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ABSTRACT

This guide is intended for use in teaching a course to broaden students' appreciation and understanding of constructed items and the construction process. The course focuses on the steps that are taken after the design and engineering phase has been completed. Laboratory assignments allow students to explore the technical processes involved in the construction process. The first two sections discuss the guide's development within the framework of North Carolina's efforts to improve technological literacy and the guide's place as part of an instructional system. A list of the course's major objectives and a course outline are provided next. The remainder of the guide consists of learning modules on the following topics: main types of structures and main steps in the construction process, managing a construction project, preparing to build a structure, building the basic structure, installing mechanical systems, finishing the structure, constructing high-rise structures, preparing to build civil structures, and building civil structures. Each module includes information about the length of time needed to complete the module, an introduction to the instructional content to be covered in class, performance objectives, a day-by-day outline of student learning activities, and lists of suggested textbooks and references. (MN)

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ACKNOWLEDGEMENTS

The North Carolina Technology Education Curriculum is the product of a curriculum redirection process begun in the early seventies. As in any change process, many individuals have contributed their time and energies to provide North Carolina students with a curriculum designed to meet their needs to be technologically literate adult citizens. The following are recognized for their vision and leadership in setting the direction for Technology Education in North Carolina schools.

Members of the N.C. Curriculum Study Taskforce who charted the course for technology education in North Carolina schools. Their study report and recommendations provided the direction for a change in the identity of the discipline and a total redirection of the curriculum.

Members of the N.C. Curriculum Committee who validated the Technology Education Curriculum Guide as appropriate study for assisting students in understanding technological systems impacting on their lives. Further, industry representatives of the committee verified the appropriateness of suggested activities reflective of practices in construction, communications, manufacturing, and transportation.

N.C. Technology Education Association who provided a forum for redirection of the discipline. It was the association that led the profession in changing identity to technology education. The association also provided opportunities for professionals to develop competence in the classroom delivery of technology education through the sponsorship of in-service programs.

Individual technology education professionals who gave leadership to other professionals in the curriculum change process. These professional leaders piloted many technology education activities in their classrooms and served as role models for other professionals.

Members of the N.C. Council of Technology Teacher Educators who provided insite and support throughout the curriculum redirection process.

Indiana curriculum developers who provided curriculum materials adopted and adapted for North Carolina Technology Education programs.

INTRODUCTION

The North Carolina Technology Education Curriculum is a program to meet every citizen's need to be technologically literate. Some basic assumptions underlie the program, and these can be divided into content assumptions, and learner assumptions.

The curriculum was developed using the belief that the appropriate content for the field is technology, and its impact on individuals and society. It was further assumed that the content is best organized around human productive systems that have been used, are now being used, and will, most likely, continue to be used. These universal systems are communication, construction, manufacturing, and transportation. Finally, it was assumed that this content can best be addressed from a systems approach with its inputs, processes, outputs, feedback, and goals/restraints.

The curriculum was further based on the assumption that education should meet the needs of individuals and the human requirements of society. It was assumed that each person living in a technological society should have a basic understanding of and the ability to assimilate the knowledge about technology. People it was assumed, should be able to interact with the technological nature of society and help impact the type of future new technologies can provide. Additionally people should be able to be contributors to a society in their several roles, including citizen, voter, investor, consumer, worker, and leader.

These assumptions caused the curriculum to be developed in such a way as to:

1. Provide an overview of technology first, allow for more indepth study in specific technological areas, and culminate with synthesis activities.

2. Be more teacher-directed, content-centered in early courses, and highly, student-directed, process centered in advanced courses.

3. Involve problem-solving and group activities of all courses.

4. Stress the how and why of technology and its relationship to our quality of life.

5. Be activity-centered learning, with the content being used to determine the appropriateness of each activity selected.

6. Be equally important to young women and young men, both of which must function in a technological society.

Finally, the curriculum was developed to be descriptive rather than prescriptive. The materials describe what to teach and suggest ways of teaching the content. At no time are daily activities prescribed in such a way to preclude individualizing the presentations to meet local conditions.

THE CURRICULUM GUIDE IN AN INSTRUCTIONAL SYSTEM

Each course in the North Carolina Technology Education Curriculum is seen as a dynamic activity involving a complete instruction system. This system generally includes seven components: the teacher, the students, a texbook when available, the curriculum guide, laboratory sheets, apparatus, and a reference library.

THE TEACHER

The teacher plays the primary role in the system. This role entails being a curriculum developer. The teacher chooses the points to emphasize and to evaluate. Care should be taken to insure that the coverage of the subject is comprehensive. You should resist "picking and choosing" only modules and activities that are the most interesting, most familiar, or the easiest to implement. All modules and activities should be included. However, you are encouraged to redesign or replace activities with your own activities that contain equivalent content.

As a technical expert, the teacher gives presentations, demonstrations, and asks questions about the subject matter. Safety information, and the demonstration of teaching/learining activities, are the responsibility of the teacher.

The teacher is an instruction manager. Managers plan, schedule, direct, and control activities. The teacher, perhaps in cooperation with students, plan the instruction by identifying the instructional goals. The activities to reach these goals are scheduled. Through presentations and application activities students are directed through the construction activities. Finally, the student's work and the teacher's management is controlled through various forms of evaluation. Since evaluation instruments should be designed to measure success in reaching the goals, these instruments should be prepared by the teacher.

The teacher is the creator of the teaching/learning environment. It is highly recommended that you create a "role playing" environment. In addition to having students do tasks that simulate construction, have them play the role of workers, managers, and owners. For example, refer to a group of students as a "work crew" or "survey party" with job titles, rather than as students who carry out assigned tasks. Help them visualize themselves in their roles. The teacher can become a job superintendent, owner, or government officer, who approves the "work crew's" job.

THE STUDENT

The target population is made up of middle-junior high or high school students. The students will often work in groups of from three to five. Their responsibilities include reading the textbook assignments, doing the worksheets as homework, and completing the activities.

THE TEXBOOK

A textbook should be selected for the course and each student should have one. A textbook contains the body of knowledge about industrial technology. It should be selected to meet the appropriate reading level, and be written in an interesting way with numerous illustrations.

THE CURRICULUM GUIDE

The curriculum guide is to be used to help plan your instruction. The introduction consists of a structure for the content and a description of an instructional system with suggestions on how to use it.

The remainder of the curriculum guide briefly describes the modules. Each module consists of an introduction, objective(s), and a description of the activities. The description of the activities includes a schedule, presentation titles, application activities, and presentation titles, references, and safety guidelines. Suggestions for getting prepared and carrying out the activity are found in the teacher activity sections.

Suggestions for a variety of optional activities may also be found throughout the curriculum guide.

THE APPARATUS

Often the course guide contains plans for specialized apparatus useful in teaching the course. Drawings will be placed with the activity in which they are used. You can use the drawings to construct the apparatus.

THE REFERENCE LIBRARY

Some courses require student reference books. The titles of these are included in the reference library and copies should be purchased for laboratory use.

DAILY LESSON PLANS AND EVALUATION

The planning of daily activities and an on going evaluation system are th teacher's responsibility and rightfully so. Each student should adapt activities and presentations to insure they help students develop the identified concepts within local conditions. The curriculum guide was designed to help you, the local professional, present a relevant, exciting course. Good luck!

INTRODUCTION

This course attempts to broaden a student's appreciation and understanding of constructed items such as roadways, low and high-rise buildings, tunnels, bridges, dams, towers, and other structures. While these structures differ in size and use, they are generally built following a set process. The study of the construction process is important in developing a knowledge about our constructed environment.

In today's world, all constructed projects may be grouped into one of four simple categories; these include residential, commercial, industrial, and civil projects. A residential structure is designed for human habitation while commercial buildings contain various types of business enterprises. Industrial projects vary by use and, therefore, include perhaps the widest assortment (size, shape, function, etc.) of structures. Civil projects are quite common; roadways, pipelines, and dams are just three examples of numerous ventures grouped into this category.

Generally, structures and/or projects are planned well in advance of the construction phase. This course focuses on the steps that follow the design and engineering phase including: preparing the site, setting foundations, building the superstructure, installing mechanical systems, closing and finishing the structure, and completion of the project. Course activities also cover methods of managing the project (including scheduling and monitoring the project). Laboratory assignments allow students to explore the technical processes involved in the construction process.

Students will benefit from this study of constructed projects through presentations and activities. Construction is a major industry in our society and it has a major impact in our economic, environmental, and social climate.

OBJECTIVES

This course attempts to broaden the students' appreciation and knowledge associated with the building of structures. As a result of the experiences in this course, students are expected to:

1. Have considerably increased their knowledge and appreciation for a broad scope of structures found in our society.

2. Be able to interpret contract working drawings and specifications for a variety of structures.

3. Understand management, and experience a variety of construction management activities.

4. Gain knowledge and experience with the characteristics and uses of a variety of construction materials.

5. Have an understanding of the tools and techniques used in construction.

6. Experience the installation of selected construction utility systems.

7. Experience the construction of a variety of structures through researching, practicing selected processes, building a model(s), and making a presentation.

8. Be able to describe a variety of structures in terms of the forces acting on them and how foundations and superstructures are constructed to sustain them.

9. Be able to identify and describe certain social and environmental impacts of built structures.

COURSE OUTLINE

Module Number	Title and Content	Time (Days)
1.	Introduction to Constructing Structures The laboratory, materials, and tools Introduction to types of structures Processing steps in construction	5
2.	Managing a Construction Project Interpreting construction documents Contracting Scheduling work and resources	6
3.	Preparing to Build a Structure Preparing the site Laying out the site	10
4.	Building the Basic Structure Foundation systems Floor systems Wall systems Roof systems Enclosing the structure	15
5.	Installing Mechanical Systems Transportation systems HVAC systems Plumbing systems Electrical power systems Communication systems	5
6.	Finishing the Structure Exterior finishing Interior finishing	8
7.	Constructing High-rise Structures Foundation systems Frame systems Utility systems	12
8.	Preparing to Build Civil Structures Scheduling construction Preparing and laying out the site	4
9.	Building Civil Structures Foundations Superstructures Finishing the project	15

MODULE: 1 : Introduction to Constructing Structures

LENGTH: 5 DAYS Construction CLUSTER

This course is concerned with building structures. Students are first introduced to the kinds of structures and what categories into which they will be placed in the confines of the course.

Students will also be introduced to the processing steps for the building of any structure.

OBJECTIVES

Having completed this module, students should be able to:

1. Recall the tools and techniques used in the Introduction to Construction course.

2. Analyze a variety of structures in terms of kinds, purposes served, and human needs met.

3. Identify the processing stages for building structures and briefly explain each.

CALENDAR

DAY	ACTIVITY
1	Complete necessary paperwork to start the class. Review tools and techniques learned in the prerequisite course, Introduction to Construction.
2	Introduce the major categories of structures: low-rise, high-rise, and civil structures. This may be a review for some students, but it is useful and should be completed.
3-5	Introduce the processing stages for building structures. Much time is spent here to insure that the students can follow the logical steps needed to complete a construction project.

DAY	ACTIVITY
1	Complete the necessary administrative paperwork to start the class. Review of tools and techniques learned in the introduction course. Suggested activity: Have all tools used gathered in one area in the room. Students must select one tool, or machine, and describe its use to the class. Tools left after the entire class has participated may be described for extra credit. Building materials may also be used in this activity. Safety should also be reviewed here.
2	Present the major categories of structures and give some examples of each. This may be a review. Suggested activity: Students should bring newspapers, magazines, and/or books that contain pictures of various structures. Have them identify which category the structures belong under. Students can then use the pictures to make a display board for the construction laboratory. NOTE: Have pictures of your own available for the students who refuse to collect materials for homework.
3-5	Introduce processing stages for building structures. Suggested activity: Describe the main steps and substages of a construction project. Then show a film and have students describe the steps they see. OR Have students describe a construction project, listing in order, the steps needed to finish the project. OR A field trip to various construction sites would be good here. Students could see work in various stages of completion on different kinds of structures.

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TEXTBOOKS

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Lux, Donald G., et.al., World of Construction. (Fifth Edition). McKnight Publishing Co., 1982, pp. 14-18.

APPENDIX

INSTRUCTIONAL MATERIALS:

I. Teacher-made slide series and/or large pictures showing the kinds of construction; also, filmstrip "How Construction Meets Your Needs" from World of Construction series from McKnight.

II. Lesson for construction processing steps

A. Orientation - in this lesson you will learn:
1. Construction processing steps.

B. Development
1. Presentation
a. Building structures
(1) Prepare to build
(2) Do earth work
(3) Build foundation
(4) Build superstructure
(5) Enclose structures
b. Installing systems
(1) Install transportation system
(2) Install climate control system
(3) Install plumbing system
(4) Install electrical system
(5) Install communication system
c. Finish project
(1) Insulate
(2) Enclose interior
(3) Finish structure
(4) Landscape site
2. Application
a. Show overhead of above and discuss.
b. Give illustration of each.

III. Follow-up

C. What are the construction processing steps?

MODULE: 2 : Managing a Construction Project

LENGTH: 6 DAYS Construction CLUSTER

For a complete understanding of the construction industry, a study of management should be incorporated into the course. This module will introduce students to construction management, both hierarchy and tasks.

Students will also learn about construction documents, especially working drawings. An understanding of managerial paperwork will increase the students' understanding of the industry.

OBJECTIVES

Upon completing this module, the students should be able to:

1. Understand the basics of construction documents.
2. Interpret working drawings.
3. Identify the different tasks construction management undertakes.
4. Complete a variety of basic construction management tasks.

CALENDAR

DAY	ACTIVITY
1-3	Present a management function chart. Have students complete a variety of construction management tasks.
4-6	Present the kinds of drawings that make up a set of working drawings. Present a set of standard legend symbols for construction and give illustrations of use from actual sets of drawings.

DAY	ACTIVITY
1-3	Present a management functions chart and interpret each element giving illustrations of each. Have students complete tasks that will help them understand the functions.

Suggested activities: Students schedule the tasks needed to complete a small construction job. They should be aware of the CPM and bar chart methods, but they can choose either method to schedule a job of their choice. Some jobs are installing a mailbox, installing a basketball post and goal, preparing, forming, and placing concrete for a sidewalk, or building a doghouse. Students may then present their schedules to the class for verification of a logical sequence of order.

Have students participate in a hiring simulation activity where company personnel managers interview and hire various craftsmen and professionals (see WOC hiring activity).

Critique the activity and relate to students some of the questions and occurences of actual interviews.

Have students participate in an inspection activity. They could inspect the school for needed corrections and improvements, or inspect their own homes.

Have students write a contract for a simple construction job.

4-6 Present a set of actual working drawings to the class. Describe the types of drawings and explain the views they represent. Have students try to visualize the building as if they were walking through it.

Contract a set of working drawings for a large project, (your school), with a set of drawings for a smaller project, like a home.

Using an acquired real specification document, point out the included kinds of contract documents as well as examples of specifications. Using a typical set of contract working drawings, (your school), explain the legend of symbols that are used. Point out that most of the symbols are standard symbols used on any set of construction drawings. Acquire a set of drawings for a bridge, dam, or highway and contrast with the set of building drawings. Point out a representative sample of symbol application. Develop an activity guide which directs students to interpret the use of a variety of architectural symbols and engineering symbols. Collect the completed guides and check for print reading problems.

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Henak, Richard M., Exploring Construction. Goodheart-Willcox Co., South Holland, IL, 1985, pp. 73-89, 105, 108, 82, 111, 289.

Landers, Jack M., Construction: Materials, Methods, Careers. Goodheart-Willcox Co., South Holland, IL, 1983, pp. 70, 81, 95, 104, 110.

Lux, Donald, et.al., World of Construction. (Fifth Edition). McKnight Publishing Co., Bloomington, IL, 1982, pp. 7, 78, 84-102, 114, 128, 282.

APPENDIX

INSTRUCTIONAL MATERIALS:

I. Student activity guides for scheduling, writing specifications, hiring simulations, and inspection, designed by the teacher or modified from the World of Construction teacher's guide, and student activity booklet.

II. Teacher-collected local construction firm organizational chart, set of contract working drawings, specification documents.

III. Teacher-collected local construction firm organizational chart, set of contract working drawings, specification documents.

IV. Lesson for presenting management functions:

A. Orientation - in this lesson you will learn:
   1. What the functions of management are
   2. How to briefly describe each function and give examples of each
   3. Management activities.

B. Development
   1. Presentation
      a. Owner
      b. President
         (1) Engineering
         (2) Labor relations
         (3) Production
         (4) Financial affairs
         (5) Marketing
      c. Project manager - home office
      d. Superintendents - on site
         (1) Field engineers
         (2) Supervisors-workers
         (3) Clerks
         (4) Subcontractor
   2. Application
      a. Discuss management
      b. Management flow chart
      c. Handout from Chapter 10.

C. Follow-up

   1. What are the functions of management?
   2. Briefly describe each and give examples.

V. Lesson for presenting specifications.

A. Orientation
   1. Why are construction specifications needed?
   2. Learn the process professionals use to write specifications.

B. Development
   1. Presentation
      a. Specifications
         (1) Example of specifications used by contractors
         (2) Work through writing a set of specifications
         (3) Worksheet to write a set of specifications
   2. Application
      a. Writing specifications
         (1) Write a set of specifications for classroom door and outside doors.

C. Follow-up
   1. Why are construction specifications needed?
   2. List five examples of criteria used to write construction specifications.

MODULE: 3 : Preparing to Build a Structure

LENGTH: 10 DAYS Construction CLUSTER

Before a structure can be built, it must be correctly located and laid out on the prepared site. This module will introduce students to the transit and techniques involved with the tools. Site preparation processes will also be discussed in this module.

OBJECTIVES

Upon completing this module, the students will be able to:

1. Make appropriate decisions and utilize appropriate machines and methods regarding the clearing and preparation of a building construction site.

2. Describe the transit and its related tools.

3. Use a transit to layout a construction site.

CALENDAR

DAY	ACTIVITY
1	Present a topographic map or 3-D map of a proposed site to be prepared. Discuss types, and functions, and uses of common earthmoving equipment for the proposed site. Describe site preparation processes.
2	Discuss the function and use of the transit and layout technique. Assign two student activities, one as an earthmoving problem concerning the proposed site, the other as a layout problem using a transit.
3-10	Students will work on the activities in groups, switching activities until they complete both assignments.

DAY	ACTIVITY
1	Present a topographic map of the original site showing a small hill, old building(s), rock debris, fence and trees (some of lumber quality). If a map is not available, select a site on the school grounds that has some of these features. Discuss the topographical features with the class. Describe the types, functions, and uses of earthmoving equipment.
2	Describe the transit and its related tools. Discuss the function and use, and demonstrate, a basic layout technique using batterboards. Present student activities in both site preparation and layout areas. Suggested activities: Assign class the problem of clearing and preparing the site according to a given site plan showing new contour lines and new structure location. Identify various management positions and decisions to be made (use a 3 x 5 card). Do the same for operators, craftsmen, and laborers (superintendent, heavy equipment operators, surveyor, truck driver, laborers). Could involve cost analysis—heavy equipment rental, cost of moving required volume of earth, labor time for moving debris, fence, etc. Students repeat demonstration on use of transit to layout batterboards for a simple structure. If a transit is not available at your school, local surveyors are willing to speak to help get their trade recognized. Some surveyors also lend equipment and help with individual instruction. The use of a 4' level and a rifle scope is a good simulation of a transit. The students should know proper transit techniques before applying them to this type of setup.
3-10	Students work on activities in small groups, switching activities until they complete both assignments.

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Landers, Jack M., Construction - Materials, Methods, Careers. Goodheart-Willcox Co., South Holland, IL, 1983, pp. 259.

Lux, Donald G., et.al., World of Construction. (Fifth Edition). McKnight Publishing Co., Bloomington, IL, 1982, pp. 19-35, 159.

APPENDIX

1. Teacher needs to obtain a topographic map of an unprepared site and a transit.

2. Set up time when a local surveyor can talk to your class.

MODULE: 4 : Building the Basic Structure

LENGTH: 15 DAYS Construction CLUSTER

This module deals with the construction of a variety of low-rise structures. Students study bearing wall, column and beam, pneumatic, tensile, cantilever, and dome-type structures, to learn how they are alike and different, the key construction and stress characteristics, appropriate materials, construction techniques, and aesthetic appeal. Materials are studied and selected skills are practiced. Problems relating to foundations, concrete design, erecting substructures, and completing a structure, are involved.

The major activity during this (and the next two) modules is the construction of a utility shed. During the construction project, students will break off into groups to complete other activities until all students have participated in the shed construction and other activities.

OBJECTIVES

Upon completing this module, the student should be able to:

1. Identify and describe a variety of foundation systems and give illustrations where each may be used.
2. Describe various methods of constructing floor systems.
3. Identify and describe a variety of wall systems and give illustrations where each may be used.
4. Identify and describe a variety of roof systems.
5. List advantages and disadvantages of a variety of construction methods for different geographical regions.
6. Differentiate among a variety of types of low-rise structures including bearing wall, column and beam, pneumatic, cantilever, and tensile.
7. Practice selected masonry, concrete, carpentry and drywall techniques.
8. Construct a small utility shed.

CALENDAR

DAY	ACTIVITY
1	Present plans for utility shed. Introduce materials to be used.
2	Discuss foundation systems. Demonstrate use of concrete blocks for the laying of foundation walls.
3-4	Have groups of students start to construct the foundation and floor system on the utility shed, while other groups participate in concrete block laying activity.
5	Define superstructures. Identify and discuss a variety of low-rise buildings.
	Students work on shed and block activities.
6	Introduce and discuss floor systems.
	Students work on shed and finish block laying activity.
7	Discuss wall systems. Student groups should construct a wall section to be used for later activities. Each group should have a different type of wall section.
8-9	Students should finish wall section, and erect the walls on the utility shed.
10	Discuss roof systems. Start constructing roof system for utility shed.
11	Discuss methods of enclosing low-rise structures.
12-15	Students should erect roof trusses and enclose roof on utility shed.

DAY	ACTIVITY
1	Present plans for utility shed. Discuss the foundation and floor system construction method for the project. Show students the materials that will be used and describe the first steps in construction.
2	Discuss foundation systems including continuous wall, piers, pilings, wood foundations, etc. Demonstrate a method of foundation construction. The use of concrete blocks for laying a corner section is a good activity for demonstration.
3-4	Students should be separated into groups. One group should start the construction of the foundation and floor of the utility shed. The other group(s) should participate in the concrete block laying activity (or other foundation construction activity). The groups will switch until all students have worked on the foundation activity, and the foundation and floor of the utility shed is finished.
5	Define superstructures and compare them with substructures (foundations). Identify and discuss a variety of low-rise buildings including bearing wall, column and beam, pneumatic, tensile, cantilever, and dome-type structures. Students work on foundation activities.
6	Discuss floor systems including trusses and joists. A discussion on the types and quality of lumber and plywood should be undertaken here. Students should finish foundation activities.
7	Discuss wall systems for low-rise structures. Introduce various types of framed walls for different purposes such as sound insulation or environment insulation. Student groups should start to construct a wall section (separate from the utility shed) to be used in later activities. Greater benefit would come from each group having a different type of wall section.

DAY	ACTIVITY
8-9	Student groups should finish their wall sections and erect the walls on the utility shed.
10	Present information on roof systems, compare different roof styles used on different low-rise structures. Introduce the various types of roof trusses and their application. Students should start constructing roof system for utility shed.
11	Present methods of enclosing low-rise structures. There is a lot of information on prefabricated wall systems with enclosures available from construction companies. This would help to tie enclosures and actual wall systems together.
12-15	Student should erect roof trusses and enclose roof on utility shed with plywood and felt paper. This is only a suggested method. There are others that you may use.

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APPENDIX

I. Plan for Presenting Foundations

A. Kinds of Foundations
1. Spread
2. Floating
3. Fiction pile
4. Bearing pile
5. Pier

B. Kinds of footings

C. Reinforcement rods

D. Forms

E. Building wood foundations

F. Waterproofing walls

G. Students complete activity sheet

II. Plan for presenting concrete block foundations

A. Presentation: Teacher Lecture - Concrete Block
1. Types of block
2. Strength
3. Tools and uses
4. Laying of concrete block
5. Finishing and curing
6. Teacher introduces bricklayer (local mason) demonstration

B. Student Activities
1. Listen and discuss lecture
2. Fill out worksheet on concrete block and tools
3. Watch demo
4. Each group will lay three courses around corner
5. Get materials
6. Lay block
7. Finish mortar joints
8. Curing (optional)
9. Cleanup

III. Presenting wood foundations

A. Presentation: Teacher Lecture - All Weather Wood Foundation
1. Can be installed in any weather
2. Wood parts are pressure treated with chemicals
   a. resist fungus (decay)
   b. resist insects
3. Subgrade is covered 4 to 6 inches layer of gravel
4. Use special rust resistant fasteners
5. Special caulking compounds
6. Plywood sheathing (treated) for siding
7. Six mil polyethylene moisture barrier
8. Treated lumber and plywood mark AWPB-FDN

MODULE: 5 : Installing Mechanical Systems

LENGTH: 5 DAYS Construction CLUSTER

This module concentrates on the installation of special systems in buildings. Systems include transportation, HVAC (heating, ventilation, air conditioning), plumbing, electrical, and communication. The wall sections that student groups built in the last module will be used in some activities to complete this module.

OBJECTIVES

Upon completing this module, the student should be able to:

1. Identify and describe the systems used in structures.

2. Understand plumbing concepts and be abie to install a basic plumbing system in a wall section.

3. Understand electrical wiring concepts and be able to install a basic electrical wiring system in a wall section.

CALENDAR

DAY	ACTIVITY
1	Discuss the mechanical systems involved in low-rise structures. Give brief overview of why and how they are used.
2-3	Present information on basic plumbing. Students should develop and install a simple plumbing system in their wall section.
4-5	Present information on basic electrical wiring. Students should develop and install a simple electrical wiring system in their wall section.

DAY	ACTIVITY
1	Present the mechanical systems that are used in low-rise structures. The ones that should be covered include: 1. Transportation systems 2. HVAC systems 3. Plumbing systems 4. Electrical systems 5. Communication systems. Give a brief overview of how and why they are used. A very good subject for this information is your own school. Arrange for the head of the maintenance department to show the students the utility rooms, and talk about the mechanical systems in the school. Simply taking down a few ceiling tiles can expose a lot of mechanical systems.
2-3	Present information on basic plumbing. Students can then develop and install a simple plumbing system in the wall section that they built in groups. It may be advisable to invite a plumbing contractor to come and speak or inspect the students' work.
4-5	Present information on basic electrical house wiring. Students can then develop and install a simple electrical system in the wall section that they built in groups. As with the plumbing unit, you could get an electrical contractor to come in and explain the concepts and/or inspect the students' work. If a simple electrical system is required in the utility shed, this would be the optimum time to install one.

BIBLIOGRAPHY

Textbook and reference materials which cover the topics in this module include the following:

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APPENDIX

1. Arrange for head of maintenance to take students on a tour of the school showing them the mechanical systems used there.

2. Contact plumbing and electrical contractors to talk to your class.

MODULE: 6 : Finishing the Structure

LENGTH: 8 DAYS Construction CLUSTER

The final step before transferring ownership of a structure is to finish the exterior and interior. On the exterior, landscaping, exterior trim, and painting are the major tasks. Interior finishing includes drywall, plaster, paint, panelling, stain, etc. Installation of cabinets and other fixtures may be included.

This module introduces the students to the tasks needed to finish the structure.

OBJECTIVES

Upon completing this module, the student should be able to:

1. Describe various methods of enclosing exteriors of low-rise buildings.
2. Describe various methods of enclosing interiors of low-rise buildings.
3. Appreciate aesthetic qualities of various finishing methods for structures.
4. Construct and finish a small utility shed.

CALENDAR

DAY	ACTIVITY
1-3	Present methods of enclosing exteriors of low-rise structures. Students should enclose the walls of the utility shed and shingle the roof.
4	Present methods of enclosing interiors of low-rise buildings. Students start to drywall one side of their wall section.
5-8	Students finish utility shed by adding trim and painting (staining) exterior. Students finish drywall activity on their wall section.

DAY	ACTIVITY
1-3	Introduce methods of enclosing low-rise structures. Have students describe the way their homes are finished on the outside. Talk about styles of house exteriors (materials) in different geographical areas. Students should then enclose the walls of the utility shed with suitable material, and finish the roof with shingles. Again, shingling is only a suggested method. There are other suitable means of enclosing a roof.
4	Introduce methods of enclosing interiors of low-rise buildings. Demonstrate the proper procedure for applying drywall. Students should then practice the technique by drywalling one side of their wall sections. If groups are large, they can finish both sides of the walls.
5-8	Students finish utility shed by adding trim and painting the exterior. Groups of students may finish drywalling their wall sections at this time.

BIBLIOGRAPHY

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Salvadori, Mario, Building. McCeaud & Stewart, Ltd., Canada, 1979.

APPENDIX

I. Plan for presenting enclosing interiors

A. Teacher Presentation: Enclosing Interiors
1. Why interiors are enclosed
   a. Hide structural members and utilities
   b. Help control the building's temperature
   c. Help control sound
   d. Provide fire protection
   e. Add beauty

2. Exterior materials (see Henak, Chapter 13, pp. 126)
   a. Sheathing
   b. Windows
   c. Doors
   d. Louvers
   e. Finished siding
   f. Cornices

3. Talk about model - give time for research

B. Student Activity

1. Listen to presentation
2. Study samples
3. Acquire materials for model
4. Begin construction

II. Presenting Drywall Information

A. Teacher Presentation: Drywall Techniques
1. Gathering materials
2. Measuring
3. Cutting
4. Installing
5. Tape joints
6. Spackle joints
7. Smooth joint tape
8. Sand
9. Safety review
10. Cleanup

B. Student Activity
1. Gather materials
2. Measuring
3. Cutting
4. Installing
5. Tape joints
6. Spackle joints
7. Smooth joint tape
8. Sand
9. Paint wall
10. Cleanup

If time permits, students can work on model.

MODULE: 7 : Constructing High-Rise Structures

LENGTH: 12 DAYS Construction CLUSTER

This module concentrates on the high-rise structure (sky scrapers). The structural integrity of such structures, and the utility systems of structures are analyzed.

Architects and engineers are fascinated with the challenge of building higher and higher skyscrapers. Chicago and New York City compete for having the world's highest building. Chicago's Sears Tower is currently the world's tallest building at 1,454 feet and 110 stories. Currently, proposals for structures 135 stories (1,535 feet), 140 stories (1,800 feet), 200 stories (2,400 feet), and 210 stories (3,000 feet), are on the drawing board. See Popular Science, December 1985, pp. 62-65, for a good analysis of super skyscrapers and why they will probably be built.

Eli Attia suggests that buildings over 70 stories become "new creatures." Horizontal wind loading is the major force on high buildings, even greater than earthquakes. Coping with congestion and the vertical movement of people and goods is a sticky problem as well. Skyscrapers have become a city unto themselves, providing space for living, working, eating, shopping, banking, and entertainment. One can imagine the logistics of supplying the 50,000 workers and 80,000 daily visitors of the World Trade Center (110 stories, 1,350 feet), a vertical city. Fourteen thousand rolls of toilet paper are consumed per day, each of which must be delivered to the appropriate floor and room.

Hopefully, students will be motivated through the study and analysis of prominent structures and the associated hands-on activity dealing with structural analysis and utility systems.

OBJECTIVES

Upon completing this module, the students should be able to:

1. Become aware of the nature, characteristics, and problems associated with high-rise structures.

2. Understand basic structural theory and build and test differing configurations of structural elements in terms of compression, tensile, and deflection force.

3. Construct various configurations of high-rise frames.

4. Describe construction techniques used in skyscraper construction and how they differ from low-rise construction techniques.

5. Identify and describe a variety of high-rise structures.

6. Understand why high-rise construction technology was developed.

CALENDAR

DAY	ACTIVITY
1	Introduce skyscrapers as high-rise buildings. Discuss how foundations for high-rise buildings differ from foundations for low-rise buildings.
2-3	Students should study selected skyscrapers individually. Students present information on the buildings they study, and class participates in a comparison of the variety of structures.
4	Introduce basic frame systems and construction techniques. Students start activity that enables them to build simple models that demonstrate these construction techniques.
5-7	Introduce beam deflection and load factors. Present activity that allows students to study these concepts. Students work in groups on models and other activities.
8	Present discussion on how utility systems differ between high and low-rise structures.
9-12	Students work in groups to complete models and other activities until all students have completed every activity.

DAY	ACTIVITY
1	Introduction of high-rise structures (skyscrapers). Discussion should include why this technology has been developed. Accumulated statistics from architectural magazines, newspapers, and books will gain student interest. If you do not have any information on skyscrapers, check the juvenile section in your local library. Often there is basic information here to get you started. A word of caution, once you get started there is a lot more pertinent, upper level information that is available, and more suitable for the high school student.
2-3	Select an activity that will help students become aware of the variety of high-rise buildings. Suggested activities: Students should study information found in libraries on selected skyscrapers. They should collect statistics about the building, techniques used in its construction, and its uses after completion. Students then give individual presentations on the information they collected. Class then participates in a comparison of the variety of structures presented. Students describe, from memory, skyscrapers that they have seen. Have them describe each building to the class. As a group, the class then should compare and contrast the variety of structures according to appearance, use, etc. Discuss foundation systems used in skyscrapers. Explain how they differ from foundation systems used in low-rise structures, and why.
4.	Introduce basic frame systems and construction techniques. Present information on steel frame, lift-slab, and core-type structures. Describe the concepts of how each is constructed and supported. Students should work in groups to complete models that demonstrate the specific construction techniques. Suggested activities: Let students develop their own model using the information you presented, and the knowledge of tools and materials in the classroom. Plans are available through CITE (Center for Implementing Technology Education) for models of each type of structure.

DAY	ACTIVITY
5-7	Introduce concept of beam deflection and load factors. Discussion should include differences between span and cantilever beam positioning and various beam shapes and compositions. Include the various types of steel beams and prestressed concrete beams used in construction. Have students relate these load factors to the style of building they are working on in model form. Present an activity that compares the strength of beams (and deflection). Suggested activity: Using a stationary dial indicator (placed against a strip of wood to represent a beam), load the beam with weight and measure the deflection. You can then turn the beam sideways, stack beams, or use different configurations and materials to test a variety of beams. This is a good visual comparison of structural members on a small scale. Students should then work in groups on models, or beam deflection activities.
8	Present information on utility systems specific to high-rise buildings, and how they differ from low-rise buildings. Include the fact that major utility lines run in vertical shafts throughout the whole building. Describe modular floor arrangement so that construction techniques will be the same from floor to floor. Information on how utility systems are incorporated into floors and ceilings to achieve maximum flexibility of items on different floors, should be included.
9-12	Students work in groups to complete models and other activities until all students have completed every activity. Arrange a field trip to a city near your school or even through the city or town your school is in. Take notice of construction techniques in old and newer buildings.

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TEXTBOOKS

The textbooks and reference materials which cover the topics in this module, include the following:

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Reid, Esmond, Understanding Buildings. MIT Press, Cambridge, MA, 1984.

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Salvadori, Mario, Why Buildings Stand Up. McGraw-Hill, 1980.

APPENDIX

I. Some objectives for skyscraper introduction

A. Know the nature, characteristics and problems found in high-rise structures such as skyscrapers.

B. Understand the vast amount of statistics associated with skyscrapers.

II. Some objectives for methods of constructing skyscrapers

A. Understand the basics of how skyscrapers are built using the theory of structures.

B. Understand different types of elements used in structures such as compression, tensile, shear, and deflection force, shape and form, size and location.

III. Some suggested objectives for structural beam theory

A. Understand and describe beam theory and how tension, compression, shear, and deflection affects the different types of materials used for structural beams.

B. Know that skyscrapers are vertical cantilever beams.

C. Understand wind loads on vertical construction.

MODULE: 8 : Preparing to Build Civil Structures

LENGTH: 4 DAYS Construction CLUSTER

Many people think only of buildings when construction is mentioned. However, it quickly becomes evident that our constructed environment consists of dams, tunnels, pipelines, towers, bridges, roadways, canals, and drilling platforms as well as buildings.

The next two modules are concerned with helping individuals become technologically literate, relative to the civil structures identified. Hopefully, after completing these modules, individuals will find it difficult to cross a bridge, a dam, or travel on an interstate without some appreciation and knowledge being experienced. The uninitiated take our constructed environment for granted. The technologically literate person understands and appreciates.

This module deals specifically with preparing for the construction of civil structures, and how this compares with the construction of other structures (buildings).

OBJECTIVES

Upon completing this module, the students should be able to:

1. Identify and describe various civil structures.
2. Understand the fundamental differences in the construction techniques between buildings and civil structures.
3. Schedule a simple, civil construction project.
4. Describe how civil construction sites are prepared.

CALENDAR

DAY	ACTIVITY
1	Present information on various types of civil structures. Discuss how scheduling activities would differ from conventional buildings.
2	Discuss how preparing and laying out a site for various civil structures differs on building construction sites.
3–4	Students participate in activities that reinforce concepts discus in the beginning of this module.

DAY	ACTIVITY
1	Introduce different types of civil structures and discuss their uses. Identify any such structures that may be in your immediate area. Be sure to include structures such as dams, tunnels, pipelines, towers, bridges, roadways, canals, drilling platforms. Discussion should include characteristics, design, evolution, materials, construction, and the associated social and environmental impacts of the various structures. Compare the method of scheduling for civil structures with the same for buildings.
2	Present information on how to prepare a construction site for civil structures. Canals, roads, and towers, are laid out on a center line, while dams and other civil structures are laid out differently. The recommended texts include little information in these areas so it would be advisable to obtain other reference sources. Check the Bibliography at the front of the course book.
3-4	Present student activities to reinforce concepts presented in the module. Suggested activities: Give presentations on how to schedule the tasks for various civil structures. The students could list the tasks for a variety of structures (compare and contrast them). Describe earthmoving activities for a proposed civil structure (of the student's choice) somewhere on the school property. Calculate amounts of earth to be moved to provide cuts and fills for hypothetical sections of roadway. Develop a model (before and after) showing the topography of a civil structure site. Structure could be chosen by the student. Students could continue to work on the activities for the remainder of the module.

BIBLIOGRAPHY

TEXTBOOKS

The textbooks and reference materials which cover the topics in this module include the following:

Bets, et.al., Exploring the Construction Industry. Teacher's Guide. McKnight Publishing Co., Bloomington, IL, 1973.

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O'Connor, Colin,, Design of Bridge Superstructures. John Wiley, 1971.

Sandak, Cass, Dams. Franklin Watts, NY, 1983.

Wahlstrom, Ernest, Dams, Dam Foundations, and Reservoir Sites. Elsevier Scientific Publishing Co., NY, 1974.

APPENDIX

Suggested activity for studying civil structures. This activity may be undertaken through both the civil structure models.

I. Orientation - in this lesson you will learn about:

- A. Components of your group project
- B. Guidelines for the group project
- C. Schedule of the activities
- D. Project reviews.

II. Development

- A. Presentation
  1. What is a group project?
     - a. Six groups of 2-5 per group
     - b. Research and report on one kind of civil structure
     - c. Individual responsibility/accountability
     - d. Group grade
  2. What is studied?
     - a. Bridges
     - b. Roadways
     - c. Pipelines
     - d. Tunnels
     - e. Towers
     - f. Dams
  3. What do we do?
     - a. Make a visual display (1/group)
     - b. Construct a scale model in an environment (1/person). (Fits into display to show broader or narrower aspect)
     - c. Written report on area of study (1/group)
       - (1) Brief history
       - (2) Present status
       - (3) Description of model
       - (4) Newest technology
       - (5) Social and environmental impacts
  4. How do we complete the project?
     - a. Work in groups
     - b. Periodic project review
       - (1) Weekly seminars
       - (2) Report progress
       - (3) Request help on problems
       - (4) Maintain work schedule
     - c. Group presentation
       - (1) ALL members involved
       - (2) Overview of written assignment
       - (3) Use visuals when appropriate

III. Application

A. Establish groups
B. Assessing/select civil structure
C. Groups meet
   1. Begin organizational work
   2. Establish responsibility/accountability
D. Provide presentation date
E. Distribute project review schedule

MODULE: 9 : Building Civil Structures

LENGTH: 15 DAYS Construction CLUSTER

Now that students are aware of civil structures, and what types there are, we should study the construction techniques themselves. These structures greatly differ from ones studied earlier in the course, although some of the materials and construction techniques are similar.

This module will allow students to study the actual construction methods for civil structures.

OBJECTIVES

Upon completing this module, the students should be able to:

1. Develop an appreciation for the various types of civil structures and the impact of each on our lives.

2. Identify and describe various types of bridges, their characteristics, evolution, design, and construction.

3. Describe the various kinds of highways and pipelines in terms of function, materials, operation, construction, and protection.

4. Differentiate among a network of pipelines in terms of function, materials, operation, construction, and protection.

5. Identify and describe various types of dams, their characteristics, purposes, evolution, design, operation, and construction.

6. Describe the various types and functions of tunnels and how they are constructed.

7. Describe the various types and functions of towers and how they are constructed.

8. Build a model and display of a selected civil structure.

CALENDAR

DAY	ACTIVITY
1	Describe foundation systems for civil structures. Introduce major activity for the module. Suggested activity is a scale model of a civil construction project.
2-5	Students work on research and models.
6	Present information on superstructures of civil structure.
7-10	Students work on models.
11	Present information on the tasks needed to finish a civil construction project.
12-13	Students finish work on models.
14-15	Student presentations on civil structure models.

PRESENTING THE MODULE

DAY	ACTIVITY
1	Describe the foundation systems used in various civil structures. Differentiate between substructures and superstructures in civil projects and buildings. Introduce major activity to be undertaken during this model. A suggested activity is to build a scale model of a civil construction project. A good place to start is with a 4' x 4' box filled with soil and an irregular topography. This will provide a chance to prepare the site, and provide an activity that is realistic, yet practical. Students should research the civil projects before starting the models.
2-5	Students work on research and models. They should produce their foundations for the various projects using techniques found in civil construction. An indepth study of reinforced concrete and/or a modular, structural section (for towers and pipelines) could be undertaken during this time.
6	Present information on superstructure of civil projects. Students should share information they have learned while researching their model.
7-10	Students continue to work on models.
11	Present information on the tasks needed to finish a civil construction project. How do these processes differ from high-rise or low-rise construction projects.
12-13	Students finish work on civil construction project.
14-15	Student presentations on civil structure models.

BIBLIOGRAPHY

TEXTBOOKS

The textbooks and reference materials which cover the topics in this module, include the following:

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