

Mercer County Community College

Arts and Communication Division

ABT 210

CONSTRUCTION DRAWINGS

COURSE DESCRIPTION

The student will produce a set of working drawings for a small commercial or industrial building. The drawings will include site, foundation floor, structural, HVAC, plumbing and electrical plans and details, along with other drawings required for the particular project. Drawings must comply with applicable federal, state, and local code requirements.

Text (s): **Reference Division Booklist**

Prerequisites: **ABT104 and ABT124**

Co-requisites:

Credits: 3

Lecture Hours: 2

Studio/Lab Hours: 2

<p>Food and Drink are Strictly prohibited in Classrooms as per Health and Safety Laws. Students may not bring in chemicals or cleaning fluids without the appropriate MSD Sheets.</p>
--

Course Coordinator: John Santosuosso

Latest Review: Fall 2004

I. GENERAL OBJECTIVES

The overall objective is to have a student take a complex problem such as the plans for a small building, from the conception to the final drawings, and persist through the various elements involved in reaching a viable conclusion.

The student is to produce a comprehensive set of working drawings for a small commercial or industrial building so as to:

- A. Become familiar with the planning and organization required on such a project.
- B. Obtain practical knowledge as to where and how to locate materials, manufacturers, and general construction information.
- C. Become aware of typical methods of construction and ways of properly representing these methods in drawings.
- D. Become adept at preparing proper or required notes, directions, and symbols on drawings.
- E. Have a basic awareness of the codes and requirements applicable by the National, State and local building authorities.
- F. Improve necessary drafting techniques required by working drawings.

II. PROJECT

A. Nature and size of the project shall be as follows:

1. A structure which will be designed for one particular venture or use.
2. Be either industrial or commercial in nature.
3. Desirable, for a profit-making venture, although governmental or institutional structures may be acceptable.
4. Project shall be moderately complex.
5. Limitations as to minimum and maximum size and complexity may be imposed by the instructor.
6. Acceptable examples of projects:
 - a) Architect' Office
 - b) Psychiatrist's Office
 - c) Bowling Alley
 - d) Contractor's Office
 - e) Photo Studio
 - f) Supermarket
 - g) Church
 - h) Clinic

B. General data required for project definition shall include:

1. Name of client
2. Description of Facility
3. Location and Address
4. Client's Agent
5. Preliminary elevations
6. Any unusual requirements
7. Preliminary elevations
8. Et cetera

C. Climatic, physical, and structural conditions for project definition shall include:

1. Site contours
2. Wind direction and velocity
3. Prevailing temperatures
4. Snow loading
5. Rainfall loads and runoff
6. Earthquake classification
7. Nature of soil
8. Frost penetration level
9. Water table data
10. Pollution restrictions
11. Buried encumbrances and easements
12. Et cetera

D. General project requirements shall conform to the following:

1. Must be an economically acceptable building based upon the use for which it is being designed.
2. Must have office space and be designed for use by both sexes. It must have separate toilet facilities for male and female employees and/or patrons.
3. Employee and patron parking must be provided.
4. Design must be so as the structure will not detract from its surroundings. It should have customer or public appeal.
5. Property may be any reasonable size for the proposed project. The client shall be considered as having full title to the land and rights-of-way.
6. Every building will be air-conditioned, at least in part.

III. DRAWINGS

General

A. General requirements of the drawings will be as follows:

1. Each drawing must show a high quality standard of workmanship--suitable for display to peers and professionals of the trade.
2. Each drawing must augment and not contradict any other in the set.
3. Each drawing must comply with the stated objectives of that drawing and overall project.
4. Each drawing must have proper notations, required dimensions, and call-outs. The title block shall be complete in all respects.
5. All drawings in a set shall be on one size and kind of drafting film. Acceptable size shall be 24" x 36", 30" x 36" or 36" x 48". All drawings shall have at least 1" border on three sides and a 2 1/2" border on the left side.
6. All drawings shall be done on good quality vellum.
7. All work shall be done in pencil with the exception of a title page, which may be ink or press-on lettering.

DRAWINGS (cont'd)

8. Drawings shall be of the scale equal to 1/4" to the 1" unless special permission is obtained from the instructor. Detail drawings shall have a scale of 1/2" = 1'-0" or larger.
9. Indicate the North arrow on all plan and site drawings.
10. Drawings shall show locations, materials, equipment, and fixtures.
11. Drawings will give details and all dimensions necessary for construction or incorporation.
12. Drawings shall show interrelations of materials, equipment, and space.

B. Floor Plan

The floor plan shall be composed of and show the following:

1. Design the floor plan for the specific purpose intended.
2. Show both male and female bathrooms.
3. Have all rooms labeled.
4. Show all windows and doors with swing. Location dimensions required.
5. All walls and structural supports shall show and be drawn to nominal scale.
6. Show toilets, sinks, tubs and showers. Show stove, refrigerator, dishwasher, and walk-in cold box if project so requires.
7. Do not show furniture or fixtures which will be supplied by the owner, but design around this furniture which must eventually be put in place before occupancy. Any item that is built-in must be shown.
8. Plans must include a mechanical room, storage or closet space, and janitorial area.

C. Site Plan

The site or plot plan shall include the following items:

1. An area shall be included, which will show the nature of the surrounding area, as well as the actual property.
2. Property lines with lengths and headings.
3. Location of stakes or monuments.
4. Show contours--existing and proposed.
5. Blocked-in outline of the proposed structure.
6. Blocked-in outline of any existing structures--on or off the property.
7. All walks, roads and parking areas shall be indicated.
8. Street centerlines, curbs, sidewalks, and storm drains must be shown.
9. Location of utilities and proposed location for the connection of them to the structure shall be drawn.
10. Show locations of manholes and fire hydrants, if existing.

Site Plan (cont'd)

11. Show all setback lines and easements.
12. North Arrow.
13. Existing and proposed landscaping.
14. Drainage of property runoff.
15. Propose drainage system for roof and parking area.

D. Foundations

Foundation drawings shall be designed according to light frame codes and show the following:

1. Foundations must extend below local frost line.
2. Width will vary according to load expected per running foot and the soil bearing capacity.
3. Pilasters and support columns must show adequate footing areas.
4. Slab floors shall have expansion joints on every side that abuts something.
5. Slab floors shall be set on or tied to the wall foundations and supported on all edges or corners.
6. Slab thickness shall conform to the codes established for the particular type of use intended.
7. Slab length to width ratio should conform to code limitations.
8. Slab floors shall be supported properly as fill tends to settle between them.
9. Provisions for plumbing, electrical service, and heating must be made before pouring on-grade slab flooring.
10. Crawl space or chase-ways should be formed along with the footings. Entrance to these areas must remain accessible.
11. Footings and/or foundations must be provided for all patios, steps, entrance pads, and air conditioner compressor mounts.
12. Dry-wall foundations shall be used where applicable.
13. Care must be observed when excavating adjacent to an existing foundation. Underpinning may be required.
14. Detail and section drawings shall be required for each separate shape or style of footing and/or foundation.
15. Reinforcing shall be shown and specified in call-outs if used.
16. Adequate dimensioning done according to standard practice will be expected.

E. Elevations

Elevation drawings shall be implemented in the best possible style of graphical workmanship and shall conform to the following:

1. The number of elevations needed to show all of the important features of the building will be necessary. If sides are similar, only one drawing will suffice.
2. Minimal dimensioning is required — overall height, length, and width, elevation of floor, ceiling and windows. Show and dimension any special feature where elevation would be hard to describe on other drawings.
3. Show all elevation sections needed to explain construction and details of dimension for each typical wall design.
4. Detail drawings shall be drawn at a scale of 1/2" to 1'- 0" or larger using actual, not nominal, sizes. Dimensioning must be complete on details.
5. Do not render the drawings. Show only minimal material representation and use call-outs to specify substances.
6. Show heavy ground or grade line. Be certain it matches your site plan.
7. Do not show below grade unless it includes some special features.
8. Show slope of all roofs, including flat roofs.
9. Do not omit gutters and leaders if they are to be incorporated.
10. Door saddles should be above grade line by a minimum of six inches.
11. Ramps should be provided for the disabled.
12. Do not show growies, but include any planting boxes which are to be provided.

F. Structural Plans

Structural floor plan shall show the material and methods by which the floor is supported and fabricated, and shall include the following:

1. Show all material, size, and exact location of all girders, beams, joists, posts, lollys, piers, and pilasters.
2. Each item shall be called out using its proper reference.
3. All openings will show framing.
4. Structural flooring must be called out and, if directional, the lay must be indicated.
5. Centerlines are all that is necessary to be shown for most supporting beams or joists.
6. On concrete floors, the direction of main reinforcing and its size should be specified.
7. The lips on which beams, joists, and concrete rests must be adequate to resist the intended load without undue strain on the member or support.
8. Any connection or detail not clear or not performed in a standard manner shall be drawn.

G. Structural Roof Plan

Structural roof plan shall show the material and methods by which the roof frame and the attached roofing is fabricated, and shall include the following:

1. Show all material, sizes, and exact location of the framework which supports the roofing materials.
2. Centerlines are required to show location of all beams, joists and stringers.
3. Call-outs of sizes could be clearly marked. Where the same size element is used repeatedly and it is obvious, the symbol "do" may be used in place of repeating the size.
4. Details of all typical connections and supports should be identified and drawn.
5. If a roof is basically the same throughout an area in one section, it may show using progressively smaller areas of the layers of each separate material required to fabricate the supporting deck and roofing.
6. Beams of the roof must be solidly supported. Block walls may not be adequate. No beam shall be placed over an opening in a supporting wall without a proper header to transmit the load to solid and adequate support.
7. Columns of pilasters supporting the upper floor or roof must agree in location with those shown on the floor and foundation plans.

H. HVAC Plans

The heating, ventilating, air conditioning, and cooling plan shall be drawn on a basic floor plan. This drawing will follow the requirement stated herein:

1. The drawing must be done using the proper and accepted symbols or any item shown. Use text and other references to locate proper symbol required.
2. The size of the heater itself will not be determined at this time; however, the distribution of heat and/or air conditioning will required good planning.
3. Location of the heater will be in the maintenance room unless other provisions are required. A "black box" shall be shown indicating the heater location. You are familiar with home heaters, so draw in a furnace of approximate size.
4. Every heating device which uses combustion to produce the heat must have an adequate flue. The chimney or stack must be constructed so as to comply with local codes and show on all drawings.
5. Show the complete system for dispersing the heat and/or cooling.
 - a) Forced hot air and A/C. All ducts and outlets shall be shown. All returns and return ducts shall show. For good results, there should be at least half as many returns as there are outlets. The minimum size duct for low velocity air should be 8" x 8" or equal. For each two to four outlets, the size of the truck duct should increase in size as it proceeds toward the source. Minimum circulation in a closed area should be enough to change the air in that room four times per hour. Each standard low velocity register is rated at approximately 500 cfm capacity.

(cont'd)

- b) Hot water or steam heat. These systems must show all piping including the returns which close the circuit. Radiators and control valves should be shown using standard symbols. Piping will be drawn using centerline indicators for position. Do not draw full size pipe, but do indicate size with call-outs.
 - c) Electric heat. Electric heat will not be allowed, except where it is considered mechanically imprudent to use the other types.
6. Separate air conditioning or cooling systems must be provided for water, steam and electrically heated buildings.
 7. Show location of all thermostats or control devices, but not indicate their wiring.
 8. All heating and/or A/C installations must be accomplished in a manner as not to damage or destroy the structural integrity of the building.
 9. The heating and A/C installations are used for the comfort of the building occupants; therefore, placement of any unit or outlet must be located with effective comfort in mind.

I. Plumbing Plans

The plumbing drawings shall include and be implemented in the following manner:

1. Show the desired location, size, and type of all water, drainage, waste, and vent piping. They may also show special piping such as sprinkler or gas and other fuel lines.
2. The number of fixtures and the size of their connecting piping shall be governed by local codes.
3. The plumbing drawings consist mainly of two major parts: The water disposal system and the fresh water distribution system. To illustrate to the master plumber how the system is to be arranged, two separate drawings are required.
 - a) A plan of the building will show the location of all piping and fixtures. Size, type of pipe, type of connections, fittings and all other details and call-outs shall be shown. Each pipe shall be drawn using the proper symbolic centerline for the use intended. Care must be exercised in locating the piping as to make it accessible for repair and installation. Do not show it placed in footings or running parallel under walls.

Since the area of the total plan which generally is required to show the details of the plumbing is not large, only the sections of the building needed may be drawn. However, section match points must be shown to locate the area drawn. The removed section should be drawn to a larger scale for clarity.

Plumbing Plans (cont'd)

- b) A second drawing called a “Riser Diagram” is also necessary. This is a vertical section, not drawn to scale, showing the order in which each fixture is connected to the waste system. It will indicate the slope with which the soil pipes will be installed so as to maintain proper flow and comply with local codes. This diagram will also show the vent system. Venting each fixture is required by code.

The venting system shown must be capable of being installed in the walls and headspace of the building shown in the plans. Care and practical consideration must be exercised to insure proper fabrication and installation.

The riser diagram may also show roof and floor drains. Required also will be a house trap and clean-out connection.

J. Electric Plan

The electrical plans shall include, but not be limited to, the following:

1. On the basic floor plan, all fixtures for lighting, both interior and exterior, shall be shown. Proper standard symbols are to be used.
2. All lighting switches are to be shown.
3. The wiring arrangement of the lighting and switches is to be indicated using looping lines.
4. All lighting shall be designed for the proper level of illumination for the use intended.
5. Circuits shall be indicated.
6. All service outlets and special outlets shall be located. Wiring of service outlets may be omitted unless particular arrangements would be desirable. Be sure to locate service where it will be usable and practical, especially for special equipment required in the operation of the establishment.
7. Electrical drawings may show such special wiring as telephone, intercoms, television, burglar, or other system required by owner.
8. Draw a basic electrical distribution diagram showing all proposed circuits, their terminal use, and power requirements. Indicate the size of circuit breaker required for each circuit.

K. Details

Details needed to describe the very construction by which the building is fabricated must be illustrated for the contractor in order to get the building one has designed. Contractors will generally be familiar with several methods by which a job may be accomplished. It is up to the designer to specify the method; a detail drawing is one way of specifying.

Details (cont'd)

Details herein shall be as specific and numerous as possible. They shall include, but not be limited to, the following:

1. Elevation sections necessary to show construction and material of:
 - a) footings and foundation
 - b) footings and pilasters
 - c) wall
 - d) floor
 - e) ceiling and roof
 - f) chimney and fireplace
 - g) Et cetera

2. Plans of:
 - a) columns or structural supports
 - b) inverter ceiling plans (if used)
 - c) patio, walks, and/or driveway details
 - d) Et cetera

3. Schedules for:
 - a) windows
 - b) doors
 - c) lighting fixtures
 - d) plumbing fixtures
 - e) Et cetera

IV. PROPOSED WEEKLY LECTURE AND WORK SCHEDULE:

- A. Introduction and Project Overview: Type and size of project will be outlined with general requirements and basic building codes emphasized. The student will select his project and have it approved by the instructor before proceeding.
- B. Basic discussions of floor plans including entrance, exit, safety, fire and other items will be broached. Various codes applicable will be pointed out. Floor plans in sketch form will be received and other construction information will be compiled.
- C. Special relations and general usefulness of areas will be advanced in a practical sense. Proper notation will be discussed. Floor plan will get final review and be committed to vellum.
- D. Requirements of a site or plot plan drawing will be enumerated. Thoughts on contours and drainage will be included along with safe property entrance and parking. Floor plans will be due. Work on site or plot plan will commence.
- E. Footings, foundations, piers, and support columns will be covered for simple structures. Methods by which these supports should be chosen so as to be acceptable to local inspection will be outlined. Proper representation of these supports will be demonstrated. Work will continue on site plan.
- F. Elevations will be discussed. Items necessary to the construction will be emphasized. Style of roofs will be discussed in light of access and room for the installation of HVAC and other necessities. Aesthetic values will be restricted only as to practical applications. Site plan will be due with the foundation plans next.

- G. Schedules and preparation of them will be the subject of this lecture. How and where information can be secured to make schedules more meaningful. The foundation plan will be due. Work should proceed on the elevations.
- H. Structural plans for the roof will be laid out. Review of methods for calculation and use of various roof member-sizing charts will be demonstrated. Types of roofing will be reviewed. The elevations are due with the structural roof plan next.
- I. Heating, ventilating, air conditioning, and cooling will be required only as far as how to show the systems properly on drawings and to understand some of the basic construction problems. The basic ideas of air movement will be used in illustrations. Sizing of ducts or piping but not machinery will be considered. Location of unit heaters, ducts, outlets, and general air movement will be of major importance. Work should continue on roof plan.
- J. Plumbing plans are outlined. Waste and vent lines will be sized by code and connections discussed in a practical light. The importance of vent lines and their incorporation into the structure are pointed out. Methods to size water lines will be shown as outlined or required by code. The structural roof plan is due. Work should proceed on the HVAC drawing.
- K. The items required on the plumbing plan will be drawn to the attention by illustrations. Both the plan and a schematic will be required and will necessarily be practical as well as follow the codes governing. The HVAC drawings will be due. Work should be proceeding on the plumbing plans.
- L. The electrical drawings necessary will be reviewed. Calculation for lighting and small appliance loads will be demonstrated and rules or codes for sizing wire pointed out. Circuitry will be explained in light of the electrical codes. The plumbing drawings should be ready.
- M. The actual electrical drawings will be discussed. Both plans and circuit schematic will be required. Interesting points in the local codes will be noted. Work should continue on the electrical plans and on any details that may have been previously overlooked.
- N. A discussion will be held on what should be incorporated into a complete set of working drawings emphasizing the details which make it possible to actually build the structure according to the designer's specification. Details and electrical plan should be complete.
- O. Any items which may require more attention may be covered at this time. Proper method for submitting the set of plans will be described. The completed set of drawings will be turned in for final review.

V. **EVALUATION:**

Each drawing will be reviewed and comments made on errors, omissions, and good points. Each will be examined as to the technical development in building construction knowledge demonstrated and the expertise of the drafting. The depth and accuracy of the details on each drawing will most often determine the superior grades.

Each drawing will be marked separately. The set will have a value of three such drawings and will be graded based on "can the building be constructed from these plans." Accuracy, adequate detail, and completeness, along with presentation and original thought, will make the basis for this grade.

Lack of attendance will adversely affect the final grade.