

**Davison Community Schools**  
**ADVISORY CURRICULUM COUNCIL**  
**I/II/III 13APR16**

***Civil Engineering and Architecture (CEA)***

**Course Essential Questions (from Phase I report):**

1. How did the art and science of architecture and civil engineering evolve over time?
2. How are visual design elements and principles manifested in architecture?
3. What are the advantages and disadvantages of using 3D architectural software rather than creating hand-produced plans?
4. How do you achieve a balance between cost-saving measures, important features, and environmental responsibility when designing a residential structure?
5. How does commercial building design and construction differ from residential building design and construction?

**Phase II Curriculum**

**Unit 1: Overview of Civil Engineering and Architecture**

**Essential Questions:**

1. How did the art and science of architecture and civil engineering evolve over time?
2. Describe three structural systems used by architects in historical construction projects.
3. How have historical innovations contributed to modern civil engineering and architecture?
4. How are visual design elements and principles manifested in architecture?
5. What abilities and interests do you possess that could translate to a career field related to civil engineering or architecture?
6. What advantages are there to bringing together a group of people with varying backgrounds and skills for brainstorming a solution to a design problem?

**Essential Understanding:**

1. Many features of ancient structures are seen in modern buildings.
2. Architectural style is often an important key to understanding how a community or neighborhood has developed and the aesthetic customs that have formed over time.
3. The multiple architectural styles that have been developed throughout history are an indication of changing needs of people and society and uses for space.
4. Visual design principles and elements constitute an aesthetic vocabulary that can be used to describe buildings and may help identify the buildings function, location, or time period.
5. Civil engineers and architects apply math, science, and discipline-specific skills to design and implement solutions.
6. Civil engineering and architecture careers are comprised of several specialties and offer creative job opportunities for individuals with a wide variety of backgrounds and goals.
7. Civil engineers are problem solvers involved in the design and construction of a diverse array of projects in a wide range of disciplines including structural, environmental, geotechnical, water resources, transportation, construction and urban planning.
8. Architects primarily focus on designing the interior and exterior “look and feel” of commercial and residential structures meant for human habitation.
9. An effective method for brainstorming possible solutions involves a collaboration of many stakeholders with a variety of skills coming together in an organized meeting called a charrette.

## Curriculum Standards

### I – Academic Foundations

- A - Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.
  - 1 - Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.
  - 5 - Use correct grammar, punctuation and terminology to write and edit documents.
  - 6 - Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.
- D - Employ basic methods of data collection and analysis to provide information for projects.
  - 1 - Use available research methods when project planning and problem-solving.
  - 2 - Provide appropriate precedents for development of a project.

### II – Communications

- B - Apply active listening skills to obtain and clarify information.
  - 1 - Interpret a given verbal message/information.
  - 2 - Interpret a given verbal message/information.
  - 3 - Model behaviors that demonstrate active listening.
- C - Listen to and speak with diverse individuals to enhance communication skills.
  - 1 - Apply factors and strategies for communicating with a diverse workforce.
  - 2 - Demonstrate ability to communicate and resolve conflicts within a diverse workforce.
- D - Exhibit public relations skills to increase internal and external customer/client satisfaction.
  - 2 - Use correct grammar to communicate verbally.
- E - Use vocabulary and visual cues commonly used in design and construction to be successful in workplace/jobsite communications.
  - 1 - Match vocabulary and visual cues to workplace/jobsite situations.
  - 2 - Utilize vocabulary and visual cues in context of design and construction situations.
- F - Use communication skills and strategies to work effectively with potential clients.
  - 1 - Deliver a presentation that explains a concept of design or preconstruction.
  - 2 - Employ facilitation skills while leading meetings that involve a variety of clients and agencies.

### III – Problem-Solving and Critical Thinking

- A - Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.
  - 1 - Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).
  - 5 - Create and implement project plans considering available resources and requirements of a project/problem to accomplish realistic planning in design and construction situations.

### IV – Information Technology Applications

- B - Employ technological tools to expedite workflow.
  - 5 - Access and navigate Internet (e.g., use a web browser).
  - 6 - Search for information and resources.
  - 12 - Deliver presentations with supporting materials.
  - 20 - Facilitate group work through management of shared files and online information.
- C - Demonstrate Digital Citizenship
  - 3 - Discuss and demonstrate proper netiquette in online communications
  - 5 - Create appropriate citations for resources when presenting research findings

### V – Systems

- C - Comply with regulations and applicable codes to establish a legal and safe workplace/jobsite.
  - 2 - Identify workplace/jobsite environmental hazards of a given situation.
  - 3 - Describe how relationships between trades/professions can facilitate smooth workflow and outcome to meet project goals.
- D - Examine all factors effecting the project and the planning process.
  - 1 - Understand social, environmental and political factors that affect the project.
  - 2 - Understand the context of the projects.
  - 3 - Explain the relationship of traditional project phases and the various roles within them to a current project.

### VII – Leadership and Teamwork

- A - Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
  - 1 - Employ leadership skills to accomplish organizational goals and objectives.
  - 3 - Employ teamwork skills to achieve collective goals and use team members' talents effectively.

- 5 - Conduct and participate in meetings to accomplish work tasks.
- B - Appreciate the diversity of needs, values and social patterns in project design to appropriately meet client needs.
  - 1 - Identify the geographic and cultural issues related to project design in a given situation.

**IX – Employability and Career Development**

- A - Know and understand the importance of employability skills.
  - 1 - Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

**X – Technical Skills**

- C - Read, interpret, and use technical drawings, documents, and specifications to plan a project.
  - 1 - Interpret drawings used in project planning.
  - 4 - Use architect’s plan, manufacturer’s illustrations and other materials to communicate specific data and visualize proposed work.
- E - Develop technical drawings drafted by hand and computer-generated plans to design structures.
  - 1 - Identify client requirements.
  - 2 - Use communication skills and strategies to work effectively with people (including clients, team members, and others).
  - 3 - Draw and sketch by hand to communicate ideas effectively.
- F - Employ appropriate representational media to communicate concepts and design.
  - 2 - Build models using referenced drawings and sketches.
- H - Apply basic organizational, spatial, structural and constructional principles to the design of interior and exterior space so that design plans are effective.
  - 1 - Develop design alternatives that address a given problem.
- L – Planning
  - 1 - Examine space relationships
  - 2 - Analyze site considerations
  - 3 - Identify building styles
  - 4 - Determine client needs
- M - Architectural Drawing Types
  - 1 - Identify architectural terms and symbols
  - 2 - Identify and develop roof styles

<b>I Know</b> Students will know about....	<b>I Can</b> Students will be able to.....
<ol style="list-style-type: none"> <li>1. Over the thousands of years people have been constructing buildings and roads. They soon learned newer methods to build something better and stronger. The art and science of Architecture and Civil Engineering is a constantly evolving field because we are always looking for better ways to build.</li> <li>2. The arc, dome, and column are three structural systems used by architects in historical construction projects.</li> <li>3. Modern Civil Engineering and Architecture are effected by many historical innovations such as the arc, used in many things today such as tunnels through a mountain.</li> <li>4. Visual design elements are manifested by the people. Something built in the 70's looks far different from some of our modern day buildings. People change over the years and therefore spark the visual transition in buildings.</li> <li>6. Having a group of individuals from varying backgrounds brainstorming possible design solutions to a problem will generate ideas with different perspectives.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect modern structural and architectural designs to historical architectural and civil engineering achievements.</li> <li>2. Identify three general categories of structural systems used in historical buildings.</li> <li>3. Explain how historical innovations have contributed to the evolution of civil engineering and architecture.</li> <li>4. Identify and explain the application of principles and elements of design to architectural buildings.</li> <li>5. Determine architectural style through identification of building features, components, and materials.</li> <li>6. Create a mock-up model depicting an architectural style or feature using a variety of materials.</li> <li>7. Identify the primary duties, and attributes of a civil engineer and an architect along with the traditional path for becoming a civil engineer or architect.</li> <li>8. Identify various specialty disciplines associated with civil engineering.</li> <li>9. Participate in a design charrette and recognize the value of using a charrette to develop innovative solutions to support whole building design.</li> <li>10. Understand the relationship among the stakeholders involved in the design and construction of a building project.</li> </ol>

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<b>Unit 2: Residential Design</b>
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<p><b>Essential Questions:</b></p> <ol style="list-style-type: none"> <li>1. Why is wood so often used for residential buildings?</li> <li>2. What alternatives to wood frame construction are available and what are the advantages and disadvantages of each?</li> <li>3. How are trusses able to span large distances?</li> <li>4. What framing systems are used to support residential roofs?</li> <li>5. How are different roof styles and pitches related to different architectural styles?</li> <li>6. What is the difference between R-value and U-value?</li> <li>7. What are some leading causes of solar gain?</li> <li>8. What key areas of a building can minimize heat loss?</li> <li>9. Why is a cost estimate important to create before starting a project?</li> <li>10. How do you achieve a balance between cost-saving measures, important features, and environmental responsibility when designing a residential structure?</li> <li>11. What are the advantages and disadvantages of using 3D architectural software rather than creating hand-produced plans?</li> <li>12. Why are organizations such as LEED important?</li> <li>13. When planning a project, how does the availability of public utilities impact the design?</li> <li>14. What options are available for the management of wastewater from a building?</li> <li>15. What are the important considerations when design a plumbing system?</li> <li>16. Why should a designer know about the different types of lighting and their applications?</li> <li>17. What are the important considerations when designing an electrical system?</li> <li>18. What information is important when documenting the design of a building?</li> </ol>	<p><b>Essential Understanding:</b></p> <ol style="list-style-type: none"> <li>1. Many residential structures are constructed with wood framing systems and are built using standard practices.</li> <li>2. A variety of roof shapes and materials are available for residential structures to address aesthetic preferences, carry design loads, and meet environmental challenges.</li> <li>3. Designers design, modify, and plan structures using 3D architectural software.</li> <li>4. Architects and engineers use a variety of views to document and detail a building project on construction drawings.</li> <li>5. The combination of concrete and rebar, called reinforced concrete, is an important component of residential foundations.</li> <li>6. Accurately determining the cost and quantities for a construction project can ensure a successful building project providing a high quality structure with less material and financial waste.</li> <li>7. An effective residential structure should include methods for adequate heating and cooling.</li> <li>8. R-value and U-factor measurements are used to select materials that with ensure a structure is properly insulated.</li> <li>9. Responsible designers maximize the potential of the property, minimize impact on the environment, and incorporate universal design concepts in order to create an attractive and functional space.</li> <li>10. Responsible designers anticipate the needs and requirements of the users.</li> <li>11. Codes are created to protect the health and safety of the public, dictate the minimum requirements that must be met in a building project, and constrain the location of structures, utilities, building construction, and landscape components placed on a site.</li> <li>12. Appropriate flow rate, pressure, and water quality are necessary for effective water supply and use.</li> <li>13. When utilities are not available within a reasonable distance to be economically brought on site, substitutions must be designed and constructed.</li> <li>14. Utilities and systems must be properly sized to minimize cost and appropriately serve the project and the structure occupants.</li> <li>15. The design of electrical and plumbing systems must be carefully integrated into the architectural and structural design of a building.</li> <li>16. Careful landscape design that takes into consideration local environmental conditions can</li> </ol>
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- improve energy efficiency, reduce noise, reduce water usage, reduce storm water runoff, and improve the visual impact of a building project.
17. Storm water runoff from a site often increases when the site is developed and is frequently regulated by local jurisdictions.
  18. Universal Design involves the design of products and environments to be usable by all people and includes barrier free accessibility to projects that may be required by federal regulations.
  19. Universal Design involves the design of products and environments to be usable by all people and includes barrier free accessibility to projects that may be required by federal regulations.

## Curriculum Standards

### I – Academic Foundations

- A - Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.
- 1 - Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.
  - 3 - Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.
  - 4 - Evaluate and use information resources to accomplish specific occupational tasks.
  - 5 - Use correct grammar, punctuation and terminology to write and edit documents.
  - 6 - Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.
  - 7 - Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.
- B - Demonstrate mathematics knowledge and skills required to pursue the full range of post-secondary education and career opportunities.
- 1 - Identify whole numbers, decimals, and fractions.
  - 2 - Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
  - 4 - Apply data and measurements to solve a problem.
  - 11 - Calculate weights, measurements, area, and volume
  - 14 - Determine pitch, rise, run, and slope
- D - Employ basic methods of data collection and analysis to provide information for projects.
- 1 - Use available research methods when project planning and problem-solving.
  - 2 - Provide appropriate precedents for development of a project.

### II – Communications

- B - Apply active listening skills to obtain and clarify information.
- 1 - Interpret a given verbal message/information.
  - 2 - Respond with restatement and clarification techniques to clarify information.
  - 3 - Model behaviors that demonstrate active listening.
- C - Listen to and speak with diverse individuals to enhance communication skills.
- 1 - Apply factors and strategies for communicating with a diverse workforce.
  - 2 - Demonstrate ability to communicate and resolve conflicts within a diverse workforce.
- D - Exhibit public relations skills to increase internal and external customer/client satisfaction.
- 1 - Communicate effectively when developing positive customer/client relationships.
  - 2 - Use correct grammar to communicate verbally.
- E - Use vocabulary and visual cues commonly used in design and construction to be successful in workplace/jobsite communications.
- 1 - Match vocabulary and visual cues to workplace/jobsite situations.
  - 2 - Utilize vocabulary and visual cues in context of design and construction situations.
- F - Use communication skills and strategies to work effectively with potential clients.
- 1 - Deliver a presentation that explains a concept of design or preconstruction.
  - 2 - Employ facilitation skills while leading meetings that involve a variety of clients and agencies.

### III – Problem-Solving and Critical Thinking

- A - Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.
- 1 - Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

- 2 - Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.
- 4 - Conduct technical research to gather information necessary for decision-making.
- 5 - Create and implement project plans considering available resources and requirements of a project/problem to accomplish realistic planning in design and construction situations.
- 6 - Evaluate and adjust design and construction project plans and schedules to respond to unexpected events and conditions.

#### IV – Information Technology

- A - Use Personal Information Management (PIM) applications to increase workplace efficiency.
  - 1 - Use Personal Information Management (PIM) applications to increase workplace efficiency.
- B - Employ technological tools to expedite workflow.
  - 5 - Access and navigate Internet (e.g., use a web browser).
  - 6 - Search for information and resources.
  - 12 - Deliver presentations with supporting materials.
  - 23 - Manage file storage.
- C - Demonstrate Digital Citizenship
  - 5 - Create appropriate citations for resources when presenting research findings

#### V – Systems

- D - Examine all factors effecting the project and the planning process.
  - 1 - Understand social, environmental and political factors that affect the project.
  - 2 - Understand the context of the projects.
  - 3 - Explain the relationship of traditional project phases and the various roles within them to a current project.
- E - Apply the suitable practices of environmental impact to enhance project acceptance and quality.
  - 1 - Evaluate the sustainable design elements of a given project.
  - 2 - Align sustainable design elements of a given project.
- F - Apply objective construction guidelines for the accommodation of people with varying physical abilities to meet accessibility requirements.
  - 1 - Explain how the Americans with Disabilities Act influences the compliance requirements for project designs.
  - 2 - Design project plans that comply with OSHA standards.

#### VII – Leadership and Teamwork

- A - Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.
  - 5 - Conduct and participate in meetings to accomplish work tasks.

#### IX – Employability and Career Development

- A - Know and understand the importance of employability skills.
  - 1 - Identify and demonstrate positive work behaviors and personal qualities needed to be employable.

#### X – Technical Skills

- A - Employ information management techniques and strategies in the workplace to assist in decision-making.
  - 1 - Use information literacy skills when accessing, evaluating and disseminating information.
- B - Employ planning and time management skills and tools to enhance results and complete work tasks.
  - 1 - Develop goals and objectives.
  - 2 - Prioritize tasks to be completed.
  - 3 - Develop timelines using time management knowledge and skills.
- C - Read, interpret, and use technical drawings, documents, and specifications to plan a project.
  - 1 - Interpret drawings used in project planning.
  - 4 - Interpret drawings used in project planning.
- E - Develop technical drawings drafted by hand and computer-generated plans to design structures.
  - 1 - Identify client requirements.
  - 2 - Use communication skills and strategies to work effectively with people (including clients, team members, and others).
  - 3 - Draw and sketch by hand to communicate ideas effectively.
  - 4 - Learn to read and produce technical drawings, understanding the significance of each line in a drawing.
- F - Employ appropriate representational media to communicate concepts and design.
  - 1 - Employ appropriate representational media to communicate concepts and design.
  - 2 - Build models using referenced drawings and sketches.
  - 3 - Utilize computer technology when communicating concepts and designs.
- G - Employ principles, conventions, standards, applications and restrictions pertaining to the manufacture and use of construction materials, components and assemblies to incorporate into project design.
  - 1 - Select building materials and assemblies upon evaluation that meet project specifications.

2 - Use appropriate combinations of building materials and components that satisfy the requirements of building programs.

H - Apply basic organizational, spatial, structural and constructional principles to the design of interior and exterior space so that design plans are effective.

1 - Develop design alternatives that address a given problem.

I - Preparing to Draw; Basic Drawing and Dimensioning Skills

1 - Identify drafting tools, materials, and equipment (including CAD)

3 - Identify and select paper sizes and determine scale

4 - Identify various line types

5 - Draw and modify lines

6 - Measure lines and angles

7 - Use acceptable lettering techniques

8 - Place dimensions and local/general notes

K - Drawing Techniques; Supplementary Views

1 - Identify pictorial drawings (i.e., isometric, oblique, perspective and presentation)

3 - Demonstrate knowledge of orthographic drawings

L - Planning

1 - Examine space relationships

2 - Analyze site considerations

3 - Identify building styles

4 - Determine client needs

5 - Incorporate building codes

6 - Identify construction material properties and uses

M - Architectural Drawing Types

1 - Identify architectural terms and symbols

2 - Identify and develop roof styles

3 - Identify and develop floor plans

4 - Develop basement and foundation plans

5 - Identify kitchen and bath arrangements

6 - Develop interior and exterior elevations

7 - Develop a building section

8 - Develop a wall section

9 - Draw architectural details

N - Site Plans

1 - Draw and dimension site and plot plans

2 - Develop landscape plan

3 - Interpret contours and topographical profiles

4 - Identify setbacks

5 - Identify utilities

Q - Supplemental Drafting Activities

2 - Develop schedules

4 - Arrange and coordinate drawings

<b>I Know</b> Students will know about....	<b>I Can</b> Students will be able to.....
<ol style="list-style-type: none"> <li>1. For residential buildings, wood is the cheapest, easiest, and fastest way of constructing the building structure. It is also extremely strong when done properly.</li> <li>2. Two wood frame alternatives include using metal (stronger, but more expensive), and concrete (ineffective for framing).</li> <li>3. Trusses are comprised of interconnected triangles that give the truss system strength.</li> <li>4. There are two primary roof framing systems used to support residential roofs: rafters and trusses.</li> <li>5. Different architectural styles have their own, unique, roof style with associated pitches.</li> <li>6. U-value is the inverse of R-value.</li> <li>7. Some leading causes of solar gain are lack of proper insulation and dark roofs absorbing heat.</li> <li>8. Insulation and glazing are two key areas where heat loss is greatest.</li> </ol>	<ol style="list-style-type: none"> <li>1. Identify typical components of a residential framing system.</li> <li>2. Recognize conventional residential roof designs.</li> <li>3. Model a common residential roof design and detail advantages and disadvantages of that style.</li> <li>4. Use 3D architectural software to design, model, and document a small building.</li> <li>5. Apply basic math skills to calculate the quantity and cost of concrete needed to pour the pad for a small building.</li> <li>6. Create a cost estimate for a small construction project, including a detailed cost break-down.</li> <li>7. Calculate the heat loss for a building envelope with given conditions appropriate for the project.</li> <li>8. Apply elements of good residential design to the design of a basic house to meet the needs of a client.</li> <li>9. Create a home design that complies with</li> </ol>

<ol style="list-style-type: none"> <li>9. In order to best examine how to maintain control of costs involved with a construction project, it is important to begin with a sound guideline based on estimation.</li> <li>10. To achieve a balance between cost-saving measures, important features, and environmental responsibility when designing a residential structure, create a small living area with the essentials, and combine many common areas where applicable.</li> <li>11. Advantages of using 3D architectural software include helping the architect to better visual his or her work, allowing the client to better see the possibility of the design, and being able to have faster turnaround. Disadvantages include needing the resources, and being properly trained in the use of the software.</li> <li>12. LEED defines the language and benchmarks utilized by the construction industry, it creates incentives for companies to innovate in ways that are defined and measureable, and it provides the public a clear metric for environmental achievement.</li> <li>13. You must consider any factors which could have an impact on the materials put into construction, including facilities such as sewers and electricity.</li> <li>14. Personal septic systems and public sewage systems are available for the management of wastewater.</li> <li>15. When designing a plumbing system, one must consider pipe size, slope, materials, paths, water heating, and pipe insulation.</li> <li>16. Designers should know how to best and most efficiently light a space.</li> <li>17. Important considerations when designing an electrical system include efficiency, simplicity, and compatibility for expansion.</li> <li>18. When documenting the design of a building, one must include materials, dimensions, and supplemental views.</li> </ol>	<p>applicable codes and requirements.</p> <ol style="list-style-type: none"> <li>10. Incorporate sustainable building principles and universal design concepts into a residential design.</li> <li>11. Create bubble diagrams and sketch a floor plan.</li> <li>12. Identify residential foundation types and choose an appropriate foundation for a residential application.</li> <li>13. Calculate the head loss and estimate the water pressure for a given water supply system.</li> <li>14. Create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that complies with applicable codes.</li> <li>15. Design an appropriate sewer lateral for wastewater management for a building that complies with applicable codes.</li> <li>16. Create a site opportunities map and sketch a project site.</li> <li>17. Choose an appropriate building location on a site based on orientation and other site-specific information.</li> <li>18. Calculate the storm water runoff from a site before and after development.</li> <li>19. Document the design of a home using 3D architectural design software and construction drawings</li> </ol>
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**Unit 3: Commercial Applications**

**Essential Questions:**

1. How do Land Use and Development regulations help or hinder development in a community?
2. Why are building codes important in the construction of buildings?
3. How does commercial building design and construction differ from residential building design and construction?
4. What factors influence the choice of commercial construction materials?
5. How do sustainable design alternatives, such as a green roof, impact the environment and quality of life?
6. What is structural engineering?
7. What is the function of a structure?
8. How do you determine the loads that must be used to design a structure?
9. In what ways is wind, snow, seismic, dead, and live loads similar to or different from each other?

**Essential Understanding:**

1. Commercial building systems differ from residential building systems in many significant ways.
2. Codes and building regulations define and constrain all aspects of building design and construction including the structure, site design, utilities, and building usage.
3. Zoning regulations are used to control land use and development.
4. Wall, roof, floor, and framing systems for commercial facilities are chosen based on many factors.
5. The purpose of a structure is to withstand all applied loads and forces and to transfer these forces to the Earth.
6. Structural engineering involves the critical analysis of forces and loads, the anticipated effect of these loads on a structure, and the design of structural



<ol style="list-style-type: none"> <li>10. How does the design of a structure impact how loads are dispersed?</li> <li>11. How does the use of mathematics help in understanding and quantifying the forces and loads on a structure?</li> <li>12. How does the structure of a building affect the form and function of that building?</li> <li>13. When planning a project how does the availability of public utilities impact the design?</li> <li>14. What options are available for the management of wastewater from a building?</li> <li>15. What are the important considerations when designing an HVAC system?</li> <li>16. Why is it important for an architect to understand how electrical, plumbing, and HVAC systems are designed and constructed?</li> <li>17. How is land surveying used in the development of a building project?</li> <li>18. What information is important to consider when planning the placement of driveways, parking spaces, and pedestrian access?</li> <li>19. How are the needs of a site user and the circulation patterns for the site interrelated?</li> <li>20. Why is it important to know the soil characteristics of a site when planning a building project?</li> <li>21. How does development change the characteristics of a site?</li> <li>22. What steps must be taken to ensure that the improvements made on a property will not adversely affect users or neighboring properties?</li> </ol>	<ol style="list-style-type: none"> <li>elements to safely and efficiently resist the anticipated forces and loads.</li> <li>7. Design loads are often dictated by building codes.</li> <li>8. Structural design includes the determination of how structures disperse the applied loads.</li> <li>9. The application of loads to a building results in resisting forces from the structure which can be predicted through the use of mathematics and physical science principles.</li> <li>10. When utilities are not available within a reasonable distance to be economically brought on site, substitutions must be designed and constructed.</li> <li>11. Utilities and systems must be properly sized to minimize cost and appropriately serve the project.</li> <li>12. Responsible designers anticipate the needs and requirements of the users.</li> <li>13. The design of mechanical systems impact the architectural and structural design of a building.</li> <li>14. Energy codes are designed to conserve natural resources, reduce operating costs, protect the environment and create healthier living and working spaces. They dictate the minimum requirements for the building envelope, lighting, mechanical systems, and service water heating for commercial facilities.</li> <li>15. The design of internal systems is documented with construction drawings specific to each system.</li> <li>16. Land surveying is used for many purposes during the design and construction of a project, including establishing the topography of a site, setting control points, and establishing the location of project features.</li> <li>17. Engineers must consider parking requirements, pedestrian access, ingress and egress, landscaping, storm water management, and site grading when creating a site design.</li> <li>18. Ingress and egress, parking, pedestrian, and handicapped access must be planned to efficiently and safely move traffic, goods, and people.</li> <li>19. The characteristics of soils present on a site impact the design and construction of improvements to a property.</li> <li>20. Codes determine the type, sizing, and placement of site features such as parking lots, entrance and exit roads, pedestrian and handicapped access, and storm water facilities.</li> <li>21. The surface conditions and topography of a site affect the quantity and quality of storm water runoff and the design of the storm water management system.</li> <li>22. A soil can be classified according to its grain size and plasticity which impact the characteristics the soil will exhibit.</li> </ol>
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**Curriculum Standards**

I – Academic Foundations

A - Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.

1 - Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

2 - Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.

- 3 - Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.
- 4 - Evaluate and use information resources to accomplish specific occupational tasks.
- 5 - Use correct grammar, punctuation and terminology to write and edit documents.
- 6 - Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.
- 7 - Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.
- B - Demonstrate mathematics knowledge and skills required to pursue the full range of post-secondary education and career opportunities.
  - 1 - Identify whole numbers, decimals, and fractions.
  - 2 - Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
  - 3 - Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.
  - 4 - Apply data and measurements to solve a problem.
  - 5 - Analyze Mathematical problem statements for missing and/or irrelevant data.
  - 7 - Analyze data when interpreting operational documents.
  - 8 - Perform algebraic operations
  - 9 - Demonstrate knowledge of geometry
  - 10 - Demonstrate knowledge of trigonometry
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- 1 - Use information literacy skills when accessing, evaluating and disseminating information.
  - 2 - Describe the nature and scope of information management.
  - 3 - Maintain records to facilitate ongoing business operations.
- B - Employ planning and time management skills and tools to enhance results and complete work tasks.
- 1 - Develop goals and objectives.
  - 2 - Prioritize tasks to be completed.
  - 3 - Develop timelines using time management knowledge and skills.
  - 4 - Use project-management skills to improve workflow and minimize costs.
- C - Read, interpret, and use technical drawings, documents, and specifications to plan a project.
- 1 - Interpret drawings used in project planning.
  - 2 - Describe written standards and that specifications that apply.
  - 3 - Recognize how specifications and standards are arranged for proper access.
  - 4 - Use architect's plan, manufacturer's illustrations and other materials to communicate specific data and visualize proposed work.

- E - Develop technical drawings drafted by hand and computer-generated plans to design structures.
  - 1 - Identify client requirements.
  - 2 - Use communication skills and strategies to work effectively with people (including clients, team members, and others).
  - 3 - Draw and sketch by hand to communicate ideas effectively.
  - 4 - Learn to read and produce technical drawings, understanding the significance of each line in a drawing.
- F - Employ appropriate representational media to communicate concepts and design.
  - 1 - Convey graphic information using multi-dimensional drawings.
  - 2 - Build models using referenced drawings and sketches.
  - 3 - Utilize computer technology when communicating concepts and designs.
- G - Employ principles, conventions, standards, applications and restrictions pertaining to the manufacture and use of construction materials, components and assemblies to incorporate into project design.
  - 1 - Select building materials and assemblies upon evaluation that meet project specifications.
  - 2 - Use appropriate combinations of building materials and components that satisfy the requirements of building programs.
- H - Apply basic organizational, spatial, structural and constructional principles to the design of interior and exterior space so that design plans are effective.
  - 1 - Develop design alternatives that address a given problem.
- I - Preparing to Draw; Basic Drawing and Dimensioning Skills
  - 1 - Identify drafting tools, materials, and equipment (including CAD)
  - 2 - Differentiate and select drafting media
  - 3 - Identify and select paper sizes and determine scale
  - 4 - Identify various line types
  - 5 - Draw and modify lines
  - 6 - Measure lines and angles
  - 7 - Use acceptable lettering techniques
  - 8 - Place dimensions and local/general notes
- J - Geometric Construction
  - 1 - Construct geometric elements
  - 2 - Divide geometric elements
  - 3 - Construct perpendicular lines
  - 4 - Construct tangent lines and arcs
  - 5 - Transfer an angle
- K - Drawing Techniques; Supplementary Views
  - 1 - Identify pictorial drawings (i.e., isometric, oblique, perspective and presentation)
  - 2 - Demonstrate knowledge of schematic drawings
  - 3 - Demonstrate knowledge of orthographic drawings
  - 4 - Draw and identify auxiliary views
  - 5 - Indicate point of material installation
- L - Planning
  - 1 - Examine space relationships
  - 2 - Analyze site considerations
  - 3 - Identify building styles
  - 4 - Determine client needs
  - 5 - Incorporate building codes
  - 6 - Identify construction material properties and uses
- M - Architectural Drawing Types
  - 1 - Identify architectural terms and symbols
  - 2 - Identify and develop roof styles
  - 3 - Identify and develop floor plans
  - 4 - Develop basement and foundation plans
  - 5 - Identify kitchen and bath arrangements
  - 6 - Develop interior and exterior elevations
  - 7 - Develop a building section
  - 8 - Develop a wall section
  - 9 - Draw architectural details
- N - Site Plans
  - 1 - Draw and dimension site and plot plans
  - 2 - Develop landscape plan
  - 3 - Interpret contours and topographical profiles
  - 4 - Identify setbacks
  - 5 - Identify utilities

O – Structural Drawings

- 1 - Draw structural details
- 3 - Analyze structural systems

P – Mechanical and Electrical Systems

- 1 - Identify and apply electrical terms, symbols, and systems
- 2 - Identify and apply plumbing terms, symbols, and systems
- 3 - Identify and apply HVAC terms, symbols, and systems

Q – Supplemental Drafting Activities

- 1 - Draw cover sheet and title block information
- 2 - Develop schedules
- 3 - Use reference sources
- 4 - Arrange and coordinate drawings
- 5 - Revise drawings

<b>I Know</b> Students will know about....	<b>I Can</b> Students will be able to.....
<ol style="list-style-type: none"><li>1. Laws and regulations can restrict certain building types from being constructed in certain areas.</li><li>2. Building codes help ensure that a building is properly constructed as to maintain a safe environment.</li><li>3. Commercial and residential building design differs by the way in which the building will be used, types of materials used, and cost.</li><li>4. Factors that influence the choice of commercial construction materials include cost, sustainability, and efficiency.</li><li>5. Sustainable design alternatives, such as a green roof, can increase the mood of the workplace, be a positive contribution to the ecosystem, and also create chances for LEED certifications.</li><li>6. Structural engineering deals with the framework of structures, and on designing those structures to withstand the stresses and pressures of their environment and remain safe, stable, and secure throughout their use.</li><li>7. A structure is meant to house and protect whatever is inside of it, as well as be used.</li><li>8. To determine the loads that must be used when designing a structure, one must calculate the total structure weight, weight while the structure is in use, and the environmental factors for the area.</li><li>9. Wind, snow, seismic, dead, and live loads all act on a structure; these values are</li></ol>	<ol style="list-style-type: none"><li>1. Identify common commercial wall systems and building materials and differentiate between load-bearing and non-load bearing walls.</li><li>2. Identify common commercial building framing systems.</li><li>3. Identify applicable building codes and regulations that apply to a given development.</li><li>4. Classify a building according to its use, occupancy, and construction type using the International Building Code.</li><li>5. Research Land Use regulations to identify zoning designations and allowable uses of property.</li><li>6. Comply with specifications, regulations, and codes during a design process.</li><li>7. Compare a variety of commercial wall systems and select an appropriate system for a given commercial application based on materials, strength, aesthetics, durability, and cost.</li><li>8. Compare a variety of commercial low-slope roof systems and select an appropriate system for a given commercial application based on materials, strength, durability, and cost.</li><li>9. Identify the pros and cons of the use of a green roof in a commercial building design.</li><li>10. Incorporate sustainable building practices, especially a green roof, into the design of a commercial building.</li><li>11. Use 3D architectural design software to incorporate revisions for the redesign of a building.</li><li>12. Use 3D architectural design software to create appropriate documentation to communicate a commercial building design.</li><li>13. Calculate the structural efficiency of a structure.</li><li>14. Use load-span tables to design structural elements.</li><li>15. Given a structural form, describe how the structural form resists and transfers applied loads.</li><li>16. Use building codes and other resources to calculate roof loading to a structure and select appropriate</li></ol>

unique to the structure and area.

10. A structure's design dictates how loads are dispersed down to the footings, and ultimately the Earth.
11. One must total and calculate the various loads that will act on a structure to ensure that it is built to withstand the minimal loads.
12. The shape of a building or object should be primarily based upon the structure's intended function or purpose.
13. The availability of public utilities may require one to be more in depth with their design. There needs to be planning for how these utilities will get in and around the building.
14. The two most common options for wastewater management are city sewage and septic systems. Septic systems are for private homes outside of the district of city sewage lines.
15. When designing a HVAC system, it is important to consider heat loss or gain, site orientation, infiltration of air, number of people, amount of lighting, and types of equipment used inside of the building.
16. An architect needs to know how mechanical systems work so that he can design his building in coordination with the system. This way, space can be left for units to be installed, and soundproofing is in place for noise reduction.
17. Land surveying is used for many purposes during the design and construction of a project, including establishing topography, setting control points, and establishing the location of project features.
18. Engineers must consider parking requirements, pedestrian access, ingress, egress, landscaping, storm water management, and site grading when creating a site design.
19. Ingress, egress, parking, pedestrian, and handicap access must be planned to efficiently and safely move traffic, goods, and people around a site.
20. The characteristics of soils present on a site impact the design and construction of improvements to a property.
21. Code determines the type, sizing, and

roof beams to safely carry the load.

17. Analyze a simply supported beam subjected to a given loading condition to determine reaction forces, sketch shear and moment diagrams, and determine the maximum moment resulting in the beam.
18. Use beam formula to calculate end reactions and the maximum moments of a simply supported beam subjected to a given loading condition.
19. Use structural analysis software to create shear and moment diagrams of simply supported beams subjected to a given loading condition.
20. Calculate the deflection of a simply supported beam subjected to a given loading condition.
21. Use building codes and other resources to determine the required floor loading and design a structural steel floor framing system (beams and girders) for a given building occupancy.
22. Identify and describe the typical usage of foundation systems commonly used in commercial construction.
23. Determine the loads transferred from a steel framed structure to the ground through a foundation.
24. Size a spread footing for a given loading condition.
25. Check structural calculations created by others for correctness.
26. Identify typical utility services for a commercial building, typical transmission/distribution methods for each utility, and methods for measuring usage.
27. Interpret and apply code requirements and constraints as they pertain to the installation of services and utilities.
28. Read and understand HVAC construction drawings for a commercial project.
29. Apply criteria and constraints to size and locate the new utility service connections for a commercial facility.
30. Modify system designs to incorporate energy conservation techniques.
31. A soil can be classified according to its grain size and plasticity which impact the characteristics the soil will exhibit.
32. Design appropriate pedestrian access, vehicular access, and a parking lot for a commercial facility.
33. Analyze a site soil sample to determine the United Soil Classification System designation and predict soil characteristics important to the design and construction of a building on the site.
34. Explain the impact of site development on storm water runoff.
35. Estimate the increase in storm water runoff from a commercial site and create a preliminary design for a storm water storage facility.
36. Identify and explain the purpose of Low Impact Development techniques in site development.
37. Apply Low Impact Development techniques to a commercial site design reduce the impact of development on storm water runoff quantity and quality.
38. Follow specifications and codes during a design process.

<p>placement of site features such as parking lots, entrance and exit roads, pedestrian and handicapped access, and storm water facilities.</p> <p>22. The surface conditions and topography of a site affect the quantity and quality of storm water runoff and the design of the storm water management system.</p>	<p>39. Given 3D architectural design software, document a commercial site design.</p>
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**Unit 4: Commercial Building Systems**

<p><b>Essential Questions:</b></p> <ol style="list-style-type: none"> <li>1. Why is it important for every team member to understand and carry out the appropriate team role when working together on a project?</li> <li>2. As the developer of a piece of property, what factors must you consider for cost effectiveness and success of your development?</li> <li>3. What types of information should you gather about a site before making a decision on site selection?</li> <li>4. What is meant by “viability analysis”?</li> <li>5. As an owner of the property, what issues are of concern to you and may affect the development of the property?</li> <li>6. How do drawings, renderings, and other documentation relate to and support the goals and criteria of a presentation?</li> </ol>	<p><b>Essential Understanding:</b></p> <ol style="list-style-type: none"> <li>1. Detailed planning, documentation, and management of a project is essential to its success.</li> <li>2. People work in teams to produce solutions to complex problems.</li> <li>3. A legal description of property is used to identify real estate in a legal transaction and can be found in a deed, mortgage, plat or other purchase documents.</li> <li>4. The selection of a site and the project being planned are interrelated. A site should be thoroughly research to determine whether it is compatible with the project to be built.</li> <li>5. Legal, physical, and financial conditions as well as the needs of the surrounding community should be taken into consideration when determining the viability of a project.</li> <li>6. Critiques and reviews are used to inform and provide suggestions for improvement.</li> <li>7. Presentations and displays of work provide the means to effectively promote the implementation of a project.</li> <li>8. A well-done presentation will enhance the quality of a team’s project.</li> </ol>
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**Curriculum Standards**

<p>I – Academic Foundations</p> <p>A - Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.</p> <ol style="list-style-type: none"> <li>1 - Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.</li> <li>2 - Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.</li> <li>3 - Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.</li> <li>4 - Evaluate and use information resources to accomplish specific occupational tasks.</li> <li>5 - Use correct grammar, punctuation and terminology to write and edit documents.</li> <li>6 - Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.</li> <li>7 - Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.</li> </ol> <p>B - Demonstrate mathematics knowledge and skills required to pursue the full range of post-secondary education and career opportunities.</p> <ol style="list-style-type: none"> <li>1 - Identify whole numbers, decimals, and fractions.</li> <li>2 - Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.</li> <li>3 - Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.</li> <li>4 - Apply data and measurements to solve a problem.</li> <li>5 - Analyze Mathematical problem statements for missing and/or irrelevant data.</li> </ol>
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- 7 - Analyze data when interpreting operational documents.
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- 10 - Identify and exhibit traits for retaining employment to maintain employment once secured.

#### X – Technical Skills

A - Employ information management techniques and strategies in the workplace to assist in decision-making.

- 1 - Use information literacy skills when accessing, evaluating and disseminating information.
- 2 - Describe the nature and scope of information management.
- 3 - Maintain records to facilitate ongoing business operations.

B - Employ planning and time management skills and tools to enhance results and complete work tasks.

- 1 - Develop goals and objectives.
- 2 - Prioritize tasks to be completed.
- 3 - Develop timelines using time management knowledge and skills.
- 4 - Use project-management skills to improve workflow and minimize costs.

C - Read, interpret, and use technical drawings, documents, and specifications to plan a project.

- 1 - Interpret drawings used in project planning.
- 2 - Describe written standards and that specifications that apply.
- 3 - Recognize how specifications and standards are arranged for proper access.
- 4 - Use architect's plan, manufacturer's illustrations and other materials to communicate specific data and visualize proposed work.

E - Develop technical drawings drafted by hand and computer-generated plans to design structures.

- 1 - Identify client requirements.
- 2 - Use communication skills and strategies to work effectively with people (including clients, team members, and others).
- 3 - Draw and sketch by hand to communicate ideas effectively.
- 4 - Learn to read and produce technical drawings, understanding the significance of each line in a drawing.

F - Employ appropriate representational media to communicate concepts and design.

- 1 - Convey graphic information using multi-dimensional drawings.
- 2 - Build models using referenced drawings and sketches.
- 3 - Utilize computer technology when communicating concepts and designs.

G - Employ principles, conventions, standards, applications and restrictions pertaining to the manufacture and use of construction materials, components and assemblies to incorporate into project design.

- 1 - Select building materials and assemblies upon evaluation that meet project specifications.

2 - Use appropriate combinations of building materials and components that satisfy the requirements of building programs.

H - Apply basic organizational, spatial, structural and constructional principles to the design of interior and exterior space so that design plans are effective.

1 - Develop design alternatives that address a given problem.

I - Preparing to Draw; Basic Drawing and Dimensioning Skills

1 - Identify drafting tools, materials, and equipment (including CAD)

2 - Differentiate and select drafting media

3 - Identify and select paper sizes and determine scale

4 - Identify various line types

5 - Draw and modify lines

6 - Measure lines and angles

7 - Use acceptable lettering techniques

8 - Place dimensions and local/general notes

J - Geometric Construction

1 - Construct geometric elements

2 - Divide geometric elements

3 - Construct perpendicular lines

4 - Construct tangent lines and arcs

5 - Transfer an angle

K - Drawing Techniques; Supplementary Views

1 - Identify pictorial drawings (i.e., isometric, oblique, perspective and presentation)

2 - Demonstrate knowledge of schematic drawings

3 - Demonstrate knowledge of orthographic drawings

4 - Draw and identify auxiliary views

5 - Indicate point of material installation

L - Planning

1 - Examine space relationships

2 - Analyze site considerations

3 - Identify building styles

4 - Determine client needs

5 - Incorporate building codes

6 - Identify construction material properties and uses

M - Architectural Drawing Types

1 - Identify architectural terms and symbols

2 - Identify and develop roof styles

3 - Identify and develop floor plans

4 - Develop basement and foundation plans

5 - Identify kitchen and bath arrangements

6 - Develop interior and exterior elevations

7 - Develop a building section

8 - Develop a wall section

9 - Draw architectural details

N - Site Plans

1 - Draw and dimension site and plot plans

2 - Develop landscape plan

3 - Interpret contours and topographical profiles

4 - Identify setbacks

5 - Identify utilities

O - Structural Drawings

1 - Draw structural details

3 - Analyze structural systems

P - Mechanical and Electrical Systems

1 - Identify and apply electrical terms, symbols, and systems

2 - Identify and apply plumbing terms, symbols, and systems

3 - Identify and apply HVAC terms, symbols, and systems

Q - Supplemental Drafting Activities

1 - Draw cover sheet and title block information

2 - Develop schedules

3 - Use reference sources

4 - Arrange and coordinate drawings

5 - Revise drawings

<b>I Know</b> Students will know about....	<b>I Can</b> Students will be able to.....
<ol style="list-style-type: none"> <li>1. It is important for every team member to understand and carry out the appropriate team role when working together on a project so that the team can function effectively.</li> <li>2. As the developer of a piece of property, one must consider location, local economics, and potential for growth.</li> <li>3. Before making a decision on site selection, one should make a list of important physical site considerations such as availability of utilities, environmental concerns, size and shape of property, and location of floodplains and wetlands.</li> <li>4. Viability analysis is an evaluation process that takes into account the factors that will influence and determine the successful implementation of a proposed project.</li> <li>5. The owner of a piece of property must be cognizant of traffic flow, available building size, and local ordinances.</li> <li>6. Drawings, renderings, and other documentation relate to and support the goals and criteria of a presentation by providing realistic visualizations of what the design/building will look like.</li> </ol>	<ol style="list-style-type: none"> <li>1. Work individually and in groups to produce a solution to a team project.</li> <li>2. Research codes, zoning ordinances and regulations to determine the applicable requirements for a project.</li> <li>3. Identify the boundaries of a property based on its legal description.</li> <li>4. Perform research and visit a site to gather information pertinent to the viability of a project on the site.</li> <li>5. Identify the criteria and constraints and gather information to promote viable decisions regarding the development of their solution.</li> <li>6. Create an architectural program, a project organization chart, and a Gantt chart and hold project progress meetings to help manage the team project.</li> <li>7. Communicate ideas while developing a project using various drawing methods, sketches, graphics, or other media collected and documented.</li> <li>8. Identify the criteria for commercial property/project viability.</li> <li>9. Investigate the legal, physical, and financial requirements of a project and consider the needs of the community to determine project viability.</li> <li>10. Apply current common practices utilized in Civil Engineering and Architecture to develop a viable solution in their project.</li> <li>11. Develop an understanding of how software is used as a tool to aid in the solution and then the communication of a project.</li> <li>12. Assemble and organize work from a commercial project to showcase the project in an effective and professional manner.</li> <li>13. Create visual aids for a presentation that include the appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for project development.</li> <li>14. Conduct an oral presentation to present a proposal for the design and development of a commercial building project.</li> </ol>
<b>Phase III Textbook/Materials</b>	
Materials provided by Project Lead The Way. No textbook is used.	