



School District of Marshfield Course Syllabus

Course Name: Civil Engineering and Architecture

Length of Course: 1 Year

Credit: 1

Program Goal(s):

Empower learners to be college and career ready through standards-based experiences in the classroom and career-based learning experiences with business and industry partners. Learners will engage through technology in design, building, problem-solving, repair or service, in a collaborative environment through theory and hands-on experiences.

Course Description:

The major focus of this course is completing long-term projects that involve the development of property sites. As students learn about various aspects of civil engineering and architecture, they apply what they learn to the design and development of a property. The course provides teachers and students freedom to develop the property as a simulation or to students to model the experiences that civil engineers and architects face. Students work in teams, exploring hands-on activities and projects to learn the characteristics of civil engineering and architecture. In addition, students use 3D design software to help them design solutions to solve major course projects. Students learn about documenting their project, solving problems, and communicating their solutions to their peers and members of the professional community of civil engineering and architecture.

Standards:

Wisconsin Technology & Engineering Broad Based (BB)		
Standard	Learning Priority	Performance Indicators
BB1: Students will analyze the core concepts of technology.	BB1.a: Analyze and use technological systems.	BB1.a.3.m: Identify inputs, processes, outputs and, at times, feedback components for technological systems. BB1.a.4.m: Explain how common energy, power and transportation systems have provisions that detect, bypass or compensate for failures within a system. BB1.a.5.h: Describe how systems can fail because of design flaws, defect parts, poorly matched parts or they were used beyond their design capabilities. BB1.a.6.h: Describe how the outputs of one subsystem are the inputs of another subsystem given a prominent energy, power and transportation system.
	BB1.b: Analyze and use tools and materials.	BB1.b.3.m: Students will describe how resources are the things needed to complete a task (e.g., tools, machines, materials, information, energy, people, capital and time).
		BB1.b.4.m: Use appropriate tools to measure and layout a piece of material (e.g., length, width, thickness, angles, circles, arcs and volume) within tolerances.
		BB1.b.5.h: Select appropriate resources and explain how trade-offs between competing values, such as availability, cost, desirability and waste influenced their decision.
		BB1.b.6.h: Choose and perform the material processing operations of forming (e.g., bending, pressing, drawing, rolling), bonding (e.g., gluing, soldering, brazing, spot welding, gas welding, arc welding), fastening (e.g., screws, nuts & bolts, rivets, clips, pins, nails) and finishing (e.g., surface preparation, cleaning, treatment, coating).
	BB1.c: Analyze and use mechanisms.	BB1.c.3.m: Define mechanical concepts such as force, work, power, torque, velocity, mechanical advantage and gear ratio.

	BB1.d: Analyze and use electricity and electronic systems.	BB1.d.7.h: Inspect and test components such as switches, connectors, relays, solid state devices and conductors and take appropriate action. BB1.e.4.m: Explain how quality control is a planned process to ensure that a product, service or system meets established criteria.
	BB1.f: Identify and analyze structures.	BB1.f.3.m: Identify and describe basic types of structures (i.e., mass, bearing wall, framed) as they relate to their function. BB1.f.4.m: Use scientific inquiry to test, collect data and make conclusions about the performance of different materials and their application in the making of structures (i.e., tensile, compression, sheer testing). BB1.f.5.h: Calculate and define the different loads acting on structures (i.e., static, dynamic, stress, strain, compression, tension). BB1.f.6.h: Justify the application of structural materials and their trade-offs in the design of structures based on design requirements through optimization (i.e., engineering design process).
Wisconsin Technology & Engineering Architecture and Construction (AC)		
Standard	Learning Priority	Performance Indicators
Standard: AC1: Students will be able to select and use architecture and construction technologies.	AC1.a: Analyze construction requirements, materials, structures, techniques and maintenance	AC1.a.5.m: Select designs for structures based on factors such as building codes and requirements, style, convenience, cost, climate, culture and function. AC1.a.6.m: Explain the function of foundations and why structures rest on a foundation. AC1.a.7.m: Discuss how modern communities are usually planned according to guidelines. AC1.a.8.m: Identify a variety of materials and subsystems that buildings generally contain. AC1.a.9.h: Assess how infrastructure is the underlying base or basic framework of a system. AC1.a.10.h: Analyze how structures are constructed using a variety of processes and procedures.

		AC1.a.11.h: The design of structures includes a number of requirements. AC1.a.12.h: Analyze how structures require maintenance, alteration or renovation periodically to improve them or to alter their intended use. AC1.a.13.h: Explain how structures can include prefabricated materials.
	AC1.b: Apply measurement systems in the planning and layout process used in the residential construction industry.	AC1.b.6.m: Calculate based on family size, approximate the number of rooms and room types required for a single-family home. AC1.b.7.m: Calculate the required materials for simple structures. AC1.b.8.m: Demonstrate basic dimensioning skills including the use of: dimension, extension, center and leader lines. AC1.b.9.m: Demonstrate use of the Standard Measuring System to the 1/16" and the Metric Measuring System to millimeters. AC1.b.10.m: Add, subtract, multiply and divide in the Standard Measuring System to the 1/16" and the Metric Measuring System to millimeters. AC1.b.11.h: Identify design solutions for residential construction problems. AC1.b.12.h: Calculate required materials for residential construction applications. AC1.b.13.h: Convert scaled blueprint drawing measurements to full dimensions for a given construction project. AC1.b.14.h: Apply conventional construction measurement processes accurately (i.e., geometric and trigonometric functions). AC1.b.15.h: Use conventional construction formulas to determine production requirements.
	AC1.c: Demonstrate the safe and appropriate use of hand tools common to the residential and commercial construction industry.	AC1.c.3.m: Demonstrate proficiency in the use of simple hand tools such as hammers, screwdrivers, handsaws, planes, sandpaper, nail sets, tin shears, framing squares, utility knives, chalk lines, etc. AC1.c.4.m: Demonstrate proficiency in obtaining and storing simple hand tools.

		AC1.c.5.h: Demonstrate and use the common hand tools of the trade safely and properly. AC1.c.6.h: Maintain and care for hand tools used in residential and commercial construction.
	AC1.e: Demonstrate project management procedures and processes as they occur in a construction project.	AC1.e.6.m: Recognize construction blueprints and specifications. AC1.e.7.m: Demonstrate proficiency in preparing an estimate from simple drawings and specifications. AC1.e.8.m: Explain the events that occur to construct any project. AC1.e.9.m: Explain how building codes vary based on geological, environmental and political influences. AC1.e.10.m: Demonstrate proficiency in creating a simple project log. AC1.e.11.m: Explain the importance of positive and constructive communication skills. AC1.e.12.h: Interpret and use residential construction blueprints and specifications. AC1.e.13.h: Estimate materials from blueprints and specifications. AC1.e.14.h: Explain the sequencing of events for specific construction projects. AC1.e.15.h: Solve common residential construction problems such as framing, plumbing and electrical, by using the official codes adopted by the state and local building standards commission. AC1.e.16.h: Create and maintain a construction log that utilizes common industry practices. AC1.e.17.h: Analyze customer service/relations as applied to project management and wholesale and retail sales.
	AC1.f: Demonstrate the value and necessity of practicing occupational safety in the construction industry facility and job site.	AC1.f.3.m: Explain electrical safety standards and proper wiring methods. AC1.f.4.m: Recognize the potential accidents and injuries that may occur in a given work environment. AC1.f.5.h: Demonstrate the safe use of electrical connection methods and electrical wiring procedures.

		AC1.f.6.h: Demonstrate the safety procedures and practices in various work environment settings pertaining to residential and commercial construction.
	AC1.g: Demonstrate the variety of building phases, systems and techniques used in architecture and construction.	AC1.g.5.m: Create a drawing and completion schedule for a simple project. AC1.g.6.m: Identify the common processes and materials used to construct a structure. AC1.g.7.m: Describe the importance of placing and engineering the structure. AC1.g.8.m: Recognize that many phases are required to complete a construction project. AC1.g.9.h: Develop building plans and schedules by using processes common to residential and commercial construction. AC1.g.10.h: Demonstrate proficiency in the practical application of the processes and materials (e.g., structural, electrical, mechanical, finish) appropriate to architectural design and construction. AC1.g.11.h: Prepare the site layout utilizing common surveying equipment and/or create a site plan. AC1.g.12.h: Analyze the phases of residential and commercial construction.
	AC1.h: Demonstrate the impact of financial, technical, environmental, political, societal and labor trends on the past and future of the construction industry.	AC1.h.2.e: Recognize that structures can only be constructed with available resources. AC1.h.3.e: Recognize that construction impacts the environment. AC1.h.4.e: Discuss the importance of energy efficiency. AC1.h.5.m: Describe historically that construction began to meet the basic need of shelter. AC1.h.6.m: Identify that structures are planned and constructed based on financial constraints. AC1.h.7.m: Distinguish how construction can impact the environment both positively and negatively. AC1.h.8.m: Identify the importance of energy efficient, safe, comfortable and healthy structures.

		AC1.h.9.h: Explain significant historical trends in the construction industry. AC1.h.10.h: Develop financial plans for construction projects. AC1.h.11.h: Explain the environmental regulations that influence residential and commercial design. AC1.h.12.h: Identify the skills and building techniques that are utilized to construct energy efficient, safe, healthy and comfortable structures.
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Wisconsin Common Career Technical Standards (WCCTS)-Creativity, Critical Thinking, Communication and Collaboration (C)

Standard	Learning Priority	Performance Indicators
Standard: 4C1: Students will think and work creatively to develop innovative solutions to problems and opportunities.	4C1.a: Develop original solutions, products and services to meet a given need.	4C1.a.4.m: Analyze elements of a problem to develop creative solutions. 4C1.a.6.m: Describe how past experiences can inform current problem solving. 4C1.a.7.h: Develop original ways to solve a given problem. 4C1.a.8.h: Design a product or service that could fulfill a human need or desire. 4C1.a.9.h: Apply past experiences to current problems in developing innovative solutions.
	4C1.b: Work creatively with others to develop solutions, products and services.	4C1.b.4.m: Explain how multiple people can develop better solutions than an individual. 4C1.b.5.m: Explain how multiple people and perspectives can develop better ideas than an individual. 4C1.b.6.m: Explain how multiple people and perspectives can improve an existing product or process better than an individual. 4C1.b.7.h: Incorporate the skills and experiences of others to develop a new solution to a problem. 4C1.b.8.h: Work as part of a team to design a product or service that could fulfill a human need or desire. 4C1.b.9.h: Work as part of a team to improve an existing product or process.
Standard: 4C2: Students will formulate and defend judgments	4C2.a: Develop effective resolutions for a given problem,	4C2.a.5.m: Analyze symptoms to identify the root cause of a problem.

and decisions by employing critical thinking skills.	decision or opportunity using available information.	4C2.a.6.m: Develop multiple resolutions for a given problem, decision or opportunity. 4C2.a.7.m: Identify problems that became worse due to poorly thought out or poorly informed solutions. 4C2.a.8.m: Explain how implementation of a solution or action may affect one or more corresponding systems. 4C2.a.9.m: Explain how different resolutions may be appropriate under different circumstances. 4C2.a.10.m: Explain the process for choosing an action or making a decision. 4C2.a.11.h: Determine the information needed to address an identified problem. 4C2.a.12.h: Contrast the benefits and drawbacks of various proposed resolutions to a given situation. 4C2.a.13.h: Predict how an action could result in unintended consequences, both positive and negative. 4C2.a.14.h: Analyze the impact of a decision using a systems thinking model. 4C2.a.15.h: Determine the best resolution for a problem, decision or opportunity based on given criteria. 4C2.a.16.h: Defend an action taken or a decision implemented.
	4C2.b: Develop and implement a resolution for a new situation using personal knowledge and experience.	4C2.b.3.m: Analyze problems to determine what past experiences might be related and relevant. 4C2.b.4.m: Analyze a problem to determine how it relates to existing knowledge. 4C2.b.5.h: Apply past experience to develop a course of action for a new situation. 4C2.b.6.h: Use existing knowledge to develop a resolution for a new situation, problem or opportunity.
Standard: 4C3: Students will communicate and collaborate with others to accomplish tasks and develop solutions to problems and opportunities.	4C3.a: Communicate thoughts and feelings with others using verbal and non-verbal language.	4C3.a.8.m: Implement effective listening skills in resolving a situation. 4C3.a.9.h: Develop a mutually acceptable response to a question or problem.

		4C3.a.11.h: Communicate effectively in the presence of a language barrier. 4C3.a.12.h: Utilize effective listening skills in creating consensus in a group.
	4C3.b: Work collaboratively with others.	4C3.b.4.m: Use idea generating practices as part of a group. 4C3.b.5.m: Describe ways to facilitate group collaboration. 4C3.b.6.m: Demonstrate the use of various tools to communicate effectively with an individual or a group. 4C3.b.7.h: Participate in group processes to generate consensus. 4C3.b.8.h: Lead group processes to generate consensus.
	4C3.c: Use interpersonal skills to resolve conflicts with others in an ethical manner.	4C3.c.5.m: Contribute to resolving conflicts that occur within a team or group. 4C3.c.6.m: Explore the ethical considerations of a current or historical action or decision. 4C3.c.7.h: Resolve conflicts productively with individuals as they arise. 4C3.c.8.h: Lead a team or group through a conflict resolution process to reach a productive outcome.
Wisconsin Common Career Technical Standards (WCCTS)-Career Development (CD)		
Standard	Learning Priority	Performance Indicators
Standard: CD1: Students will consider, analyze and apply an awareness of self, identity and culture to identify skills and talents.	CD1.a: Identify person strengths, aptitudes and passions.	CD1.a.2.m: Assess personal strengths, aptitudes and passions related to potential future careers CD1.a.3.h: Evaluate various occupations and career pathways to identify personal, academic and career goals based on personal strengths, aptitudes and passions.
	CD1.b: Demonstrate effective decision-making, problem solving and goal setting.	CD1.b.4.m: Identify long and short-term goals. CD1.b.5.h: Use a decision-making and problem-solving model.
	CD1.c: Interact effectively with others in similar and diverse teams.	CD1.c.7.m: Display cooperative behavior and identify personal strengths and assets in groups. CD1.c.11.h: Evaluate how the personal strengths and assets of others contribute to a cooperative group atmosphere. CD1.c.12.h: Assess how respect and appreciation for individual and

		cultural differences impacts group processes.
	CD1.d: Apply a range of relevant decision-making strategies.	CD1.d.4.m: Apply decision-making strategies to personal and team interactions. CD1.d.5.h: Predict the outcome of various decisions on personal, social and career success. CD1.d.6.h: Evaluate the impact of personal decision-making strategies on specific outcomes.
Standard: CD2: Students will identify the connection between educational achievement and work opportunities in order to reach personal and career goals.	CD2.a: Apply academic experiences to the world of work, inter-relationships and the community.	CD2.a.2.m: Describe a diverse range of opportunities available beyond high school. CD2.a.3.h: Evaluate how performance and connections within the learning community enhance future opportunities. CD2.a.4.h: Determine those opportunities that best support attainment of a specific career goal.
	CD2.b: Assess attitudes and skills that contribute to successful learning in school and across the life span.	CD2.b.5.m: Apply academic information from a variety of sources to enhance career preparedness and lifelong learning. CD2.b.6.m: Research local and regional labor market and job growth information to analyze career opportunities. CD2.b.7.h: Interpret and analyze the impact of current education, training and work trends on life, learning and career plans. CD2.b.8.h: Assess education and training opportunities to acquire new skills necessary for career advancement. CD2.b.9.h: Analyze local and regional labor market and job growth information to select a career pathway for potential advancement.
Standard: CD3: Students will create and manage a flexible and responsive individualized learning plan to meet their career goals.	CD3.a: Investigate the world of work in order to gain knowledge of self in order to make informed career decisions.	CD3.a.5.m: Demonstrate the ability to use technology to retrieve and manage career information that inspires educational achievement. CD3.a.6.m: Build an ongoing awareness of personal abilities, skills, interests and motivation and determine how these fit with chosen career pathway. CD3.a.7.m: Develop an individual learning plan to enhance educational achievement and attain

		career goals based on a career pathway. CD3.a.9.m: Use assessment results in educational planning including career awareness. CD3.a.10.h: Analyze how career plans may be affected by personal growth, external events and changes in motivations and aspirations. CD3.a.11.h: Apply academic and employment readiness skills in work-based learning situations such as internships, shadowing and/or mentoring experiences. CD3.a.12.h: Evaluate changes in local, national and global employment trends, societal needs and economic conditions related to career planning. CD3.a.14.h: Implement an individual learning plan to maximize academic ability and achievement.
	CD3.b: Examine and evaluate opportunities that could enhance life and career plans and articulate plan to guide decisions and actions.	CD3.b.2.m: Describe educational levels (e.g., work-based learning, certificate, two-year, four-year and professional degrees) and performance skills needed to attain personal and career goals. CD3.b.3.m: Demonstrate openness to exploring a wide range of occupations and career pathways. CD3.b.4.h: Implement strategies for responding to transition and change with flexibility and adaptability. CD3.b.5.h: Evaluate the relationship between educational achievement and career development.
	CD3.c: Employ career management strategies to achieve future career success and satisfaction.	CD3.c.3.m: Identify work values and needs. CD3.c.4.m: Define adaptability and flexibility in the world of work. CD3.c.5.h: Determine how principles of equal opportunity, equity, respect, inclusiveness and fairness, affect career planning and management. CD3.c.6.h: Discuss how adaptability and flexibility, especially when initiating or responding to change, contributes to career success.

Standard: CD4: Students will identify and apply employability skills.	CD4.a: Identify and demonstrate positive work behaviors and personal qualities needed to be employable.	CD4.a.4.m: Demonstrate flexibility and willingness to learn new knowledge and skills. CD4.a.5.m: Identify positive work-qualities typically desired in each of the career cluster's pathways. CD4.a.6.h: Evaluate how self-discipline, self-worth, positive attitude and integrity displayed in a work situation affect employment status. CD4.a.7.h: Assess how flexibility and willingness to learn new knowledge and skills affect employment status. CD4.a.8.h: Apply communication strategies when adapting to a culturally diverse environment. CD4.a.9.h: Use positive work-qualities typically desired in each of the career cluster's pathways. CD4.a.10.h: Manage work roles and responsibilities to balance them with other life roles and responsibilities.
	CD4.b: Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.	CD4.b.3.m: Use technology to assist in career exploration and job-seeking activities. CD4.b.4.m: Compare and contrast personal attributes with employment needs and trends. CD4.b.5.h: Use multiple resources to locate job opportunities. CD4.b.6.h: Prepare a resume, cover letter, employment application. CD4.b.7.h: Employ critical thinking and decision-making skills to exhibit qualifications to a potential employer in an interview.
	CD4.c: Identify and exhibit traits for retaining employment.	CD4.c.3.m: Distinguish between appropriate behaviors in a social vs. professional setting. CD4.c.4.h: Model behaviors that demonstrate reliability and dependability. CD4.c.5.h: Maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite. CD4.c.6.h: Complete required employment forms and documentation. CD4.c.7.h: Summarize key activities necessary to retain a job in an industry.

	CD4.d: Develop positive relationships with others.	CD4.d.4.m: Use cooperative behavior in helping peers accomplish goals and tasks. CD4.d.5.h: Participate in co-curricular and community activities to enhance the school experience. CD4.d.6.h: Evaluate the best method to assist co-workers in accomplishing goals and tasks. CD4.d.7.h: Examine the skills required to enable students to successfully transition to post-secondary opportunities. CD4.d.8.h: Use a systematic approach to academic and career planning for students to achieve their learning, socio-cultural and work goals.
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Wisconsin Common Career Technical Standards (WCCTS)-Environmental Health and Safety (EHS)

Standard	Learning Priority	Performance Indicators
Standard: EHS1: Students will identify the importance and interrelationships of health, safety and environmental systems and evaluate the impacts of these systems on organizational performance for continuous improvement.	EHS1.d: Implement personal and jobsite safety rules and regulations to maintain and improve safe and healthful working conditions and environments.	EHS1.d.5.m: Recognize and use systems in school and in the community that protect and enhance personal, environmental health and safety. EHS1.d.6.m: Discuss employee rights and responsibilities and how to apply them in a workplace setting. EHS1.d.7.h: Assess workplace conditions with regard to personal and environmental health and safety. EHS1.d.8.h: Identify different workplace systems that protect and enhance personal and environmental health and safety. EHS1.d.9.h: Describe employee rights and responsibilities to maintain workplace health and safety, including compliance with rules and laws.

Key Vocabulary:

Aesthetics	Emphasis	Nominal Strength	Statically Determinate
Arch	Façade	Pattern	Strain
Architect	Fascia	Post-and-Lintel Construction	Strength
Axial Force	Fenestration	Potable Water	Stress
Backsight	Floor Joists	Property Survey	Structural Engineer
Balance	Floor Plan	Rafter	Stud

Beam	Footing	Range	Subfloor
Bearing	Foresight	Rebar	Sustainability
Benchmark (BM)	Form	Repetition	Tensile Strength
Building Code	Foundation	Rhythm	Texture
Charrette	Girder	Riser	Top Plate
Circuit Breaker	Header	Runoff Coefficient	Topographic Survey
Civil Engineer	Ingress	R-Value	Township
Column	Insulation	Safety Factor	Truss
Compression Strength	Internal Force	Section	U-Factor
Concrete	Invert	Setback	Underlayment
Contrast	Keystone	Shape	Unity
Decking	Lateral Load	Shear Force	Universal Design
Deflection	Lavatory	Sheathing	Value
Deformation	Live Load	Sill	Variance
Dead Load	Load	Sole Plate	Vernacular Architecture
Design Load	Load Bearing Wall	Space	Water Closet
Easement	Moment	Span	Yield Stress
Egress	Moment Arm	Specifications	Zoning Ordinance
Element of Design	Movement	Stakeholder	
Elevation	Municipality	Static Head	

Topics/Content Outline- Units and Themes:

Quarter 1:

Unit 1: Overview of Civil Engineering and Architecture

- Lesson 1.1 History of Civil Engineering and Architecture
- Lesson 1.2 Careers in Civil Engineering and Architecture

Unit 2: Residential Design

- Lesson 2.1 Building Design and Construction

Quarter 2:

- Lesson 2.2 Cost and Efficiency Analysis
- Lesson 2.3 Residential Design

Quarter 3:

Unit 3: Commercial Applications

- Lesson 3.1 Commercial Building Systems
- Lesson 3.2 Structures
- Lesson 3.3 Services and Utilities

Quarter 4:

- Lesson 3.4 Site Considerations

Unit 4: Commercial Building Design Problem

- Lesson 4.1 Commercial Design Problem
- Lesson 4.2 Commercial Design Presentation

Primary Resource(s):
• Project Lead the Way: Civil Engineering and Architecture Curriculum

