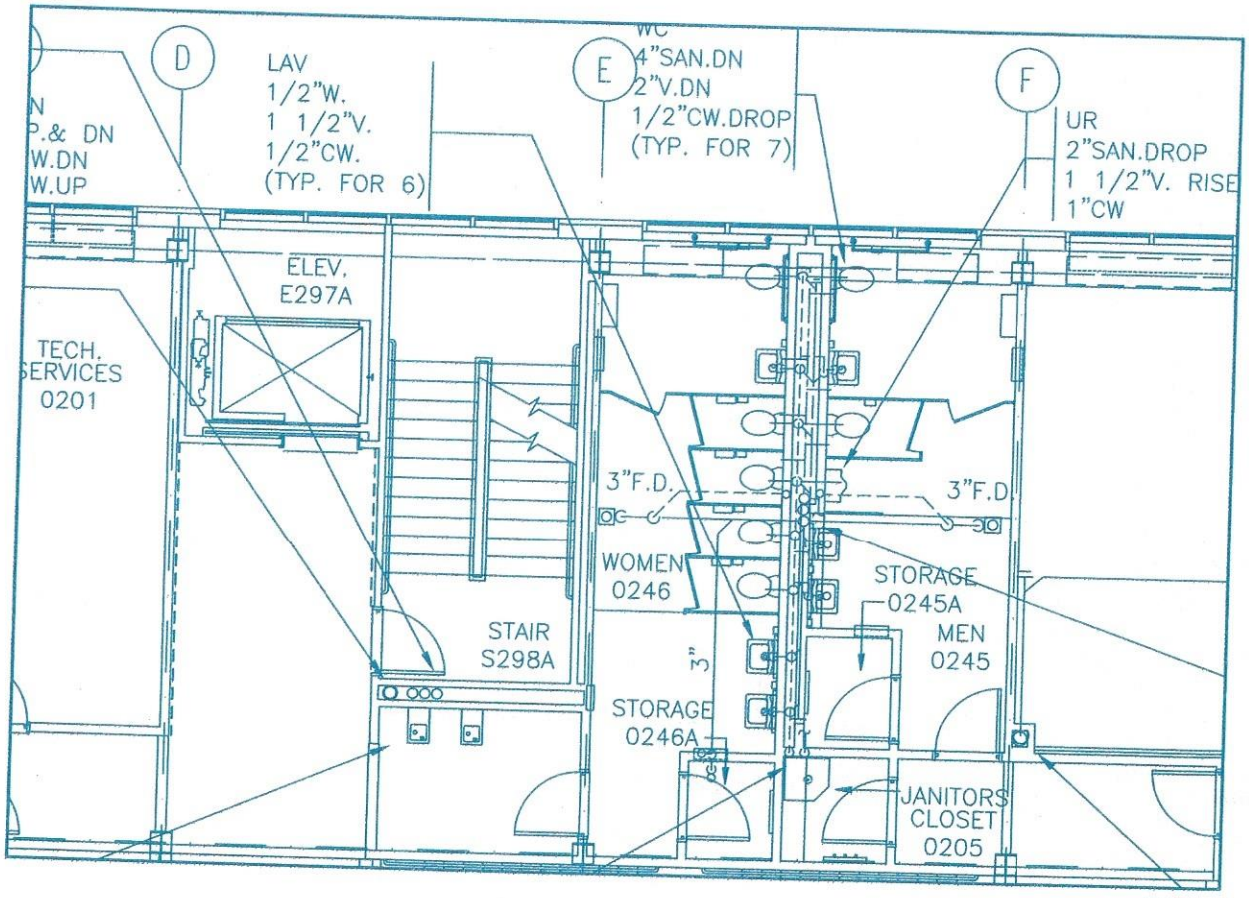
Topographic (topo) maps provide a representation of vertical dimension that gives a feel for the shape or contour of a piece of land. Topo maps identify physical features such as mountains, lakes, and streams. These maps indicate where highways and railroads run. They often include information on drainage and land use such as orchards and woodland.




00105-15_SA02.EPS

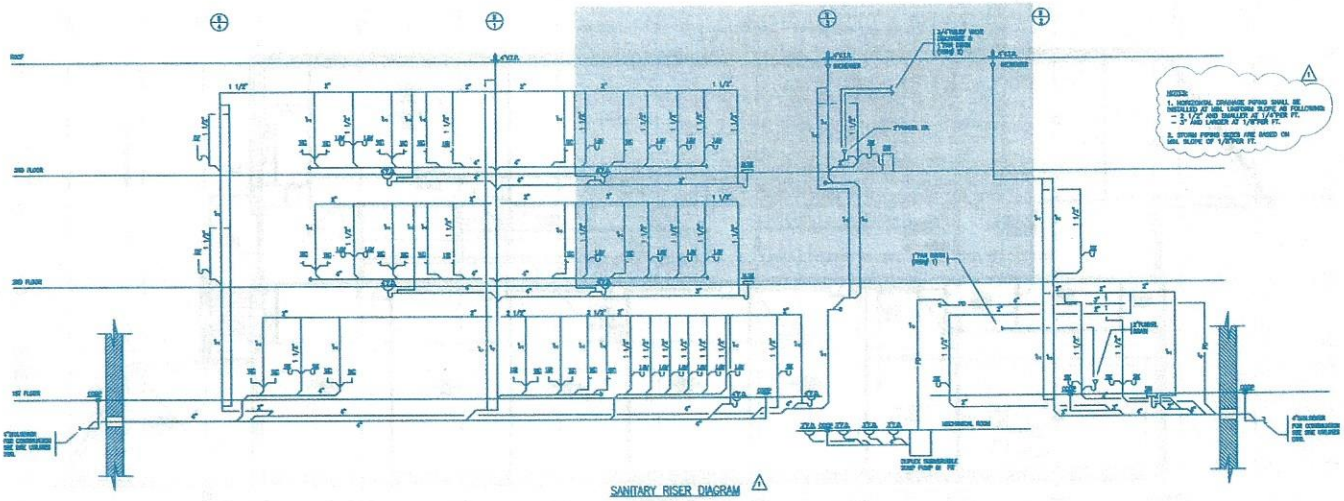


1 FIRST FLOOR PLUMBING PLAN
1/16"=1'-0"




00105-15_F18.EPS

*Figure 18* Plumbing plan.




1 SANITARY RISER DIAGRAM
N.T.S.

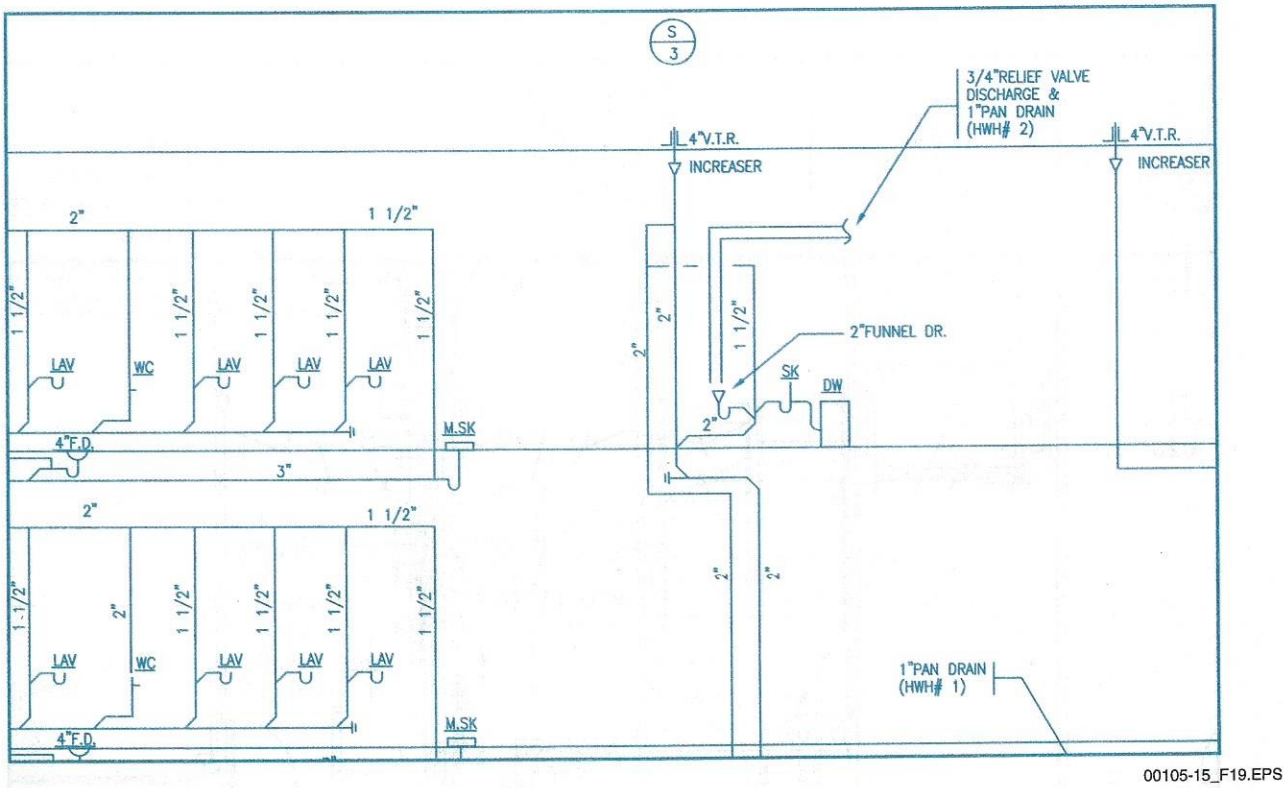



*Figure 19* Plumbing isometric drawing (sanitary riser diagram).

More complex electrical plans include locations of switchgear, transformers, main breakers, and motor control centers.

The electrical plans usually start with a set of general notes (*Figure 20*). These notes cover items ranging from main transformers to the coordination of underground penetrations into the building.

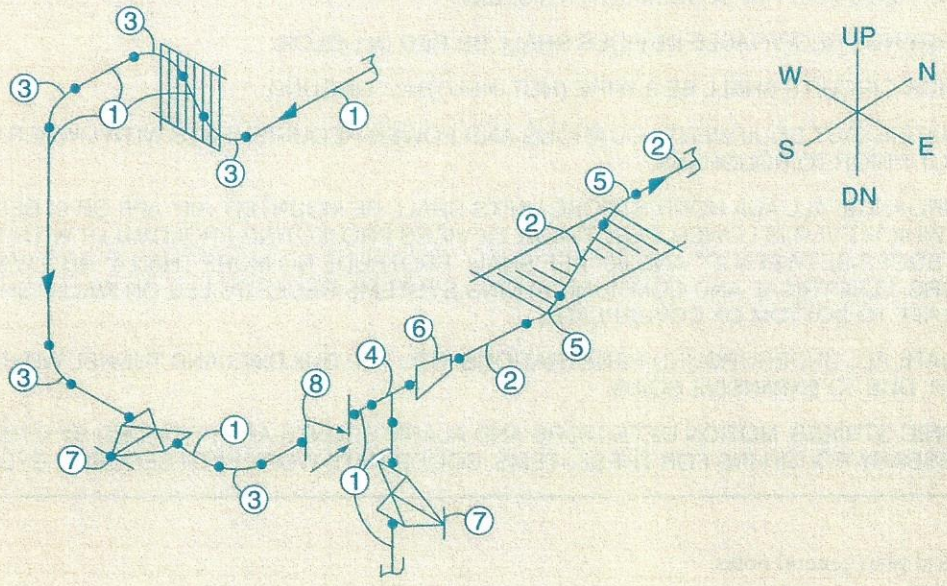
The electrical plans can include lighting plans, which show the location of lights and receptacles (refer to *Drawing 3*, First Floor Lighting Plan, in the *Appendix*), power plans (*Figure 21*), and panel schedules (*Figure 22*). Electrical plans have an electrical legend, which defines the symbols (*Figure 23*) used on the plan and a key to the abbreviations (*Figure 24*) used on the plan. Depending on the size and scope of the drawings, the legend is often on a separate drawing sheet of its own, rather than on each individual drawing.

## Isometric Drawings

An isometric drawing is a type of three-dimensional drawing also known as a pictorial illustration. Typically in isometric construction drawings, objects are shown at a 30-degree angle in isometric drawings to provide a three-dimensional perspective rather than a flat, two-dimensional view.

BILL OF MATERIAL

| P.M. | REQ'D | SIZE | DESCRIPTION |
|---|---|---|---|
| 1 | | 1-1/2" | PIPE SCH/40 ASTM-A-120 GR.B |
| 2 | | 3/4" | PIPE SCH/40 ASTM-A-120 GR.B |
| 3 | 5 | 1-1/2" | 90° ELL ASTM-A-197 BW |
| 4 | 1 | 1-1/2" | TEE ASTM-197 STD |
| 5 | 2 | 3/4" | 45° ELL ASTM-197 STD |
| 6 | 1 | 1-1/2" × 3/4" | BELL RED. CONC. |
| 7 | 2 | 1-1/2" | GATE VA. BW ASTM-B62 |
| 8 | 1 | 1-1/2" | CHECK VA. SWING BW 150# |

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## GENERAL NOTES (FOR ALL ELECTRICAL SHEETS)

1. COORDINATE LOCATION OF LUMINARIES WITH ARCHITECTURAL REFLECTED CEILING PLANS.
2. COORDINATE LOCATION OF ALL OUTLETS WITH ARCHITECTURAL ELEVATIONS, CASEWORK SHOP DRAWINGS AND EQUIPMENT INSTALLATION DRAWINGS.
3. COORDINATE LOCATION OF MECHANICAL EQUIPMENT WITH MECHANICAL PLANS AND MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN.
4. PROVIDE (1) 3/4"C WITH PULL WIRE FROM EACH TELEPHONE, DATA OR COMMUNICATION OUTLET SHOWN, TO ABOVE ACCESSIBLE CEILING, AND CAP.
5. 3-LAMP FIXTURES SHOWN HALF SHADED HAVE INBOARD SINGLE LAMP CONNECTED TO EMERGENCY BATTERY PACK FOR FULL LUMEN OUTPUT. SEE SPECIFICATIONS.
6. SITE PLAN DOES NOT INDICATE ALL OF THE UG UTILITY LINES, RE: CIVIL DRAWINGS FOR ADDITIONAL INFORMATION. CONTRACTOR TO FIELD VERIFY EXACT LOCATION OF ALL EXISTING UNDERGROUND UTILITY LINES OF ALL TRADES PRIOR TO ANY SITE WORK.
7. THE LOCATIONS OF ALL SMOKE DETECTORS SHOWN ARE CONSIDERED TO BE SCHEMATIC ONLY. THE ACTUAL LOCATIONS (SPACING TO ADJACENT DETECTORS, WALLS, ETC.) ARE REQUIRED TO MEET NFPA 72.
8. ANY ITEMS DAMAGED BY THE CONTRACTOR SHALL BE REPLACED BY THE CONTRACTOR.
9. "CLEAN POWER" AND COMMUNICATION/COMPUTER SYSTEM REQUIREMENTS SHALL BE COORDINATED WITH COMMUNICATION/COMPUTER SYSTEMS CONTRACTOR.
10. REFER TO ARCHITECTURAL PLANS, ELEVATIONS AND DIAGRAMS FOR LOCATIONS OF FLOOR DEVICES AND WALL DEVICES. LOCATION WILL INDICATE VERTICAL AND/OR HORIZONTAL MOUNTING. IF DEVICES ARE NOT NOTED OTHERWISE THEY SHALL BE MOUNTED LONG AXIS HORIZONTAL AT +16" TO CENTER.
11. ALL PLUGMOLD SHOWN SHALL BE WIREMOLD SERIES V2000 (IVORY FINISH) WITH SNAPICOIL #V20GB06 (OUTLETS 6" ON CENTER). PROVIDE ALL NECESSARY MOUNTING HARDWARE, ELBOWS, CORNERS, ENDS, ETC. REQUIRED FOR A COMPLETE SYSTEM.
12. ALL EMERGENCY RECEPTACLE DEVICES SHALL BE RED IN COLOR.
13. ALL BRANCH CIRCUITS SHALL BE 3-WIRE (HOT, NEUTRAL, GROUND).
14. COORDINATE EXACT EQUIPMENT LOCATIONS AND POWER REQUIREMENTS WITH OWNER AND ARCHITECT PRIOR TO ROUGH-INS.
15. ADA COMPLIANCE: ALL ADA HORN/STROBE UNITS SHALL BE MOUNTED +90" AFF OR 6" BELOW FINISHED CEILING, WHICH EVER IS LOWER. ELECTRICAL DEVICES PROJECTING FROM WALLS WITH THEIR LEADING EDGES BETWEEN 27" AND 80" AFF SHALL PROTRUDE NO MORE THAN 4" INTO WALKS OR CORRIDORS. ELECTRICAL AND COMMUNICATIONS SYSTEMS RECEPTACLES ON WALLS SHALL BE 15" MINIMUM AFF TO BOTTOM OF COVERPLATE.
16. COORDINATE ALL UNDERGROUND PENETRATIONS INTO THE BUILDING AND TUNNEL WITH STRUCTURAL ENGINEER, DUE TO EXPANSIVE SOILS.
17. ELECTRONIC STRIKES, MOTION DETECTORS AND ALARM SHUNTS ARE PROVIDED BY OTHERS. PROVIDE ALL NECESSARY ROUGH-INS FOR THESE ITEMS. COORDINATE WORK WITH SECURITY SYSTEM PROVIDER.

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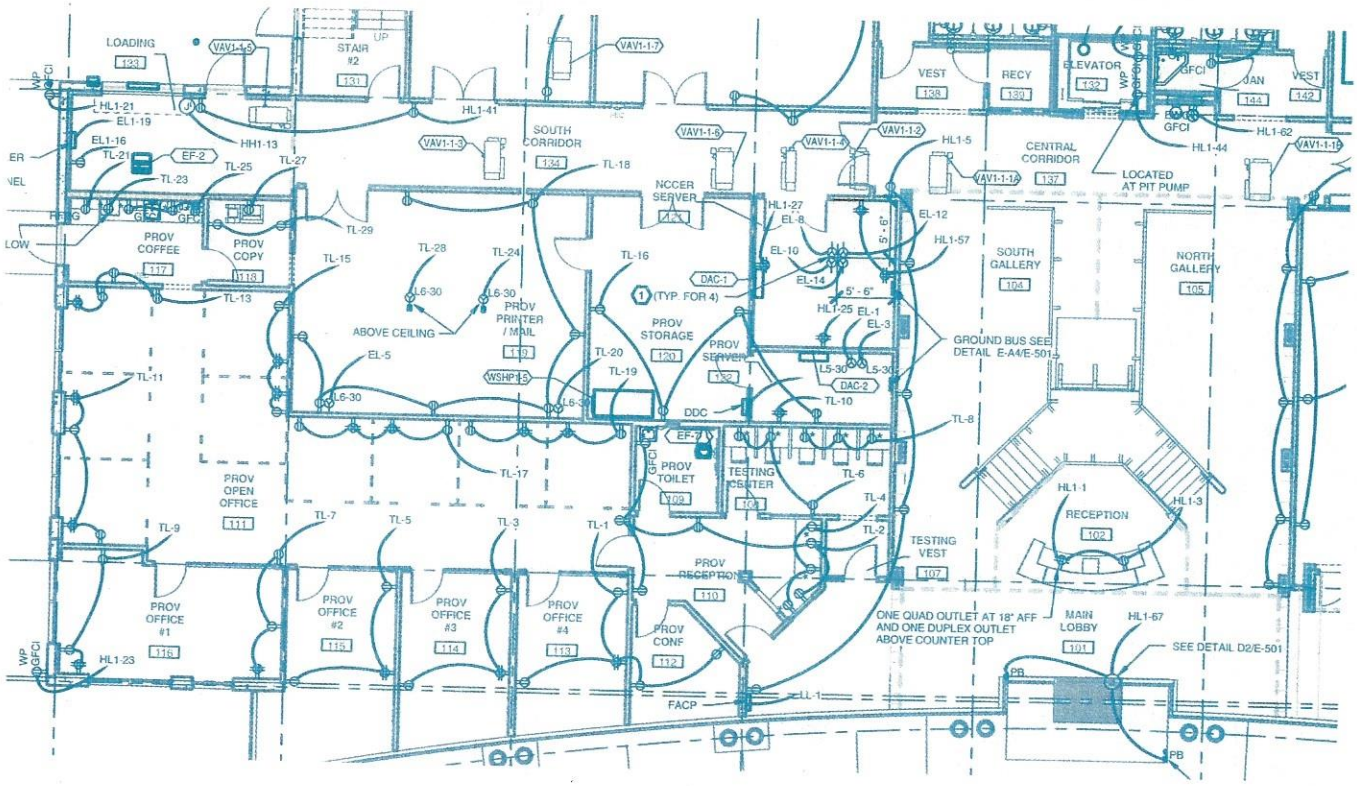
*Figure 20* Electrical plan general notes.




00105-15_F21.EPS

*Figure 21* Portion of a power plan.

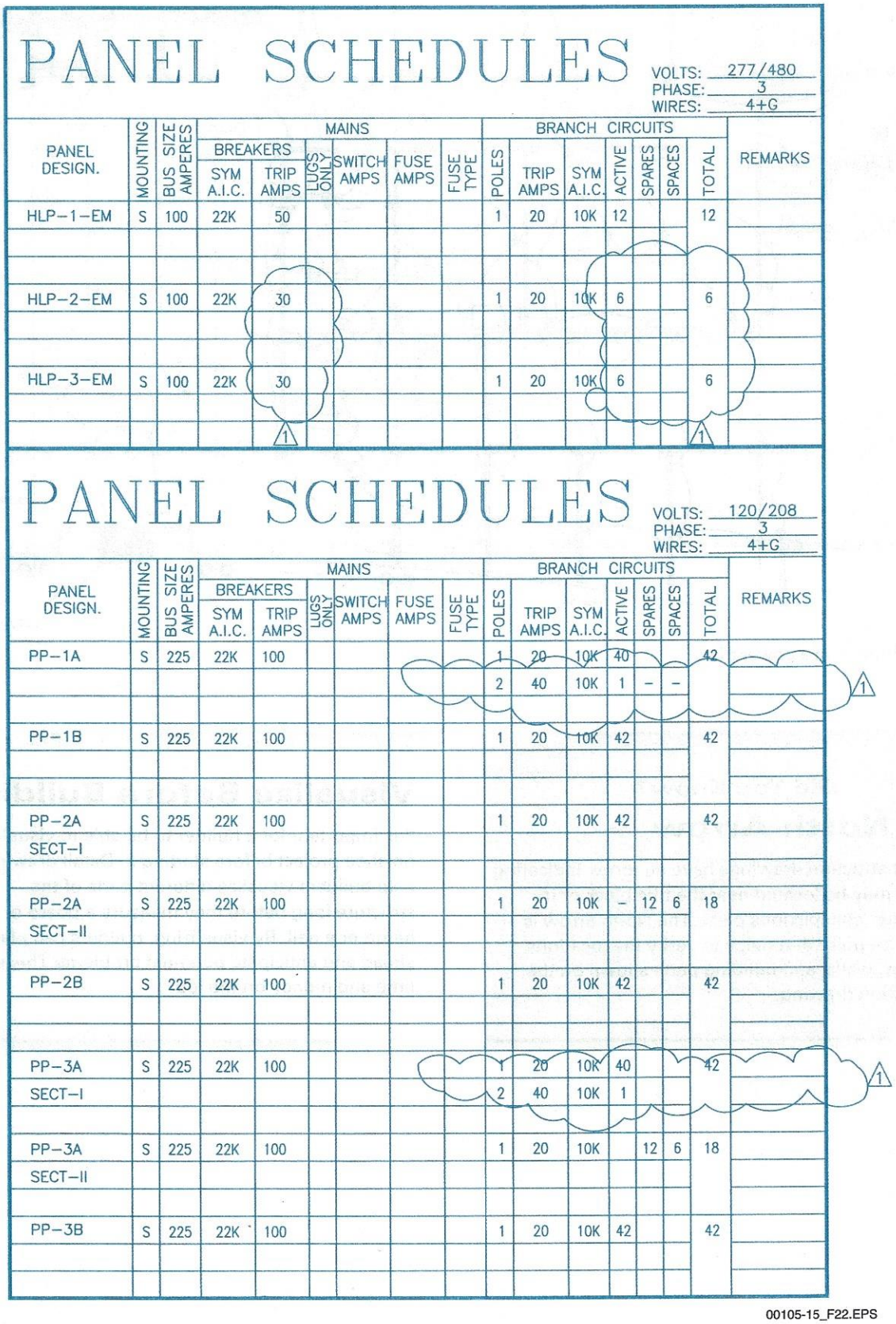
### Did You Know?

## The North Arrow

Most construction drawings have an arrow indicating North. It may be located near the title block or in some other conspicuous place. The North arrow is a reference point that helps to verify the locations of objects, walls, and building parts shown on the construction drawing.

## Visualize Before Building

It is important for a builder to be able to visualize a finished project before starting it. Detail drawings help builders visualize different parts of the structure long before they measure a board or hammer a nail. By visualizing, builders can plan ahead and anticipate potential problems. This saves time and money on the job.



# PANEL SCHEDULES

VOLTS: 277/480
PHASE: 3
WIRES: 4+G

| PANEL DESIGN. | MOUNTING | BUS SIZE AMPERES | MAINS: BREAKERS SYM A.I.C. | MAINS: BREAKERS TRIP AMPS | MAINS: LUGS ONLY | MAINS: SWITCH AMPS | MAINS: FUSE AMPS | MAINS: FUSE TYPE | BRANCH CIRCUITS: POLES | BRANCH CIRCUITS: TRIP AMPS | BRANCH CIRCUITS: SYM A.I.C. | BRANCH CIRCUITS: ACTIVE | BRANCH CIRCUITS: SPARES | BRANCH CIRCUITS: SPACES | BRANCH CIRCUITS: TOTAL | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP–1–EM | S | 100 | 22K | 50 | | | | | 1 | 20 | 10K | 12 | | | 12 | |
| HLP–2–EM | S | 100 | 22K | 30 | | | | | 1 | 20 | 10K | 6 | | | 6 | |
| HLP–3–EM | S | 100 | 22K | 30 | | | | | 1 | 20 | 10K | 6 | | | 6 | |
| | | | | 1 | | | | | | | | | | | 1 | |

# PANEL SCHEDULES

VOLTS: 120/208
PHASE: 3
WIRES: 4+G

| PANEL DESIGN. | MOUNTING | BUS SIZE AMPERES | MAINS: BREAKERS SYM A.I.C. | MAINS: BREAKERS TRIP AMPS | MAINS: LUGS ONLY | MAINS: SWITCH AMPS | MAINS: FUSE AMPS | MAINS: FUSE TYPE | BRANCH CIRCUITS: POLES | BRANCH CIRCUITS: TRIP AMPS | BRANCH CIRCUITS: SYM A.I.C. | BRANCH CIRCUITS: ACTIVE | BRANCH CIRCUITS: SPARES | BRANCH CIRCUITS: SPACES | BRANCH CIRCUITS: TOTAL | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PP–1A | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | 40 | | | 42 | |
| | | | | | | | | | 2 | 40 | 10K | 1 | – | – | | 1 |
| PP–1B | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | 42 | | | 42 | |
| PP–2A | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | 42 | | | 42 | |
| SECT–I | | | | | | | | | | | | | | | | |
| PP–2A | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | – | 12 | 6 | 18 | |
| SECT–II | | | | | | | | | | | | | | | | |
| PP–2B | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | 42 | | | 42 | |
| PP–3A | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | 40 | | | 42 | |
| SECT–I | | | | | | | | | 2 | 40 | 10K | 1 | | | | 1 |
| PP–3A | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | | 12 | 6 | 18 | |
| SECT–II | | | | | | | | | | | | | | | | |
| PP–3B | S | 225 | 22K | 100 | | | | | 1 | 20 | 10K | 42 | | | 42 | |

00105-15_F22.EPS

*Figure 22* Panel schedules.

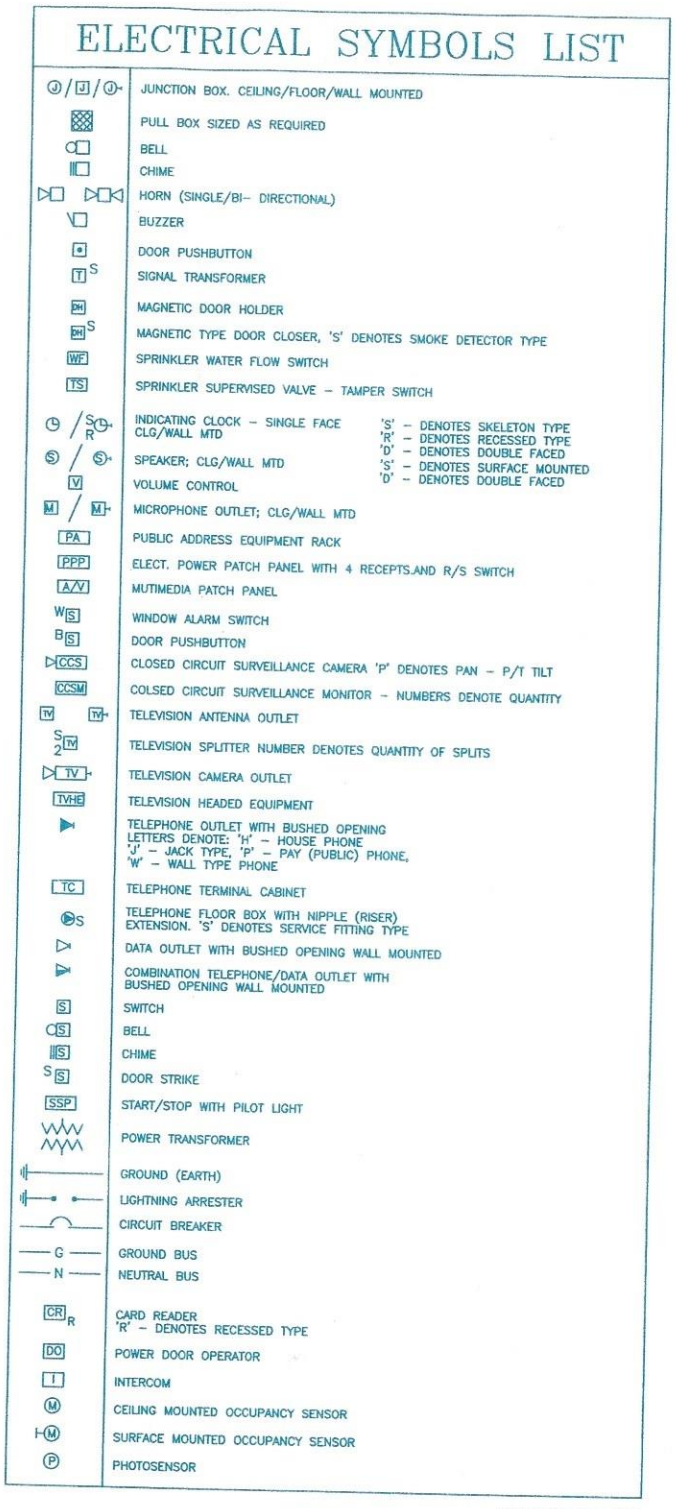



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*Figure 23* Electrical symbols list.

### 1.1.7 Fire Protection Plans

Another important drawing that may be included in a set of drawings is the **fire protection plans** (refer to *Drawing 4*, First Floor Fire Protection Plan, in the *Appendix*). This drawing shows the piping, valves, heads, and switches that make up a building's fire sprinkler system. A fire sprinkler symbols list is usually included on a separate sheet along with the fire sprinkler specifications, details and assembly drawings, and riser diagrams.

## 1.2.0 Basic Components of Construction Drawings

Most construction drawings are laid out in a fairly standardized format. This section describes the following five parts of a construction drawing:

- **Title block**
- Border
- Drawing area
- Revision block
- Legend

### 1.2.1 Title Block

The first thing to look at on any drawing is the title block. The title block is normally in the lower right-hand corner of the drawing or across the right edge of the paper (*Figure 25*). The title block has two purposes. First, it gives information about the structure or assembly. Second, it is numbered so the print can be filed easily.

Different companies put different information in the title block. Generally, it contains the following:

- *Company logo* – Usually preprinted on the drawing.
- *Sheet title* – Identifies the project.
- *Date* – Date the drawing was checked and readied for seal, or issued for construction.
- *Drawn by* – Initials of the person who drafted the drawing.
- *Drawing number* – Code numbers assigned to a project
- *Scale* – The ratio of the size of the object as drawn to the object's actual size.

# ELECTRICAL ABBREVIATIONS

| | |
|---|---|
| A | AMPERE(S) |
| AC | ALTERNATING CURRENT |
| ACB | AIR CIRCUIT BREAKER |
| AFF | ABOVE FINISHED FLOOR |
| AFG | ABOVE FINISHED GRADE |
| AL | ALUMINUM |
| ALT | ALTERNATE |
| ASYM | ASYMMETRICAL |
| ATS | AUTOMATIC TRANSFER SWITCH |
| AWG | AMERICAN WIRE GAUGE |
| BC | BOTTOM CONDUIT |
| BD | BUS DUCT |
| BFG | BELOW FINISHED GRADE |
| BIL | BASIC IMPULSE LEVEL |
| BLDG | BUILDING |
| BX | ARMORED CABLE |
| C | CONDUIT |
| CATV | CABLE ANTENNA TELEVISION SYSTEM |
| CCAB | CONTROL CABINET |
| CCTV | CLOSED CIRCUIT TELEVISION |
| CH | CABINET HEATER |
| CKT | CIRCUIT |
| CKT BKR/CB | CIRCUIT BREAKER |
| CL | CLOSET |
| CLG | CEILING |
| COND | CONDUCTOR |
| CO | CONDUIT ONLY |
| CT | CURRENT TRANSFORMER |
| CU | COPPER |
| DB | DUCT BANK |
| DMB | DIMMER BOARD |
| DC | DIRECT CURRENT |
| DH | DUCT HEATER |
| DIM | DIMMER CONTROL |
| DISC | DISCONNECT |
| DM | DAMPER MOTOR |
| DN | DOWN |
| DP | DISTRIBUTION POWER PANEL(BOARD) |
| DT | DOUBLE THROW |
| DWG | DRAWING |
| EA | EACH |
| E.C. | ELECTRICAL CONTRACTOR |
| E.HTR | ELECTRIC HEATER |
| ELEV | ELEVATOR |
| EL | ELECTRIC |
| EM | EMERGENCY |
| EMT | ELECTRICAL METALLIC TUBING |
| ENT | ELECTRICAL NON-METALLIC TUBING |
| EWC | ELECTRIC WATER COOLER |
| EX | EXISTING |
| F | FUSE |
| FA | FIRE ALARM |
| FACP | FIRE ALARM CONTROL PANEL |
| FBO | FURNISHED BY OTHERS |
| FCC | FLAT CONDUCTOR CABLE |
| FCU | FAN COIL UNIT |
| FDR | FEEDER |
| FL | FLOOR |
| FLUOR | FLUORESCENT |
| F.P.C. | FIRE PROTECTION CONTRACTOR |
| FS | FUSIBLE SWITCH |
| F.S.C. | FOOD SERVICE CONTRACTOR |
| FT | FEET OR FOOT |
| G.C. | GENERAL CONTRACTOR |
| GEN | GENERATOR |
| GF | GROUND FAULT |
| GG | GROUND GRID |
| GRD | GROUND |
| HC | HUNG CEILING |
| H.I.D. | HIGH INTENSITY DISCHARGE |
| HP | HORSEPOWER |
| H.P.S. | HIGH PRESSURE SODIUM |
| HPU | HEAT PUMP UNIT |
| HT | HEIGHT |
| HV | HIGH VOLTAGE |
| HW | HEAVY WALL RIGID CONDUIT |
| HZ | FREQUENCY IN CYCLES PER SECOND |
| IC | INTERRUPTING CAPACITY |
| IG | ISOLATED GROUND |
| IMC | INTERMEDIATE METALLIC CONDUIT |
| INC | INCANDESCENT |
| JB | JUNCTION BOX |
| K | KEY OPERATED |
| kVA | KILOVOLT AMPERE(S) |
| kVAR | KILOVAR(S) |
| kW | KILOWATT(S) |
| kWhr | KILOWATT(S) HOUR(S) |
| LP | LIGHTING PANEL |
| L.P.S. | LOW PRESSURE SODIUM |
| LTG | LIGHTING |
| LV | LOW VOLTAGE |
| MATV | MASTER ANTENNA TELEVISION SYSTEM |
| MC | METAL CLAD CABLE |
| MCC | MOTOR CONTROL CENTER |
| MCM | THOUSAND CIRCULAR MIL(S) |
| MCP | MOTOR CONTROL PANEL |
| M.C. | MECHANICAL CONTRACTOR |
| MH | MANHOLE |
| MIC | MICROPHONE |
| MIN | MINIMUM |
| MS | MAGNETIC STARTER |
| MTD | MOUNTED |
| MTG | MOUNTING |
| MTR | MOTOR |
| MTS | MANUAL TRANSFER SWITCH |
| N | NEUTRAL |
| NA | NON-AUTOMATIC |
| NC | NORMALLY CLOSED |
| NF | NON-FUSE |
| N.I.C. | NOT IN CONTRACT |
| NL | NIGHT LIGHT |
| NO | NORMALLY OPEN |
| NP | NETWORK PROTECTOR |
| NTS | NOT TO SCALE |
| OC | ON CENTER |
| OL | OVERLOAD ELEMENT |
| P | POLE |
| PA | PUBLIC ADDRESS |
| PB | PULL BOX |
| P.C. | PLUMBING CONTRACTOR |
| PF | POWER FACTOR |
| Ø | PHASE |
| PL | PILOT (INDICATOR) LIGHT |
| PNL | PANEL (PANELBOARD) |
| PP | POWER PANEL |
| PRI | PRIMARY |
| PT | POTENTIAL TRANSFORMER |
| PVC | POLYVINYL CHLORIDE |
| PWR | POWER |
| R | RECESSED |
| RC | REMOTE CONTROL |
| REC | RECEPTACLE |
| S | SURFACE |
| SC | SEPARATE CIRCUIT |
| SDB | SUB-DISTRIBUTION BOARD |
| SEC | SECONDARY |
| SMR | SURFACE METAL RACEWAY |
| SP | SINGLE POLE |
| SPK | SPEAKER |
| ST | SINGLE THROW |
| SW | SWITCH |
| SWBD | SWITCHBOARD |
| SYM | SYMMETRICAL |
| T | THERMOSTAT |
| TEL | TELEPHONE |
| TB | TERMINAL BOX |
| TC | TOP CONDUIT |
| TCAB | TELEPHONE CABINET |
| T.C.C. | TEMPERATURE CONTROL CONTRACTOR |
| TP | TAMPER PROOF |
| TV | TELEVISION |
| TYP | TYPICAL |
| UG | UNDERGROUND |
| UH | UNIT HEATER |
| UNG | UNGROUNDED |
| UON | UNLESS OTHERWISE NOTED |
| UPS | UNINTERRUPTED POWER SYSTEM |
| V | VOLT(S) |
| VA | VOLTAMP(S) |
| VAR | VOLT AMPERES REACTIVE |
| VP | VAPORPROOF |
| W | WATT(S) |
| WP | WEATHERPROOF |
| WT | WATERTIGHT |
| XFR | TRANSFORMER |
| XP | EXPLOSION PROOF |

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*Figure 24* Electrical abbreviations.


*Figure 25* The title block of a construction drawing.

- *Revision blocks* – Information on revisions, including (at a minimum) the date and the initials of the person making the revision. Other information may include descriptions of the revision and a revision number.

Every company has its own system for such things as project numbers and departments. Every company also has its own placement locations for the title and revision blocks. Your supervisor should explain your company's system to you.

### 1.2.2 Border

The border is a clear area of approximately half an inch around the edge of the drawing area. It is there so that everything in the drawing area can be printed or reproduced on printing machines with no loss of information.

### 1.2.3 Drawing Area

The drawing area presents the information for constructing the project, such as the floor plan, elevations of the building, sections, and details.

### 1.2.4 Revision Block

A revision block is located in the drawing area, usually in the lower right corner inside the title block or near it. Different companies put the revision block in different places. This block is used to record any changes (revisions) to the drawing. It typically contains the revision number, a brief description, the date, and the initials of the person who made the revisions (*Figure 26*). All revisions must be noted in this block and dated and identified by a letter or number.

**CAUTION**

It is essential to note the revision designation on a construction drawing and to use only the latest version. Otherwise, costly mistakes may result.

### 1.2.5 Legend

Each line on a construction drawing has a specific design and thickness that identifies it. Note that some of the lines may be used to identify off-site utilities. The identification of these lines and other symbols is called the legend. Although a legend doesn't automatically appear on every construction drawing, when it does, it explains or defines symbols or special marks used in the drawing (*Figure 27*). Be aware that legends are specific only to the set of drawings in which they are contained.

# Importance of Specifications

Specifications clarify information that cannot be shown on the drawings. Specifications are very important to the architect and owner to ensure compliance to the standards set. The figure provided shows one page of the specifications for a building's air handling units.

M.E. RINKER SR. HALL
SCHOOL OF BUILDING CONSTRUCTION
BR-191

AIR HANDLING UNITS
SECTION 15760

2.1 AIR HANDLING UNITS

A. Units shall be of the type, size and capacity as set forth in the schedule. The fan outlet velocities and coil and filter face velocities shall be within 5% of the values specified in the schedule. Units shall be double wall McQuay, or approved equal.

B. The units, as assembled, shall be complete with fans, coils, insulated casing, filters, drives and accessories. Each unit, including the fan enclosure, shall have essentially constant cross-sectional dimensions as to width and height. Internal baffles shall be provided as required to prevent bypassing of coils and filters.

C. The casing shall consist of an independent structural steel frame, properly reinforced and braced for maximum rigidity, having individually removable, flush mounted, insulated panels. The casing shall be of sectionalized construction, consisting basically of individual fan section, coil section, access sections, filter section, and drain pan. Sections shall be joined with continuous gasketing to form an air tight closure. Sections shall be so designed that the method of joining can be performed with relative ease and without damage to the insulation and vapor barrier.

The framework shall be constructed of AISC structural rolled shapes having minimum thickness of 1/8" (3 mm) or die formed sheet steel having the minimum gauges set forth in the following schedules:

| Maximum Individual Casing Cross-Section | Minimum Framework Gauge |
|---|---|
| Up to 30 sq.ft. (2.8 sq.m.) | 14 |
| 30.5 sq.ft. to 47 sq.ft. (2.81 to 4.4 sq.m.) | 12 |
| 48 sq.ft. (4.45 sq.m.) and up | 10 |

D. Framework shall be designed with recesses suitable to receive enclosure panels, providing neat appearance, airtight enclosure, and ease of panel removal.

E. Enclosure panels 12 sq. ft. in area and larger shall be constructed of not less than 18 gauge die formed sheet steel. Should the sides or top of a casing section exceed 20 sq. ft. in area, the panels shall be fabricated of more than one piece, with the individual panels recessed into intermediate structural members.

Protection for the insulation edges shall be provided around the perimeter of each

GEA 0300-0600

15760 - 2
Revision No. 1
Dec. 19, 2001

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| PROJ | NO | REVISION | RVSD | CHKD | APPD | DATE |
|---|---|---|---|---|---|---|
| 3483 | 01 | RELEASED FOR CONSTRUCTION | | APD | NWS | JULY 92 |
| 3483 | 02 | DELETED PART OF LINE 12037 | | APD | NWS | AUG 92 |
| 3483 | 03 | A ADDED WELDING SYMBOL | | APD | NWS | AUG 92 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |

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*Figure 26* The revision block of a construction drawing.

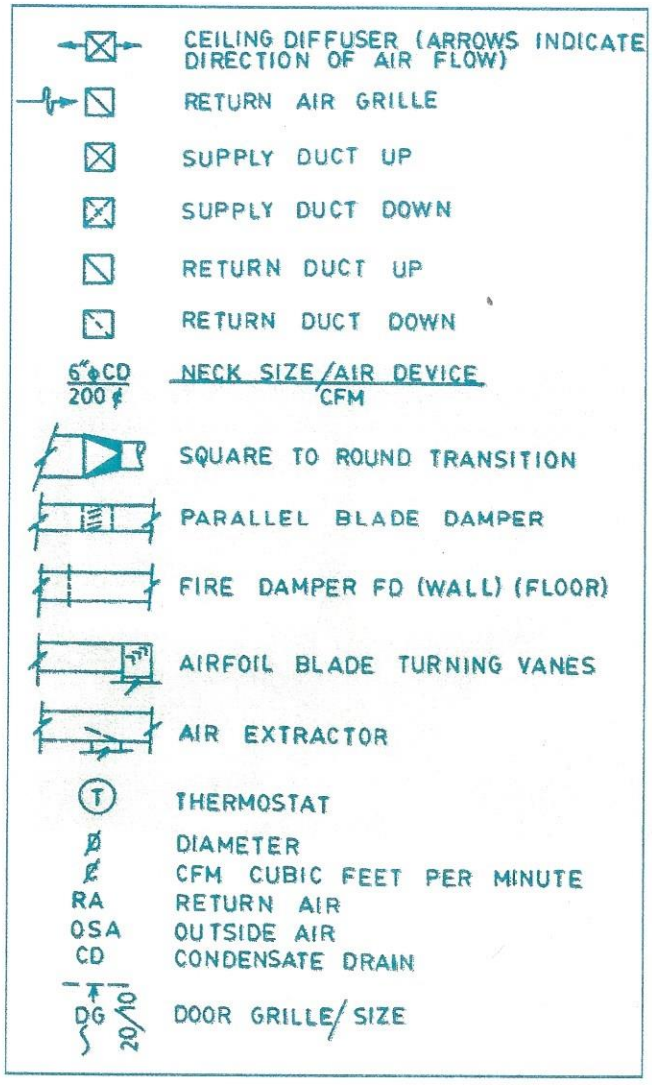


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*Figure 27* Sample legend.

## 1.3.0 Drawing Elements

Various drawing elements make it easier and quicker for people to read and understand construction drawings. This section covers several of the most common drawing elements.

### 1.3.1 Lines of Construction

It is very important to understand the meanings of lines on a drawing. The lines commonly used on a drawing are sometimes called the *alphabet of lines*. Here are some of the more common types of lines (*Figure 28*):

- **Dimension lines** – Establish the dimensions (sizes) of parts of a structure. These lines end with arrows (open or closed), dots, or slashes at a termination line drawn perpendicular to the dimension line.
- **Leaders** *and arrowheads* – Identify the location of a specific part of the drawing. They are used with words, abbreviations, symbols, or keynotes.
- *Property lines* – Indicate land boundaries.
- *Cut lines* – Lines around part of a drawing that is to be shown in a separate cross-sectional view.
- *Section cuts* – Show areas not included in the cutting line view.
- *Break lines* – Show where an object has been broken off to save space on the drawing.
- **Hidden lines** – Identify part of a structure that is not visible on the drawing. You may have to look at another drawing to see the part referred to by the lines.
- *Center lines* – Show the measured center of an object, such as a column or fixture.
- *Object lines* – Identify the object of primary interest or the closest object.

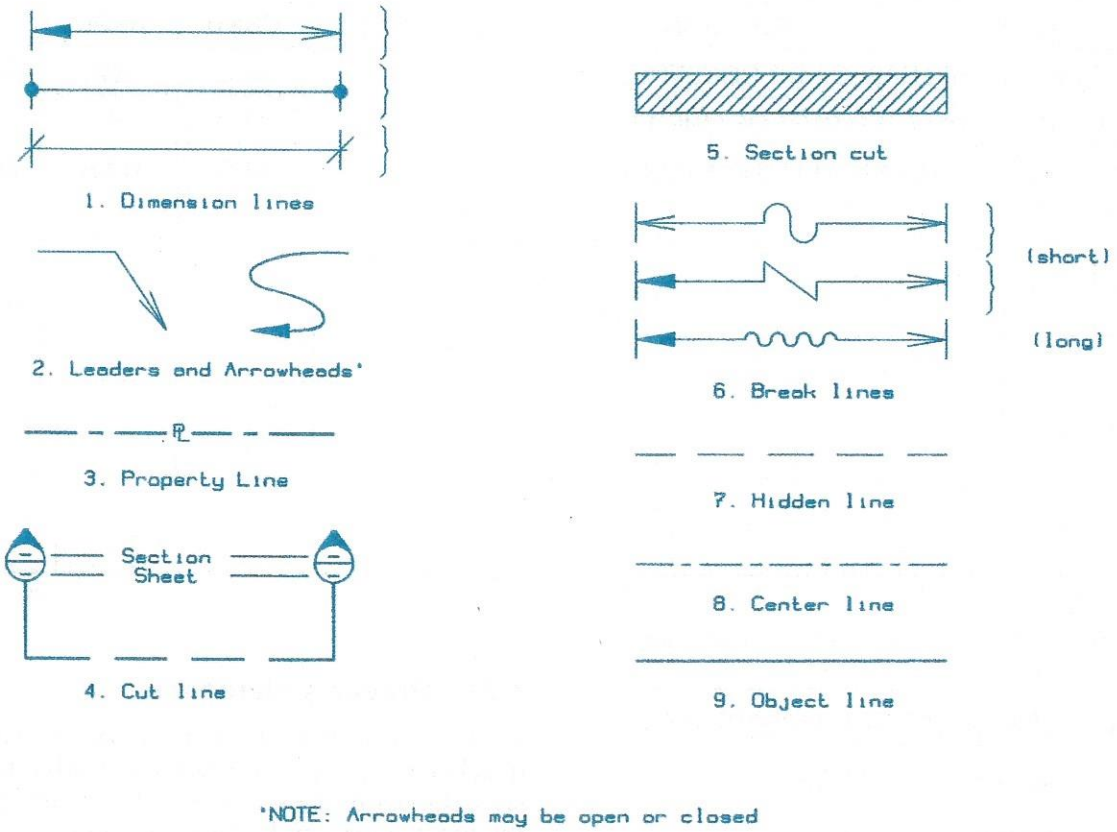


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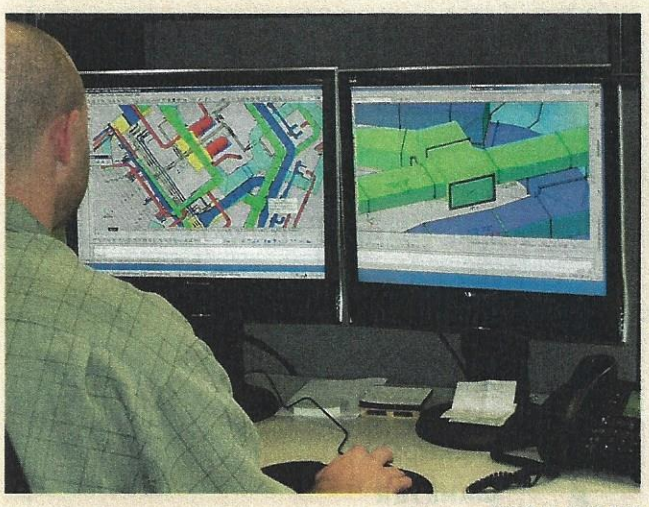
*Figure 28* Lines of construction.

## What Is Computer-Aided Drafting?

The use of computers is a cost-effective way to increase drafting productivity because the computer program automates much of the repetitive work. A CAD system generates drawings from computer programs. CAD has the following advantages over hand-drawn construction drawings:

- It is automated.
- The computer performs calculations quickly and easily.
- Changes can be made quickly and easily.
- Commonly used symbols can be easily retrieved.
- CAD can include three-dimensional modeling of the structure.



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## Regional and Company Differences

Although most symbols are standard, there can be slight variations in different regions of the country. Always check the title sheet or other introductory drawing to verify the symbols you find on the project drawings.

Your company may also use some special symbols or terms. Your instructor or supervisor will tell you about conventions that are unique to your company.

### 1.3.2 Abbreviations, Symbols, and Keynotes

**Architects** and **engineers** use systems of abbreviations, symbols, and keynotes to keep plans uncluttered, making them easier to read and understand. Examples of some of these items appear throughout this module. Following is additional information on these items and some variants that are commonly used.

Each trade has its own symbols, and workers should learn to recognize the symbols used by other trades. For example, an electrician should understand a carpenter's symbols, a carpenter should understand a plumber's symbols, and so on. Then, no matter what symbols are encountered on a project, the workers will understand what the symbols mean.

**Did You Know?**

## Legality of Construction Drawings

Construction drawings are incorporated into building contracts by reference, making them part of the legal documents associated with a project. When describing the project to be completed, the legal contract between the builder and the owner refers to the accompanying construction drawings for details that would be too lengthy to write out. That makes tracking changes or revisions to construction drawings over the course of a project vitally important. If an error is made along the way, either the owner or the builder must be able to find the discrepancy by reading the drawings. Taking care of construction drawings over the course of the project makes good business sense.

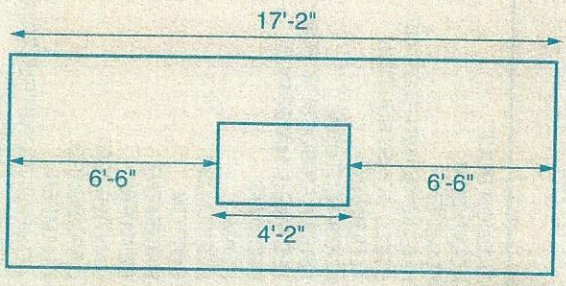
Abbreviations used in construction drawings are short forms of common construction terms. For example, the term *on-center* is abbreviated O.C. Some common construction abbreviations are listed in *Figure 29*.

Abbreviations should always be written in capital letters. Abbreviations for each project should be noted on the title sheet or other introductory drawing page such as the legend page. Books that list construction abbreviations and their meanings are available. You do not need to memorize these abbreviations, as you will start to remember them as you use them.

## Check All the Plans

Always double-check all the plans for a project. Be familiar with other trade work that may affect your job. Determine whether an electrical conduit is close to the plumbing pipes or whether a framing member is placed too close to an HVAC duct. By knowing all the work planned for a particular area, you can prevent errors and save time and money.

If a particular dimension is missing on the plan you will be using, check the other plans to see if it is included there. The part of the building you are working on will also be shown on other plans.



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When taking measurements from a set of plans, make sure that the dimensions of each measured section add up to the total measurement. For instance, if you are looking at a drawing of a wall with one window, add up the measurement from the left end of the wall to the left side of the window, the width of the window, and the measurement from the right side of the window to the right end of the wall. Make sure this total matches the measurement of the entire wall.

## ABBREVIATIONS

| | |
|---|---|
| A.B. | – ANCHOR BOLT |
| ADD'L | – ADDITIONAL |
| ADJ. | – ADJACENT |
| A.I.S.C. | – AMERICAN INSTITUTE OF STEEL CONSTRUCTION |
| ALT. | – ALTERNATE |
| ARCH. | – ARCHITECTURAL |
| A.S.T.M. | – AMERICAN SOCIETY FOR TESTING & MATERIALS |
| BLDG. | – BUILDING |
| BM. | – BEAM |
| B.O. | – BOTTOM OF |
| BOT. | – BOTTOM |
| BSMT. | – BASEMENT |
| BTWN. | – BETWEEN |
| CANT. | – CANTILEVER |
| CB. | – CARDBOARD |
| CH. | – CHAMFER |
| C.J. | – CONTROL/CONSTRUCTION JOINT |
| CLR. | – CLEAR, CLEARANCE |
| C.M.U. | – CONCRETE MASONRY UNIT |
| COL. | – COLUMN |
| CONC. | – CONCRETE |
| CONN. | – CONNECTION |
| CONST. | – CONSTRUCTION |
| CONT. | – CONTINUOUS |
| CONTR. | – CONTRACTOR |
| CTRD. | – CENTERED |
| DET. | – DETAIL |
| DIAG. | – DIAGONAL |
| DIAM. | – DIAMETER |
| DIM. | – DIMENSION |
| DISCONT. | – DISCONTINUOUS |
| DWG. | – DRAWING |
| EA. | – EACH |
| E.F. | – EACH FACE |
| EL. | – ELEVATION |
| ELECT. | – ELECTRICAL |
| ELEV. | – ELEVATOR |
| EQ. | – EQUAL |
| E.W.B. | – END WALL BARS |
| E.W. | – EACH WAY |
| EXIST. | – EXISTING |
| EXP. JNT. | – EXPANSION JOINT |
| EXT. | – EXTERIOR |
| F.D. | – FLOOR DRAIN |
| FDN. | – FOUNDATION |
| FIN. | – FINISH |
| FLR. | – FLOOR |
| F.O.B. | – FACE OF BRICK |
| F.O.CONC. | – FACE OF CONCRETE |
| F.O.W. | – FACE OF WALL |
| FS. | – FLAT SLAB |
| FT. | – FOOT |
| FTG. | – FOOTING |
| F.W. | – FILLET WELD |
| GA. | – GAUGE |
| GAL. | – GALVANIZED |
| G.L. | – GLU-LAM BEAM |
| GR. | – GRADE |
| GR. BM. | – GRADE BEAM |
| H.A.S. | – HEADED ANCHOR STUD |
| HORIZ. | – HORIZONTAL |
| H.S.B. | – HIGH STRENGTH BOLT |
| I.D. | – INSIDE DIAMETER |
| IN. | – INCH |
| INT. | – INTERIOR |
| JNT. | – JOINT |
| LB. | – POUND |
| LIN. FT. | – LINEAL FEET |
| L.L.V. | – LONG LEG VERTICAL |
| MAT'L. | – MATERIAL |
| MAX. | – MAXIMUM |
| MECH. | – MECHANICAL |
| MID. | – MIDDLE |
| MIN. | – MINIMUM |
| MISC. | – MISCELLANEOUS |
| MTL. | – METAL |
| N.I.C. | – NOT IN CONTRACT |
| NO. | – NUMBER |
| NOM | – NOMINAL |
| N.T.S. | – NOT TO SCALE |
| O.C. | – ON CENTER |
| O.D. | – OUTSIDE DIAMETER |
| O.H. | – OPPOSITE HAND |
| OPNG. | – OPENING |
| PL | – PLATE |
| P.S.F. | – POUND PER SQUARE FOOT |
| P.S.I. | – POUND PER SQUARE INCH |
| R. | – RADIUS |
| REINF. | – REINFORCEMENT |
| REQ'D. | – REQUIRED |
| RM. | – ROOM |
| SCHED. | – SCHEDULE |
| SECT. | – SECTION |
| SHT. | – SHEET |
| SIM. | – SIMILAR |
| S.L.V. | – SHORT LEG VERTICAL |
| SPC. | – SPACE |
| SPEC. | – SPECIFICATION |
| SQ. | – SQUARE |
| STD. | – STANDARD |
| STIFF. | – STIFFENER |
| STL. | – STEEL |
| STOR. | – STORAGE |
| SYM. | – SYMMETRICAL |
| T.&B. | – TOP AND BOTTOM |
| THK. | – THICKNESS |
| T.O. | – TOP OF |
| TYP. | – TYPICAL |
| U.N.O. | – UNLESS NOTED OTHERWISE |
| VAR. | – VARIES |
| VERT. | – VERTICAL |
| V.I.F. | – VERIFY IN FIELD |
| WT. | – WEIGHT |

SYMBOLS

| | |
|---|---|
| ℄ | CENTER LINE |
| ϕ | DIAMETER |
| | ELEVATION |
| & | AND |
| W/ | WITH |
| PL | PLATE |
| X | BY |
| # | NUMBER |
| @ | AT |
| □ | SQUARE |
| L | ANGLE |

00105-15_F29.EPS

*Figure 29* Abbreviations.

# Request for Information (RFI)

A request for information (RFI) is used to clarify any discrepancies in the plans. If you notice a discrepancy, you should notify the foreman. The foreman will write up an RFI, explaining the problem as specifically as possible and putting the date and time on it. The RFI is submitted to the superintendent, who passes it to the general contractor, who passes it to the architect or engineer, who then resolves the discrepancy.

Always refer to specifications and the RFI when deciding how to interpret drawings.

DATE 12/07/12 RFI NO. 1

PROJECT NAME GERMANS FROM RUSSIA PROJECT NO. 15-1593

REQUEST: REF D.W.G.NO. M2 REV. DETAIL 1/M2 OTHER

WILL THE 16 X 10 INTAKE AIR DUCTWORK RUNNING THROUGH RM 116 REQUIRE WALL MOUNTED FIRE DAMPERS ON ALL 4 EXIT CORRIDOR WALL PENETRATIONS AND WILL THE 14 X 10 TRANSFER DUCTWORK REQUIRE THE INSTALLATION OF A FIRE DAMPER AS WELL?

BY: LARRY MAYRE REPLY BY (DATE): 12/20/12

REPLY:

ANSWER: ALL DUCTWORK IS ABOVE CEILING, SO OK AS IS.

DATE: 12/19/12

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Symbols are used on a drawing to tell what material is required for that part of the project. A combination of these symbols, expanded and drawn to the same size, makes up the pictorial view of the plan. There are architectural symbols (*Figure 30*); civil and structural engineering symbols (*Figure 31*); mechanical symbols (*Figure 32*); plumbing symbols (*Figure 33*); and electrical symbols. Slightly different symbols may be used in different parts of the country or by different companies. The symbols used for each set of plans should be indicated on the title sheet or other introductory drawing. Many code books, manufacturers' brochures, and specifications include symbols and their meanings.

Some plans use keynotes (*Figure 34*) instead of symbols. A keynote is a number or letter (usually in a square or circle) with a leader and arrowhead that is used to identify a specific object. Part of the drawing sheet (usually on the right-hand side) lists the keynotes with their numbers or letters. The keynote descriptions normally use abbreviations.

### 1.3.3 Using Gridlines to Identify Plan Locations

Have you ever used a map to find a street? The map may have used a grid to make locating a detailed area easier. For example, the index might have referred you to section B-3, so you located B along the side of the map and 3 along the top. Then you located the intersection of the two to find the street.

The gridline system shown on a plan (*Figure 35*) is used like the grid on a map. On a drawing such as a floor plan, a grid divides the area into small parts called bays.

The numbering and lettering system begins in the upper left-hand corner of the floor plan. The numbers are normally across the top and the letters are along the side. To avoid confusion, certain letters and the symbol for zero are not used. Omitted from the gridline system are the letters I, O, and Q; and numbers 1 and 0.

A gridline system makes it easy to refer to specific locations on a plan. Suppose you want to refer to one outlet, but there are a dozen on a plan. Simply refer to "the outlet in bay C-8".

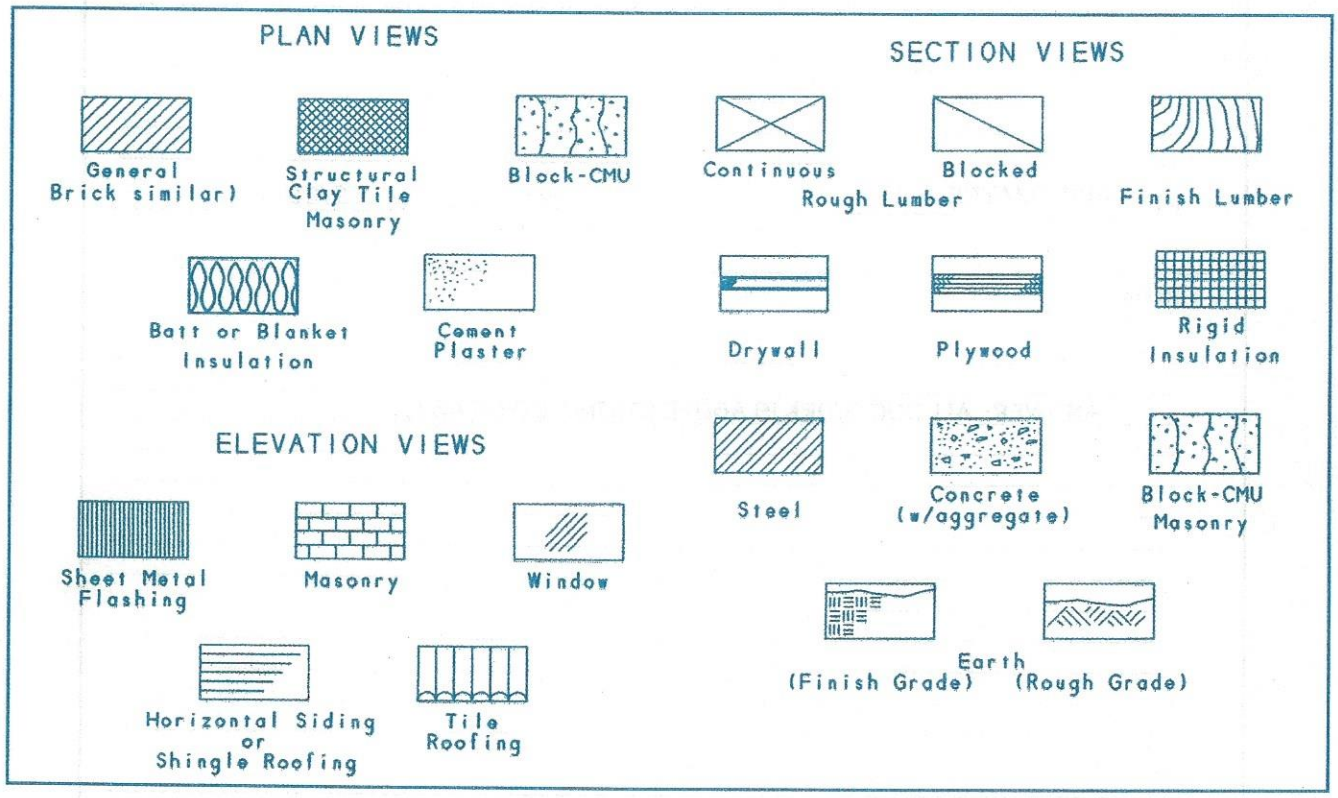


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*Figure 30* Architectural symbols.

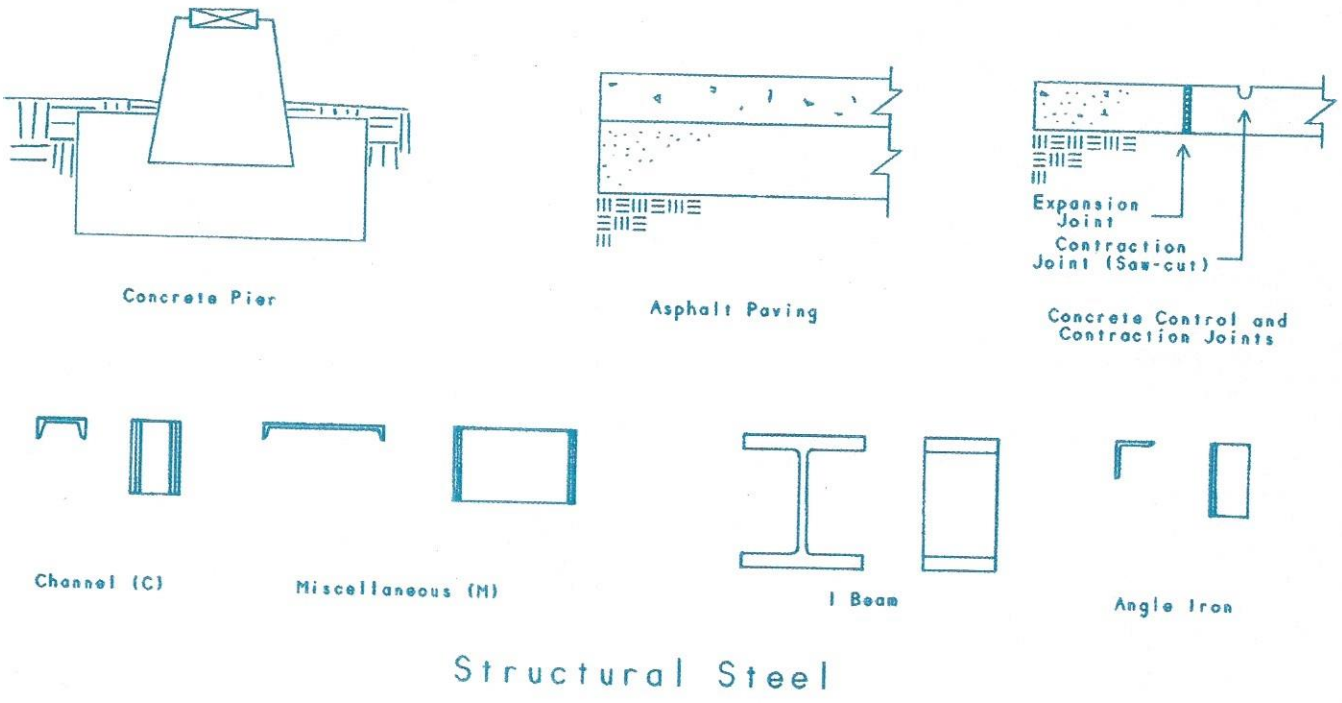


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*Figure 31* Civil and structural engineering symbols.

GOING GREEN

## Green Construction

Green construction refers to a method of designing and building structures using materials and techniques that help minimize the stress on our natural resources and the environment.

With just under 5 percent of the world's population, the United States manages to consume about 19 percent of the world's energy (buildings account for 40 percent of this consumption) and produces 170 million tons (154,221,406 metric tons) of construction and demolition debris a year. In response to these numbers, and a general increase in environmental awareness, organizations such as the US Green Building Council (USGBC) created environmental assessment systems, such as the LEED (Leadership in Energy and Environmental Design) Green Building Rating System. Systems like LEED provide green standards for the construction industry to follow, and they officially certify structures (nonresidential) that meet USGBC's strict criteria.

The LEED program was launched in 1988. It is a voluntary national standard that awards points for incorporating green strategies into areas such as site planning, safeguarding water quality and efficiency, efficiency in energy use and recycling, conservation of resources and materials, and the design, quality, and efficiency of the indoor environment.

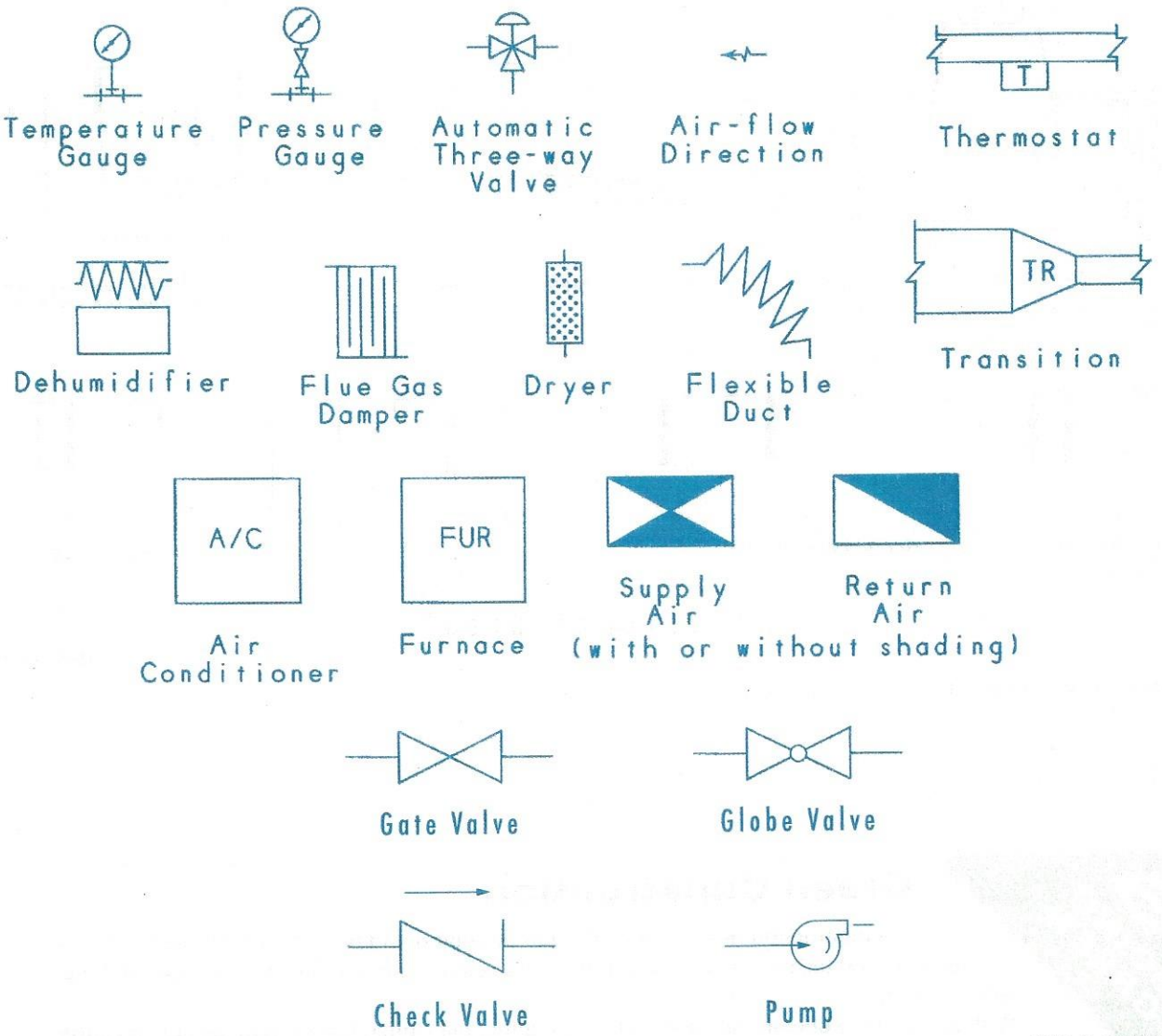


*Figure 32* Mechanical symbols.

## Care of Construction Drawings

Construction drawings are valuable records and must be cared for. Follow these rules when handling construction drawings:

- Never write on a construction drawing without authorization.
- Keep drawings clean. Dirty drawings are hard to read and can cause errors.
- Fold drawings so that the title block is visible.
- Fold and unfold drawings carefully to avoid tearing.
- Do not lay sharp tools or pointed objects on construction drawings.
- Keep drawings away from moisture.
- Make copies for field use; don't use originals.

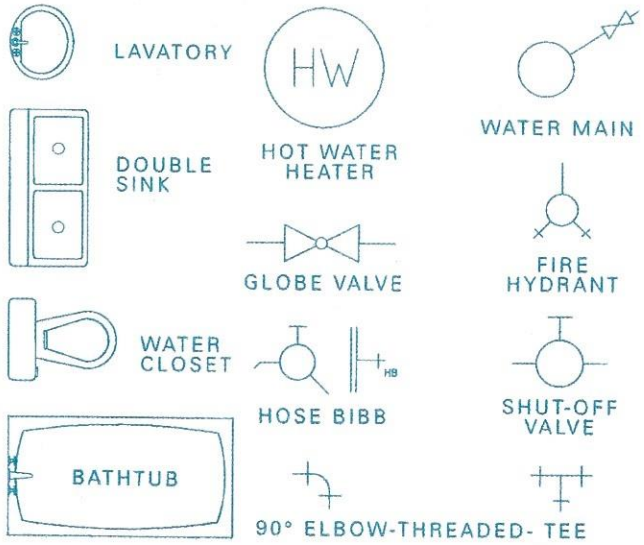


*Figure 33* Plumbing symbols.

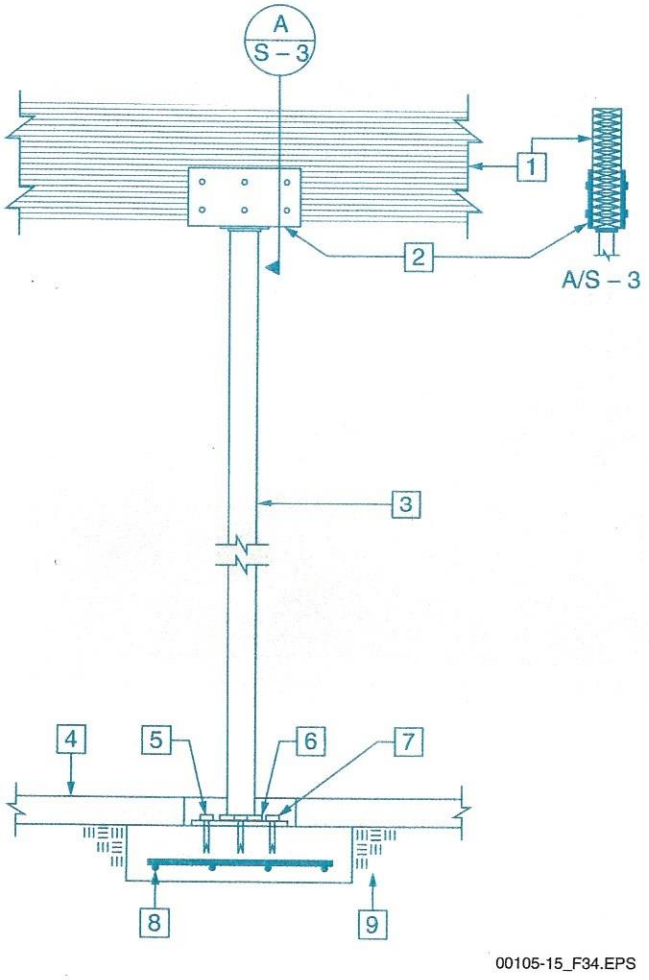


*Figure 34* Keynotes.

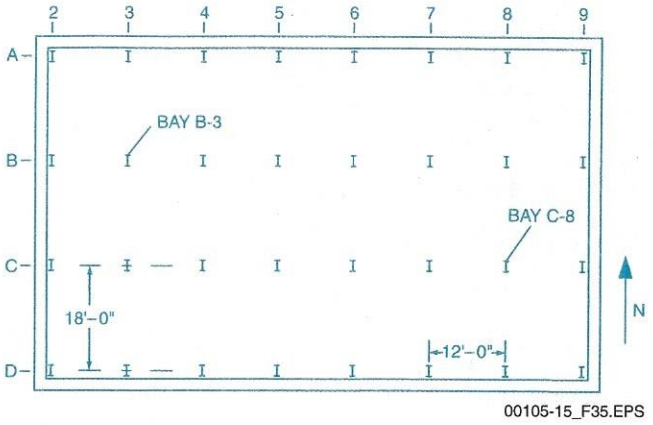


*Figure 35* Grid.

## 1.4.0 Dimensions and Drawing Scale

Dimensions and their associated drawing scales provide information that is essential for correctly translating construction drawings into actual buildings. This section describes the basic features and purpose of dimensions and drawing scales. How to read and use different types of drawing scales will be discussed later.

### *1.4.1 Dimensions*

Dimensions are the parts of the drawings that show the size and the placement of the objects that will be built or installed. Dimension lines can have arrowheads or slashes at both ends, with the dimension itself written near the middle of the line. The dimension is a measurement written as a number, and it may be written in inches with fractions (6½"), in feet with inches (1'-2"), or in inches with decimals (3.2"). When the metric system is used, the dimensions are usually expressed in meters, centimeters, or millimeters (9 mm).

To do accurate work, workers need to know how to read dimensions on construction drawings. This means they need to know whether the dimensions measure to the exterior or the interior of an object. To understand the difference, look at *Figure 36*, which shows a piece of pipe. There are two measurements that could be taken to get the pipe's dimensions.

The first measurement is from the pipe's exterior edge on one side directly across to its exterior edge on the other side. The second measurement is from the pipe's inside (interior) edge on one side directly across to its interior edge on the other side. Even though the difference between these two dimensions may be only a fraction of an inch (the thickness of the pipe), they are still two completely different dimensions.

This is important to remember because any dimensioning inaccuracy or miscalculation in one place will affect the accuracy of calculations in other places.

### 1.4.2 Drawing Scale

The scale of a drawing tells the size of the object drawn compared with the actual size of the object represented. The scale is shown in one of the spaces in the title block, beneath the drawing itself, or in both places. The type of scale used on a drawing depends on the size of the objects being shown, the space available on the paper, and the type of plan.

On a site plan, the scale may read SCALE: 1" = 20'-0". This means that every 1 inch on the drawing represents 20 feet, 0 inches. The scale used to develop site plans is an **engineer's scale**.

On a floor plan, the scale may read SCALE: ¼" = 1'-0". This means that every ¼ inch on the drawing represents 1 foot, 0 inches. Floor plans are developed using an **architect's scale**. This scale is divided into fractions of an inch. Metric floor plans typically use a ratio of 1:50, indicating that each millimeter on the drawing represents 50 meters.

Some drawings are not drawn to scale. A note on such drawings reads **not to scale (NTS)**.

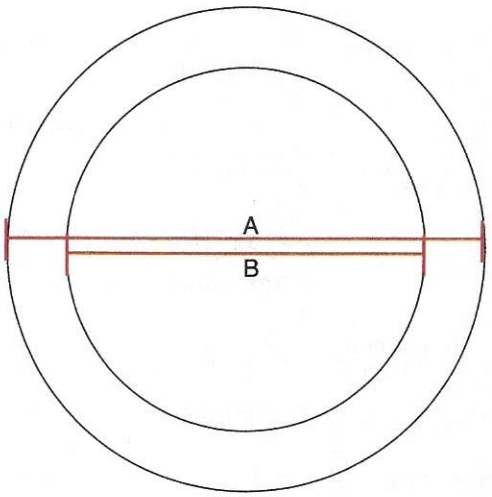


*Figure 36* Exterior and interior dimensions on pipe.

**CAUTION**

When a plan is marked NTS, workers cannot measure dimensions on the drawing and use those measurements to build the project. Not-to-scale drawings give relative positions and sizes. The sizes are approximate and are not accurate enough for construction.

GOING GREEN

## Recycling Rinker Hall, University of Florida in Gainesville

An example of a LEED Gold rated building is Rinker Hall on the campus of the University of Florida in Gainesville, Florida. During the planning phase of the building, special consideration was given to land use and the use of recycled and recyclable materials. Special attention was also given to planning the incorporation of the most recent green technologies in the areas of water consumption and conservation, heating and cooling energies, and other power needs required to run the various systems of a building.


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A few of the green strategies incorporated into the construction of Rinker Hall include:

- Orienting the structure on a pure north-south axis to allow it to use low-angle light for daytime lighting.
- Using rooftop skylights and a central skylight-covered atrium to light specific areas using natural sunlight.
- Using shade walls on the east and west sides of the building.
- Landscaping with native trees and flora that require minimal watering.
- Installing water-free urinals and fixtures that use 20 percent less water than mandated.

With the various green strategies, materials selection, and building techniques employed, Rinker Hall and all of its systems use up to 57 percent less energy than a similar structure designed in minimal compliance with the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).

## 1.5.0 Measuring Scales

Standard and metric rulers and measuring tapes are usually used in a shop or in the field for a variety of measuring tasks. However, there are other types of rulers called scales used by draftsmen to produce drawings. They are also used by many workers to take scaled measurements on a drawing. These include the architect's scale, the **metric scale** (metric architect's scale), and the engineer's scale. Knowing how these scales work makes it easier to understand the information contained in a set of drawings.

### 1.5.1 Architect's Scale

The architect's scale is often used to create construction drawings. An architect's scale translates the large measurements of real structures (rooms, walls, doors, windows, duct, etc.) into smaller measurements for drawings. Architect's scales are available in several types, but the most common include the triangular and flat scales. A flat scale is shown in *Figure 37*. The triangular architect's scale is most commonly used because it can combine up to twelve different scales on one tool. Each side of the triangular form has two faces, and two scales are combined on each face. Architect's scales are available in 6- and 12-inch lengths.

Each scale on an architect's scale is designated to a different fraction of an inch that equals a foot. These fraction designations appear on the right and left corners of each scale. You read an architect's scale from left to right or right to left, depending on which scale you are reading.

Look at the point of measurement in *Figure 37*. It represents 57 feet when read from the left on the ⅛-inch scale and equals 18 feet when read from the right on the ¼-inch scale.

Now look at *Figure 38*. Using the ⅜-inch scale and reading from the right, you can determine that the section of duct is 7-feet, 5-inches long. Notice how the 0 point on an architect's scale is not at the extreme end of the measuring line. This is because numbers to the right of the 0 represent fractions of one foot (or inches).

### Checking Scales on Drawings

Normally the scale of a drawing is marked directly on the drawing itself. If it is not, however, do not guess what the scale is. Rather, compare different scales by identifying a given length on the drawing (for example, an 8-foot, 6-inch pipe), and then find the scale that measures the pipe at 8-feet, 6-inches. Check at least two items on the drawing this way before proceeding.

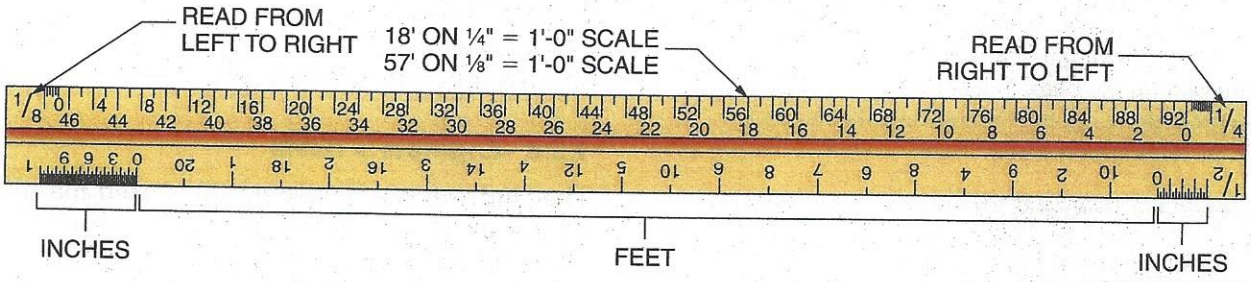



*Figure 37* The architect's scale.

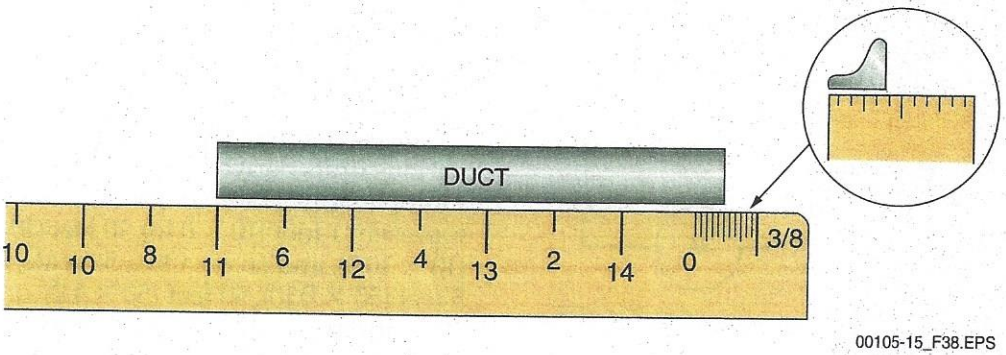



*Figure 38* Measuring a section of duct with an architect's scale.

### 1.5.2 Metric Scale (Metric Architect's Scale)

Similar to the architect's scale is the metric scale, sometimes referred to as a metric architect's scale (*Figure 39*). Common lengths indicated on metric scales are 30 and 60 millimeters. Like the architect's scale, a metric scale can have a number of scales on it and is used to generate drawings. *Figure 39* shows how 10 meters would be shown on a 1:200 scale. The actual length on the plans is 50 mm, equaling 10 meters of real distance on the project.

Metric scales are calibrated in units of 10. Some of the most common metric scales include 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, and 1:1,000.

The two common length measurements used with the metric scale on architectural drawings are the meter and millimeter, the millimeter being $\frac{1}{1000}$ of a meter. On drawings drawn to scale between 1:1 and 1:100, the millimeter is typically used. The millimeter symbol (mm) will not be shown, but there should be a note on the drawing indicating that all dimensions are given in millimeters unless otherwise noted.

On drawings with scales between 1:200 (*Figure 39*) and 1:2,000, the meter is generally used. Again, the meter symbol (m) will not be shown, but the drawing will have a note indicating that all dimensions are in meters unless otherwise noted. Land distances shown on site and plot plans, expressed in metric units, are typically given in meters or kilometers (1,000 meters).

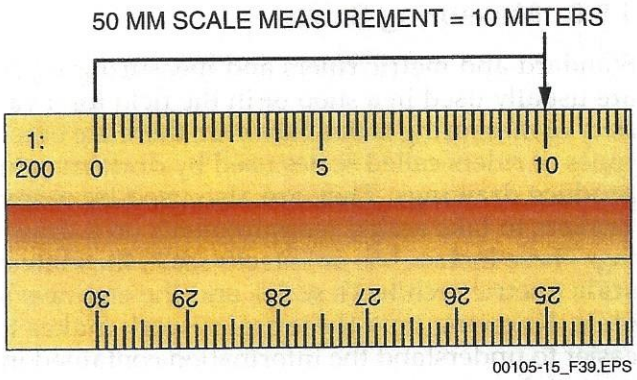



*Figure 39* Metric architect's scale.

Reading a metric scale is easy once you identify the scale to use and the length that the scale increments represent on the drawing. Here's how it works.

The unit of length in *Figure 39* is the meter and the object on the drawing starts at 0 and extends out to the 10 on the scale. At a 1:200 ratio this object would be 10 meters long. This is because every millimeter on the scale represents 200 millimeters on the object. For example, if there are 50 millimeters from 0 to 10, multiply the 50 by 200, which gives 10,000 mm (50 mm × 200 = 10,000 mm). Because the unit being used is the meter and there are 1000 mm in one meter, divide the 10,000 mm by 1,000, which results in 10 meters. This same process is also used to determine lengths for other ratios on the scale.

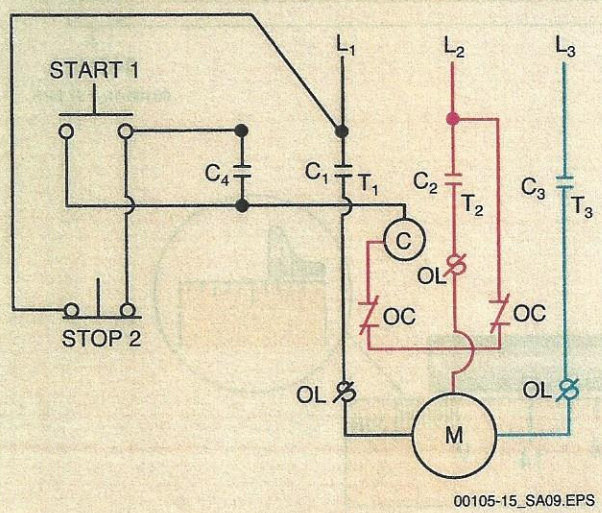
### 1.5.3 Engineer's Scale

The engineer's scale (*Figure 40*) is used mainly for land measurements on site plans, which means the scale must accommodate very large measurements. Each engineer's scale is set up as multiples of 10 and the measurements are taken in decimals. This is different from the architect's scale in that a unit is represented by a portion of an inch. The most common engineer's scales are 10, 20, 30, 40, 50, and 60, which can all be combined on the triangular engineer's scale.

For each scale, the measurements can represent various units derived from that scale number and a multiple of 10. For example on a 10 scale, 1 inch can represent 1 foot (10 × 0.10), 10 feet (10 × 1.0), 100 feet (10 × 10.0), and so on. On a 50 scale, an inch can be 5 feet (50 × 0.10), 50 feet (50 × 1.0), or 500 feet (50 × 10.0), and so on. This same process can also be used to determine lengths on the scales.

## Schematic Drawings

Most plumbing and electrical sketches are single-line drawings or schematic drawings. These drawings illustrate the scale and relationship of the project's components. In a single-line or schematic plumbing drawing, the line represents the centerline of the pipe. In a single-line or schematic electrical drawing, the line represents electrical wiring routing or circuit.



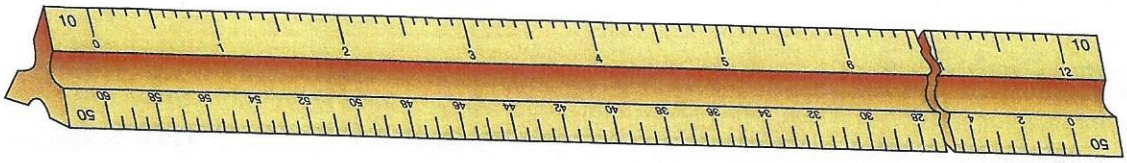
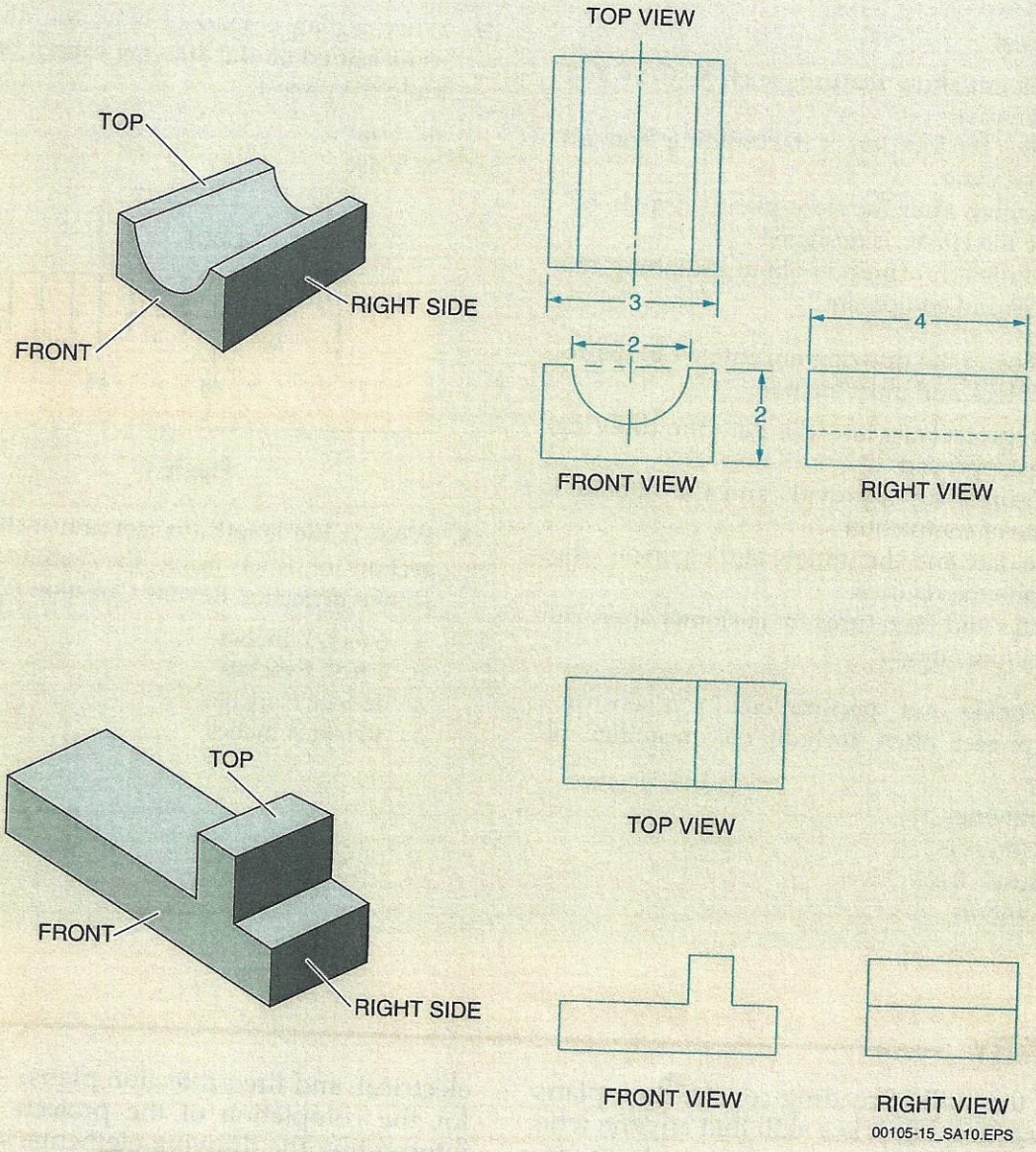



*Figure 40* The engineer's scale.

## Orthographic Drawings

Orthographic drawings are used for elevation drawings. They show straight-on views of the different sides of an object with dimensions that are proportional to the actual physical dimensions. In orthographic drawings, the designer draws lines that are scaled-down representations of real dimensions. Every 12 inches, for example, may be represented by ¼ inch on the drawing. Similarly, in an example using metric measurements with a ratio of 1:2, every 30 millimeters may be represented by 15 millimeters on the drawing.



## Additional Resources

*Blueprint Reading for Construction*, James Fatzinger. 2003. Upper Saddle River, NJ: Prentice Hall.

*Blueprint Reading for the Construction Trades*, Peter A. Mann. 2005. Ontario, Canada: **Micro-press.com.**

*Reading Architectural Plans for Residential and Commercial Construction*, Ernest R. Weidhaas. 2001. Englewood Cliffs, NJ: Prentice Hall Career & Technology.

*Reading Architectural Work Drawings*, Edward J. Muller and Phillip A. Grau III. 2003. Upper Saddle River, NJ: Prentice Hall.

Autodesk, 1 Market St, Suite 500, San Francisco, CA 94105, USA; 3D design, engineering and entertainment software and parent company of the AutoCAD software suite. **www.autodesk.com.**

Datacad, P.O. Box 815, Simsbury, CT 06070, USA. Windows-based CADD solutions. **www.datacad.com.**

## 1.0.0 Section Review

1. A site plan _____.
   a. does not show features such as trees and driveways
   b. shows the location of the building from an aerial view
   c. is drawn after the floor plan is drawn, before the HVAC is designed
   d. includes information about plumbing fixtures and equipment

2. Revisions to the drawing are entered in the revision block and must include _____.
   a. the project tag and the date the drawing was approved
   b. engineering approvals and the intended date of completion
   c. the date and the initials of the person who made the revision
   d. dates and signatures for customer approval documentation

3. Code books and specifications for a construction project often include the meanings of _____.
   a. drawings
   b. references
   c. glossaries
   d. symbols

4. When a plan is marked NTS, the dimensions as measured on the drawing cannot be used to build the project.
   a. True
   b. False

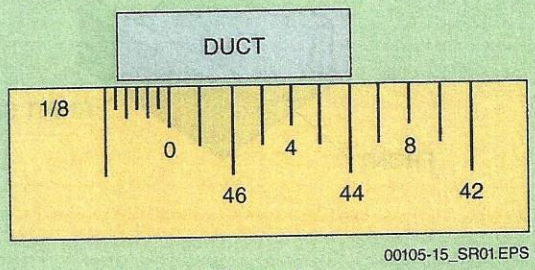



**Figure 1**

5. What is the length (in feet and inches) of the section of duct using the architect's scales shown in Section Review Question *Figure 1*?
   a. 6 feet, ¾ inches
   b. 6 feet, 5 inches
   c. 44 feet, ¾ inches
   d. 48 feet, 4 inches

## SUMMARY

Mastering the skill of reading construction plans requires practice, but it is a skill that anyone who works in the construction trades needs to develop. Each of the different types of construction drawings commonly found on a job site—civil, architectural, structural, mechanical, plumbing, electrical, and fire protection plans—is important for the completion of the project. By correctly interpreting the drawing elements, symbols, and scales that are used workers can visualize the entire project, detect inconsistencies or errors early, and possibly avoid costly mistakes or rework.

# Review Questions

1. Which type of plan shows the layout of the HVAC system?
   a. Plumbing
   b. Structural
   c. Mechanical
   d. Foundation

2. Electrical plans can include _____.
   a. exterior elevations
   b. section drawings
   c. plumbing isometrics
   d. lighting plans

3. The title block generally contains _____.
   a. revision blocks
   b. special marks used in the drawing
   c. the mechanical plans
   d. the legend

4. The latest revision date on a set of construction drawings can be found _____.
   a. inside the detail
   b. in the schedule
   c. inside the title block
   d. in the legend

5. The Alphabet of Lines consists of _____.
   a. the line types used on a construction drawing
   b. lines that are indicated using letters of the alphabet
   c. lines that match up detail and section drawings
   d. lines that indicate land boundaries on the site plan

6. On a gridline system, a grid divides the area into small parts called _____.
   a. segments
   b. bays
   c. sections
   d. PODS

7. When the metric system is used, dimensions are written in _____.
   a. inches, feet, and yards
   b. degrees, radians, and gradians
   c. CADS, RADS, and KRADS
   d. meters, centimeters, and millimeters

8. If the scale on a site plan reads SCALE: 1" = 20'-0", then every _____.
   a. 1/20th of an inch on the drawing represents 20 feet, 0 inches
   b. 20 inches on the drawing represents 1 foot, 0 inches
   c. inch on the drawing represents 20 feet, 0 inches
   d. 20 inches on the drawing represents 20 feet, 0 inches

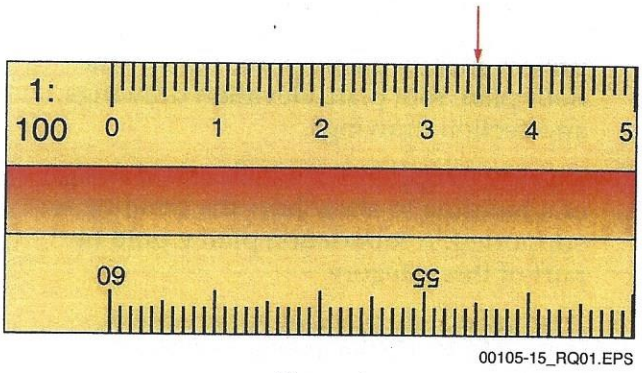


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**Figure 1**

9. What is the length in meters at the point indicated by the arrow on the metric scale in Review Question *Figure 1*? The unit of length used on the scale is the meter.
   a. 3500
   b. 350
   c. 35
   d. 3.5

10. An engineer's scale is set up in multiples of _____.
    a. 5
    b. 10
    c. 12
    d. 39.37

# Trade Terms Quiz

*Fill in the blank with the correct term that you learned from your study of this module.*

1. A(n) _____ is a side view that shows height.
2. A(n) _____ usually has an arrowhead at both ends, with the measurement written near the middle of the line.
3. A(n) _____ is a qualified, licensed person who creates and designs drawings for a construction project.
4. _____, which show the design of the project, include many parts, such as the floor plan, roof plan, elevation drawings, and section drawings.
5. _____ support the architectural design of a building to show how the building is supported. A foundation plan would be part of this category.
6. Also called site plans or survey plans, _____ show the location of the building from an aerial view, as well as the natural contours of the earth.
7. Almost all construction drawings today are made by _____.
8. _____ are solid or dashed lines showing the elevation of the earth on a civil drawing.
9. _____ are enlarged views of some special features of a building, such as floors and walls.
10. A(n) _____ is a person who applies scientific principles in design and construction.
11. _____, or engineered drawings for electrical supply and distribution, include locations of the electric meter, switchgear, and convenience outlets.
12. A large, horizontal support made of concrete, steel, stone, or wood that may be shown in structural plans is a _____.
13. Schematic drawings called _____ show all the equipment, pipelines, valves, instruments, and controls needed to operate a piping system.
14. An element of architectural drawings, _____ refers to the height above sea level or other defined surface.
15. Architectural, civil and structural engineering, mechanical, and plumbing _____ may be used on a drawing to tell what material is required for that part of the project.
16. Also called a plan view, a(n) _____ is an aerial view of the layout of each room.
17. A(n) _____ is a one-line drawing showing the flow path for electrical circuitry or the relationship of all parts of a system.
18. Part of the structural plans, the _____ shows the lowest level of the building.
19. Plans for gas, oil, or steam heat piping may be included in the _____ plan.
20. When a plan is marked _____, it means that the drawing gives approximate positions and sizes only.
21. A(n) _____ is a dashed line on a plan showing an object obstructed from view by another object.
22. A(n) _____ is a type of three-dimensional drawing that is included in a plumbing plan.
23. The meter and millimeter are two common length measurements used with the _____ on architectural drawings.
24. In drafting, an arrowhead is placed on a(n) _____ to identify a component.
25. _____ are written statements provided by the architectural and engineering firm to define the quality of work to be done and to describe the materials to be used.
26. The _____ defines the symbols used in architectural plans.
27. _____ are engineered plans for motors, pumps, piping systems, and piping equipment.

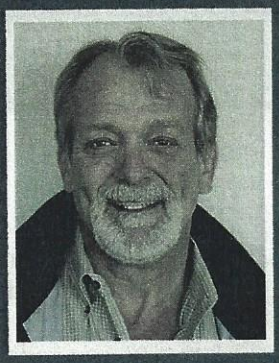


28. A(n) _____ is a cross-sectional view that shows the inside of an object or building.
29. The triangular and flat scales are the two most common types of _____.
30. A(n) _____ shows the shape of the roof and the materials that will be used to finish it.
31. The _____ of a drawing tells the size of the object drawn compared with the actual size of the object represented.
32. _____ show the layout for the plumbing system that supplies hot and cold water, for the sewage disposal system, and for the location of plumbing fixtures.
33. Part of the construction drawing, the _____ gives information about the structure and is numbered for easy filing.
34. _____ are the traditional name for construction drawings.
35. The drawing that makes up a building's piping, valves, and switches is a(n) _____.
36. A(n) _____ is used mainly for land measurements on site plans.

## Trade Terms

Architect
Architect's scale
Architectural plans
Beam
Blueprints
Civil plans
Computer-aided drafting (CAD)
Contour lines
Detail drawings
Dimension line
Electrical plans
Elevation (EL)
Elevation drawing
Engineer
Engineer's scale
Fire protection plan
Floor plan
Foundation plan
Hidden line
HVAC
Leader
Legend
Mechanical plans
Metric scale
Not to scale (NTS)
Piping and instrumentation drawings (P&IDs)
Plumbing isometric drawing
Plumbing plans
Roof plan
Scale
Schematic
Section drawing
Specifications
Structural plans
Symbol
Title block

Cornerstone of Craftsmanship



# Jan Prakke

Lake Mechanical Contractors Inc.
Director of Safety and Training

***How did you choose a career in the construction industry?***
A friend of mine had just started his own plumbing company and needed help with a large project he landed. He called me up and asked if I would be willing to help him. I replied that I knew nothing about plumbing and asked if I would really be a help. He replied "Are you stupid?" I answered no. "Fine—I will pick you up at seven." It was my first time on a construction site and I truly enjoyed the work so much that I quit my permanent job and began a career in the plumbing industry.

***Who inspired you to enter the industry?***
There were a couple of people. My father-in-law was a career sheet metal worker in Chicago. And of course there was Tom Kissane, the plumber who hooked me into the trade. Both of these guys inspired craftsmanship, taught me to do the job right the first time, and to show pride in my work.

***What types of training have you been through?***
I have had training in the following areas:

- NCCER Apprenticeship
- NCCER Trainer
- NCCER Master Trainer
- Medical Gas Certification
- OSHA 503 Certification
- Rigging Train the Trainer Program
- Certifications earned to operate several different types of heavy equipment
- Certifications earned in several different pipe-joining methods

***How important is education and training in construction?***
If you want to succeed in any craft or profession it is always important to keep learning. The education I received in the past and plan to receive in the future will only make me a stronger asset to my company.

***How important are NCCER credentials to your career?***
The credentials I received from NCCER from my apprenticeship through the Master Trainer credential have been invaluable. It's an outstanding program with industry recognition that is unparalleled in the construction industry.

***How has training/construction impacted your life?***
The construction and training fields have impacted my life by allowing me to raise my family at a comfortable level. It has also helped me to instill in my children the discipline to do a job well the first time.

***Tell us about your present job.***
At present, I am the Director of Safety and Training for Lake Mechanical Contractors, Inc. I direct our apprenticeship program and train our field personnel on the new products and techniques that come on the market.

***What do you enjoy most about your job?***
I thoroughly enjoy teaching the apprenticeship classes. Trainees come in to the program knowing very little about plumbing, and about half-way through the program, the light comes on and they suddenly understand the terminology and know how to complete specific tasks. The questions then get more technical, and their hunger to learn more excites them as well as me.

***Would you suggest construction as a career to others? Why?***
I always tell my students about an episode of 60 Minutes on TV. The show profiled Jim Varney (the star of the movie, "Ernest Goes to Camp"). The 60 Minutes crew walked around his mansion and grounds, asking him questions about his career in acting. Once they reached the garage, they saw all of his nice cars. In the corner of the building, there was a pile of tile-setting tools, trowels, saws, etc. He explained that, prior to making it as an actor, he was a tile setter. The reporter asked why he still kept his tools. He was rich and famous—why keep them around? His reply struck home with me: "Because you never know when things will go bad. I will always have my trade to fall back on." So no matter what you do in life, you will always have a backup plan as a craftworker.

***How do you define craftsmanship?***
Craftsmanship is the work of a skillful person, done with great care and expertise; caring about what you are doing and showing pride in the finished product.

# Trade Terms Introduced in This Module

**Architect**: A qualified, licensed person who creates and designs drawings for a construction project.

**Architect's scale**: A specialized ruler used in making or measuring reduced scale drawings. The ruler is marked with a range of calibrated ratios for laying out distances, with scales indicating feet, inches, and fractions of inches. Used on drawings other than site plans.

**Architectural plans**: Drawings that show the design of the project. Also called architectural drawings.

**Beam**: A large, horizontal structural member made of concrete, steel, stone, wood, or other structural material to provide support above a large opening.

**Blueprints**: The traditional name used to describe construction drawings.

**Civil plans**: Drawings that show the location of the building on the site from an aerial view, including contours, trees, construction features, and dimensions.

**Computer-aided drafting (CAD)**: The making of a set of construction drawings with the aid of a computer.

**Contour lines**: Solid or dashed lines showing the elevation of the earth on a civil drawing.

**Detail drawings**: Enlarged views of part of a drawing used to show an area more clearly.

**Dimension line**: A line on a drawing with a measurement indicating length.

**Electrical plans**: Engineered drawings that show all electrical supply and distribution.

**Elevation (EL)**: Height above sea level, or other defined surface, usually expressed in feet or meters.

**Elevation drawing**: Side view of a building or object, showing height and width.

**Engineer**: A person who applies scientific principles in design and construction.

**Engineer's scale**: A straightedge measuring device divided uniformly into multiples of 10 divisions per inch so that drawings can be made with decimal values. Used mainly for land measurements on site plans.

**Fire protection plan**: A drawing that shows the details of the building's sprinkler system.

**Floor plan**: A drawing that provides an aerial view of the layout of each room.

**Foundation plan**: A drawing that shows the layout and elevation of the building foundation.

**Hidden line**: A dashed line showing an object obstructed from view by another object.

**HVAC**: Heating, ventilating, and air conditioning.

**Leader**: In drafting, the line on which an arrowhead is placed and used to identify a component.

**Legend**: A description of the symbols and abbreviations used in a set of drawings.

**Mechanical plans**: Engineered drawings that show the mechanical systems, such as motors and piping.

**Metric scale**: A straightedge measuring device divided into centimeters, with each centimeter divided into 10 millimeters. Usually used for architectural drawings and sometimes referred to as a metric architect's scale.

**Not to scale (NTS)**: Describes drawings that show relative positions and sizes only, without scale.

**Piping and instrumentation drawings (P&IDs)**: Schematic diagrams of a complete piping system.

**Plumbing isometric drawing**: A type of three-dimensional drawing that depicts a plumbing system.

**Plumbing plans**: Engineered drawings that show the layout for the plumbing system.

**Roof plan**: A drawing of the view of the roof from above the building.

**Scale**: The ratio between the size of a drawing of an object and the size of the actual object.

**Schematic**: A one-line drawing showing the flow path for electrical circuitry or the relationship of all parts of a system.

**Section drawing**: A cross-sectional view of a specific location, showing the inside of an object or building.

**Specifications**: Precise written presentation of the details of a plan.

**Structural plans**: A set of engineered drawings used to support the architectural design.

**Symbol**: A drawing that represents a material or component on a plan.

**Title block**: A part of a drawing sheet that includes some general information about the project.

# Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.


*Blueprint Reading for Construction*, James Fatzinger. 2003. Upper Saddle River, NJ: Prentice Hall.

*Blueprint Reading for the Construction Trades*, Peter A. Mann. 2005. Ontario, Canada: **Micro-press.com**.

*Reading Architectural Plans for Residential and Commercial Construction*, Ernest R. Weidhaas. 2001. Englewood Cliffs, NJ: Prentice Hall Career & Technology.

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Autodesk, 1 Market St, Suite 500, San Francisco, CA 94105, USA; 3D design, engineering and entertainment software and parent company of the AutoCAD software suite. **www.autodesk.com**.

Datacad, P.O. Box 815, Simsbury, CT 06070, USA. Windows-based CADD solutions. **www.datacad.com**.


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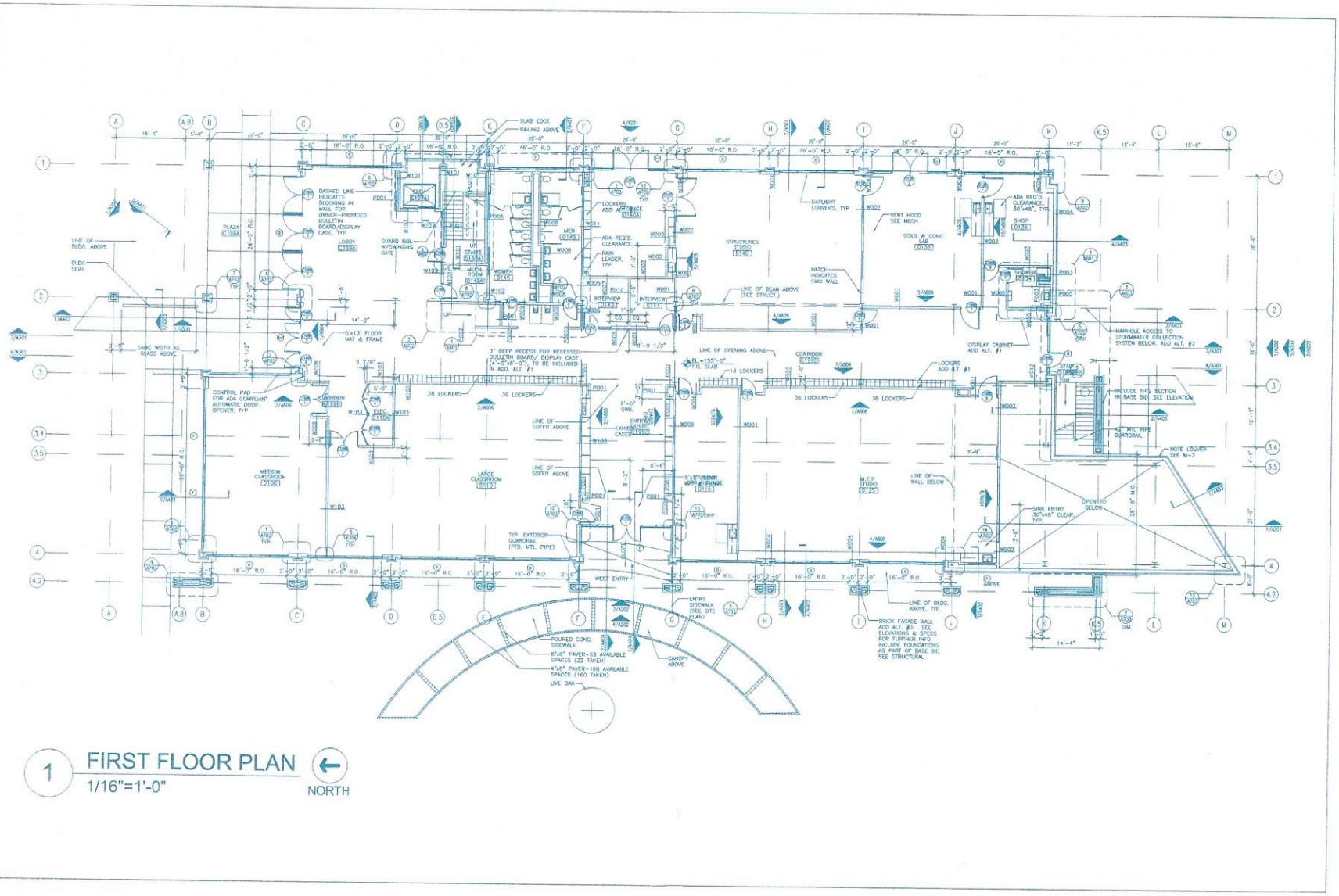
Croxton Collaborative/Gould Evans Associates, Figures 2–11, 16–19, 22–25, SA02, SA04, Construction Drawings 1-4

Colonial Webb, SA05

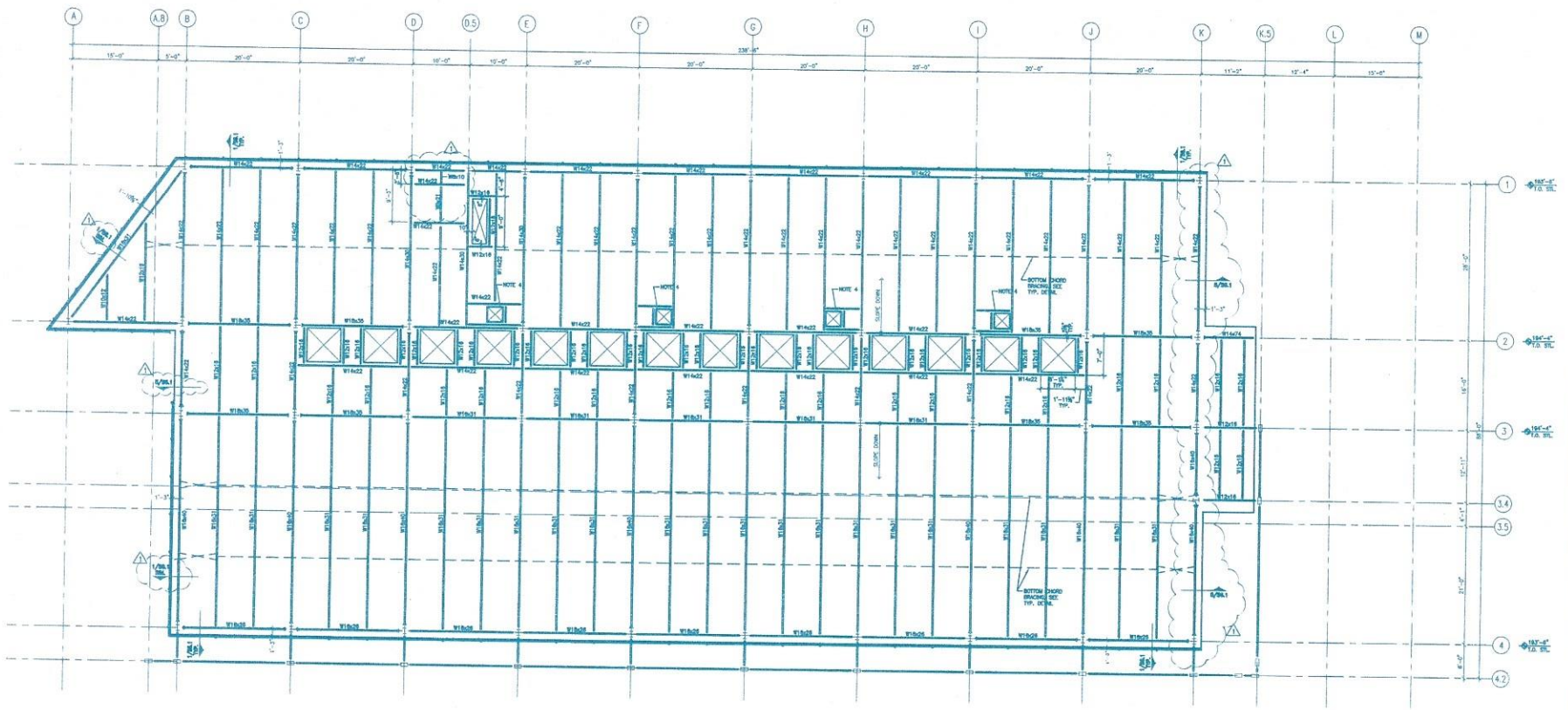
Ritterbush-Ellig-Hulsing PC, SA07

# Appendix

## Construction Drawings



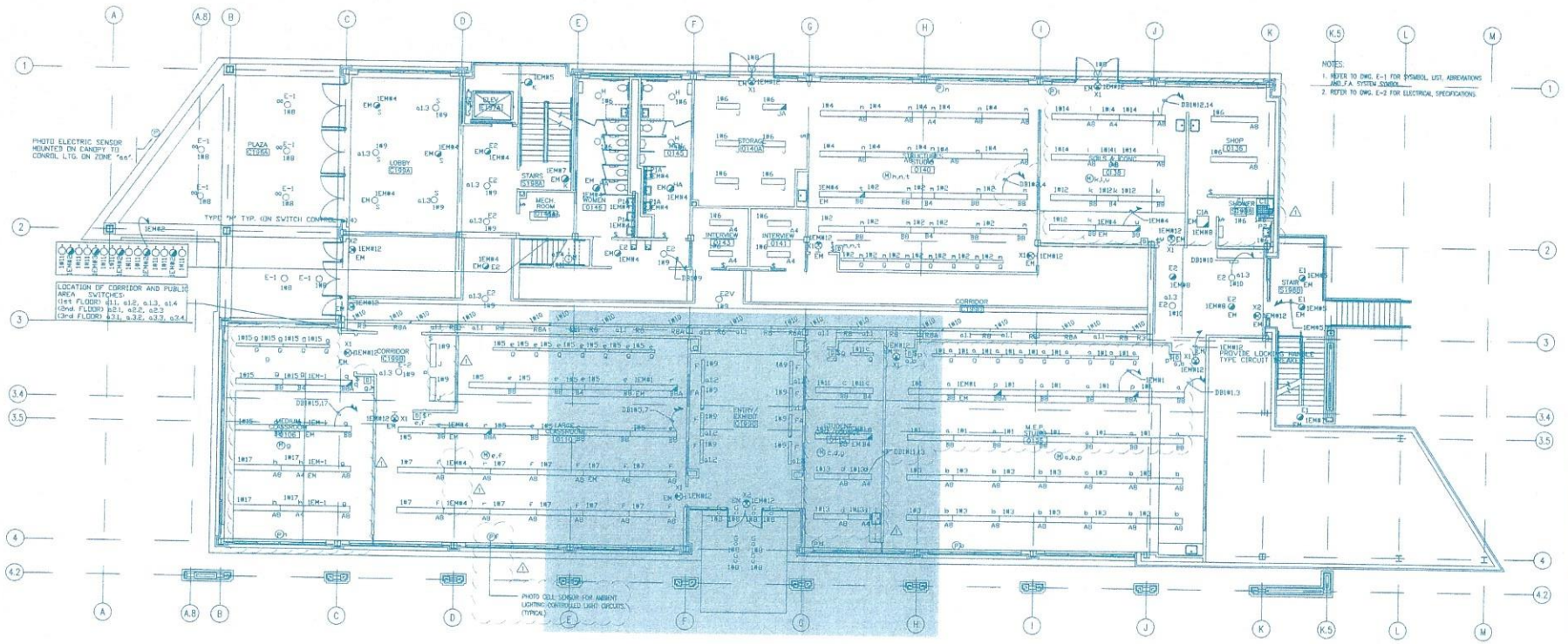

*Drawing 1,* First Floor Plan



1 1/16"=1'-0" ROOF FRAMING PLAN NORTH

*Drawing 2,* Roof Framing Plan

00105-15_BP02.EPS



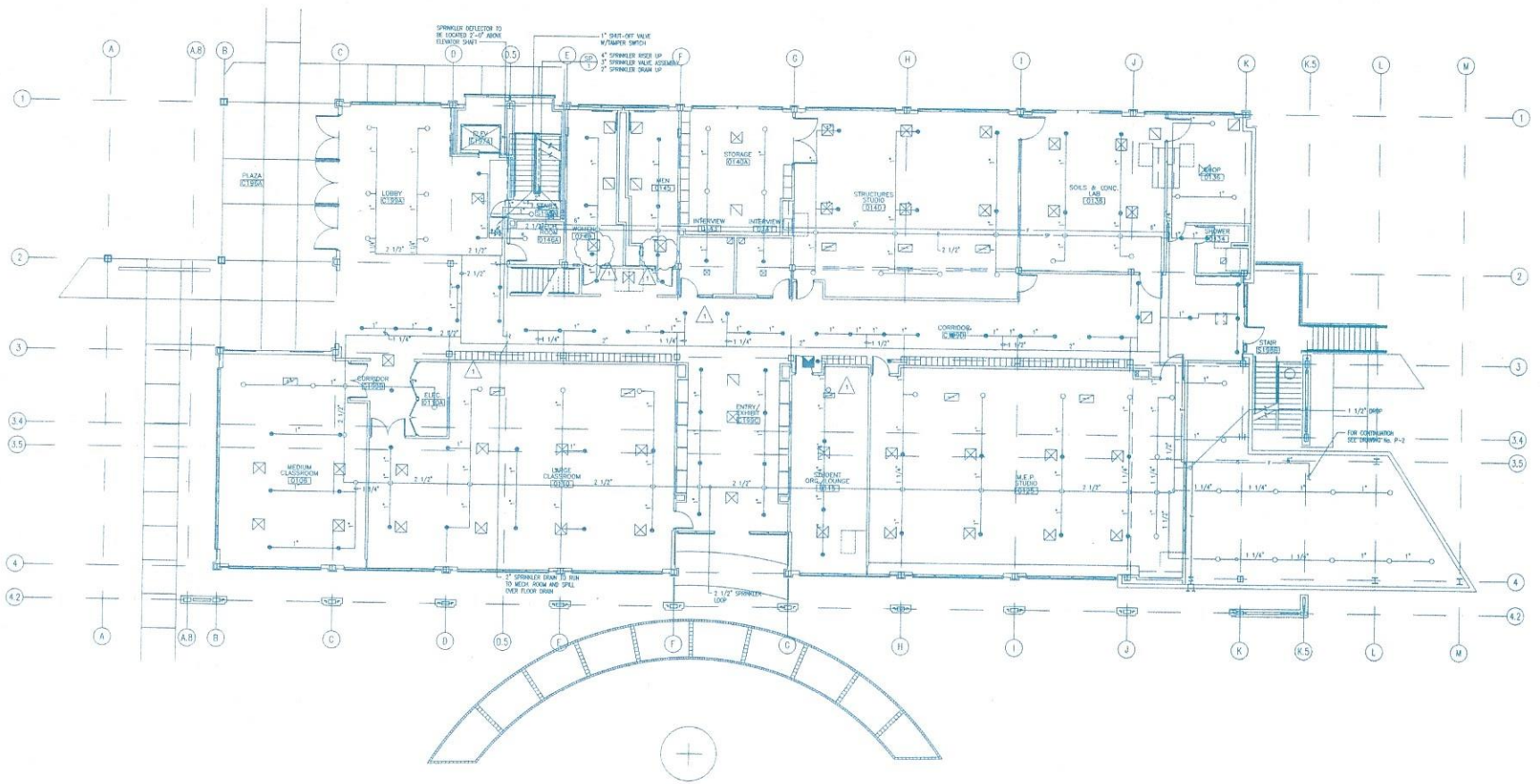

1 FIRST FLOOR LIGHTING PLAN

1/16"=1'-0"

NORTH

*Drawing 3,* First Floor Lighting Plan

00105-15_BP03.EPS




*Drawing 4,* First Floor Fire Protection Plan

00105-15_BP04.EPS