Wall Township Public Schools	Board Approval Date: 8/20/2024
Course Title: Architectural Studio	
Course Description: Students will Demonstrate a professional understanding of how to solve a design problem using the skills they have previously learned in the Prerequisite classes. Students will be able to generate design solutions to a real world problem in a team setting utilizing their Engineering 2 or Architecture 2 knowledge. Design Problems will be focused on the built environment.	

New Jersey Student Learning Standards- Computer Science & Design Thinking (Click here to skip below to a description about the Standards)

Course Sequence & Pacing

Unit Title	Estimated Number of Instructional Periods
Unit 1 : Overview of Civil Engineering / Architectural Studio Design	5
Unit 2 : Project Presentation, Collaboration, and Design Communication Standards	5
Unit 3 : Project Planning, Research and Data Collection	10
Unit 4 : Environmental Analysis and Site Planning	10

Unit 5 : Civil Engineering and Architectural Design	15
Unit 6 : Structural Engineering and Advanced Technology	20
Unit 7 : Final Project and Design Collaboration	20

Unit 1

Desired Results

Unit 1 Title: Overview of Civil Engineering / Architectural Studio Design

Unit Summary: Students will be able to differentiate between Civil Engineering and Architectural Design. Students will be able to understand the pros and cons of each and the value that each provides to the overall design process.

Learning Standards

NJSLS Computer Science & Design Thinking:

8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.

8.2.12.ITH.3: Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.

8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than other

Interdisciplinary Connections

Career Readiness, Life Literacies, & Key Skills *(CLKS)*:9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs
Computer Science & Design Thinking (*CS & DT***):** 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers 8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback. 8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. 8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). 8.2.12.ED.1: Use appropriate technology and techniques to solve a problem or create a product. 8.2.12.ETW.1: Analyze the impact of technology on culture, individuals, and society. 8.2.12.EC.1: Develop a computational artifact to solve a problem or illustrate a concept.
Interdisciplinary Connections: RI.CI.11–12.2 Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text. RI.MF.11–12.6 Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. RL.CR.11–12.1 Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain. RL.CI.11–12.2 Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

Learning Targets

Unit Essential Questions:

- What are the key differences between Civil Engineering and Architectural Design?
- How do Civil Engineers and Architects collaborate in the design process?
- What role does functionality play in Civil Engineering?
- How does aesthetics impact Architectural Design?
- Why is collaboration important in the design process?

Unit Enduring Understandings:

- Civil Engineering focuses on functionality and safety.
- Architectural Design emphasizes aesthetics and user experience.
- Collaboration between Civil Engineers and Architects leads to well-rounded designs.

Vocabulary: Civil Engineering, Architectural Design, Collaboration,Design process, Aesthetics, Functionality

Students will be able to:

- Differentiate the roles and responsibilities of Civil Engineers and Architects.
- Understand the fundamental principles of civil engineering and architectural design.
- Identify and explain the roles and responsibilities of civil engineers and architects.
- Demonstrate the ability to conceptualize basic design projects integrating civil engineering and architectural elements.
- Appreciate the importance of collaboration between these fields.

Learning Activities & Differentiation:

- Group discussions on roles in Civil Engineering and Architectural Design.
- Case study analyses of collaborative projects.
- Research diverse historical and cultural contributions to both fields.

Assessment Evidence

Formative Assessments:

- Quizzes on key concepts.
- Reflective journals.
- Group discussions.
- Case study presentations.
- Peer feedback on collaborative efforts.

Summative Assessments:

- Group presentations on case studies.
- Comparative essays.
- Design projects illustrating the integration of Civil Engineering and Architectural Design.
- Written reports on the roles and responsibilities of each discipline.
- Visual projects demonstrating understanding.

Common Benchmark Assessments:

- Essays comparing and contrasting Civil Engineering and Architectural Design.
- Evaluations of group project presentations.
- Analysis of historical case studies.

Alternative Assessments:

- Visual projects demonstrating key concepts.
- Multimedia presentations.

Core Instructional & Supplemental Materials

Textbooks on Civil Engineering and Architectural Design.
Design software tutorials.

Accommodations and Modifications: Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Students with Disabilities: Provide graphic organizers to help with understanding and organizing information

English Language Learners: Simplify language and provide instructions in both English and the student's native language

Students at Risk of Failure: Offer frequent check-ins and feedback. Break down assignments into smaller, manageable tasks with clear deadlines.

Students with 504s: Allow the use of assistive technology. Preferential seating to allow for easy teacher to student access.

Gifted & Talented: Encourage participation in additional project work that explores advanced topics in civil engineering and architecture.

Unit 2

Desired Results

Unit 2 Title: Project Presentation, Collaboration, and Design Communication Standards

Unit Summary: Students will learn how to present their projects effectively, collaborate with peers, and follow design communication standards.

Learning Standards

NJSLS Computer Science & Design Thinking:

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas

9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments.

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

Interdisciplinary Connections

Career Readiness, Life Literacies, & Key Skills *(CLKS)*: Effective communication, teamwork.

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs

Computer Science & Design Thinking ***(****CS & DT****)*****:** Presentation software, design tools.

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

8.2.12.D.4: Develop a prototype to demonstrate the design process.

8.2.12.NT.1: Evaluate the use of emerging technology to address real-world problems.

8.2.12.ETW.2: Analyze ethical issues and decisions involving digital culture and technology.

Interdisciplinary Connections:

RI.CI.11–12.2
Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text.

RI.MF.11–12.6
Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.

RL.CR.11–12.1
Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.CI.11–12.2
Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

Learning Targets

Unit Essential Questions:	**Unit Enduring Understandings:**
• How can effective communication enhance project collaboration?	• Clear communication and collaboration are vital for project success.

• What are the key elements of a successful project presentation? • Why are design communication standards important? • How do different presentation tools impact the delivery of a project? • What strategies can be used to improve collaboration within a team?	• Following design communication standards ensures clarity and professionalism. • Effective presentations convey ideas clearly and persuasively.
Vocabulary: Collaboration, Presentation skills, design communication standards, teamwork, feedback, professionalism	
Students will be able to: • Develop and deliver effective project presentations. • Collaborate with peers to enhance their projects. • Utilize appropriate design communication standards and tools to articulate design ideas.	
Learning Activities & Differentiation: • Peer reviews of presentation drafts. • Group work on collaborative projects. • Inclusion of diverse perspectives in project topics.	

Assessment Evidence

Formative Assessments:

- Peer feedback on presentations.
- Draft presentation reviews.
- Reflective journals.
- Group discussions on collaboration.

- Practice presentation sessions.

Summative Assessments:

- Final project presentations.
- Written reports on collaboration strategies.
- Evaluation of presentation skills using a rubric.
- Group project outcomes.
- Reflective essays on the importance of communication.

Common Benchmark Assessments:

- Rubric-based assessment of presentation skills.
- Evaluation of teamwork and collaboration in group projects.
- Analysis of peer feedback effectiveness.

Alternative Assessments:

- Multimedia presentations.
- Visual aids and models to support presentations.

Core Instructional & Supplemental Materials

Presentation software (e.g., PowerPoint, Google Slides).
Resources on effective communication and presentation skills.

Design and engineering software:
Autodesk Revit, Lumion 3D Rendering, Makerbot 3D Printing, VR Modeling Technology, Autodesk Civil 3D, Onshape 3D Modeling, Adobe Illustrator.

Accommodations and Modifications:
Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Students with Disabilities: Provide a template for presentations. Allow for alternative presentation methods such as video or audio recording.

English Language Learners: Use visual aids and sentence starters to support presentation skills.

Students at Risk of Failure: Provide additional time and feedback sessions to refine presentation skills. Create a step by step template to aid with creating presentations.

Students with a 504: Allow extended time for presentation preparation and practice. Provide extra time outside of class for student to present.

Gifted & Talented Students: Encourage the creation of more complex and advanced presentations using Adobe Illustrator or using more design tools on Google Slides.

Unit 3

Desired Results

Unit 3 Title: Project Planning, Research and Data Collection

Unit Summary: Students will learn how to plan projects, conduct research, and collect relevant data

Learning Standards

NJSLS Computer Science & Design Thinking:

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

Interdisciplinary Connections

Career Readiness, Life Literacies, & Key Skills *(CLKS)*: Research skills, data analysis.

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs

Computer Science & Design Thinking ***(****CS & DT****)*****:** Use of research tools and databases.

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

8.2.12.EC.2: Create a computational artifact to illustrate a concept or solve a problem.

8.2.12.ED.2: Develop and test a prototype to solve a problem.

8.2.12.D.3: Evaluate the effectiveness of various design solutions

Interdisciplinary Connections:

RI.CI.11–12.2

Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text.

RI.MF.11–12.6
Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.

RL.CR.11–12.1
Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.CI.11–12.2
Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

Learning Targets

Unit Essential Questions:

- What are the steps involved in effective project planning?
- How does data collection influence the design process?
- What tools and methods are used in research for design projects?
- How can accurate data improve project outcomes?
- What challenges might arise during the research phase of a project?

Unit Enduring Understandings:

- Thorough planning and research are essential for successful projects.
- Data collection provides valuable insights that shape the design process.
- Effective research methods lead to accurate and useful data.

Vocabulary: Project planning, research, data collection, analysis, methodology Documentation

Students will be able to:

- Develop comprehensive project plans.
- Conduct research and collect data to inform their designs.
- Create detailed project plans including timelines, resources, and objectives.
- Conduct thorough research and data collection to inform design decisions.
- Analyze and interpret data to support project development and problem-solving.

Learning Activities & Differentiation:

- Research projects on diverse contributions to engineering and design.
- Data analysis exercises.
- Group discussions on research methods.

Assessment Evidence

Formative Assessments:

- Research proposals.
- Data collection plans.
- Quizzes on research methods.
- Reflective journals on research experiences.
- Peer reviews of research plans.

Summative Assessments:

- Research reports.
- Project plans.

- Presentations on research findings.
- Data analysis projects.
- Written reflections on the research process.

Common Benchmark Assessments:

- Evaluations of research proposals.
- Analysis of data collection plans.
- Reviews of research reports.

Alternative Assessments:

- Visual data presentations.
- Multimedia research summaries.

Core Instructional & Supplemental Materials

Design and engineering software:
Autodesk Revit, Lumion 3D Rendering, Makerbot 3D Printing, VR Modeling Technology, Autodesk Civil 3D, Onshape 3D Modeling, Adobe Illustrator.

Accommodations and Modifications: Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Specific Strategies and Practices that Support Students with Disabilities:
Students receiving Special Education programming have specific goals and objectives, as well as accommodations and modifications outlined within their Individualized Education Plans (IEP) due to an identified disability and/or diagnosis. In addition to exposure to the general education curriculum, the instruction is differentiated based upon the student's needs. The IEP acts as a supplemental curriculum guide inclusive of instructional strategies that support each learner.

- Small group/One to one - Additional time - Review of directions - Student restates information - Space for movement or breaks - Extra visual and verbal cues and prompts - Preferential seating - Follow a routine/schedule - Rest breaks - Verbal and visual cues regarding directions and staying on task - Checklists - Immediate feedback

Students with Disabilities: Using digital tools and software to assist with planning and data collection
English Language Learners: Offer bilingual research materials and translated resources
Students at Risk of Failure: Provide regular progress checks and one on one feedback
Students with 504 Plans: Allow extended time for research activities and project planning
Gifted & Talented Students: Encourage deep dives into advanced research topics and the usage of data visualization methods.

Unit 4

Desired Results

Unit 4 Title: Environmental Analysis and Site Planning

Unit Summary:

Students will explore environmental analysis and site planning, focusing on factors such as topography, climate, vegetation, and soil conditions. They will learn methods for conducting site surveys, environmental impact assessments, and sustainable land use planning. Students will engage in hands-on activities to analyze a site and develop integrated site plans. Emphasis will be placed on sustainable and environmentally responsible design practices. Through collaborative projects and individual assignments, students will apply their knowledge to real-world scenarios, developing comprehensive site plans that demonstrate their understanding of environmental analysis and sustainable planning principles.

Learning Standards

NJSLS:

8.2.12.ETW.2: Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.

8.2.12.ETW.3: Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than other

Interdisciplinary Connections

Career Readiness, Life Literacies, & Key Skills *(CLKS)***:** Environmental awareness, sustainability.

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs

Computer Science & Design Thinking (*CS & DT***):** Use of GIS and environmental analysis tools.

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

8.2.12.ED.4: Develop and test a prototype to demonstrate the design process.

8.2.12.D.5: Analyze the results of a prototype and make necessary modifications.

8.2.12.EC.3: Apply computational thinking to develop a solution to a real-world problem.

Interdisciplinary Connections:

RI.CI.11–12.2
Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text.

RI.MF.11–12.6
Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.

RL.CR.11–12.1
Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.CI.11–12.2
Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text

Learning Targets

Unit Essential Questions:

- How does conceptual design influence the final project outcome?
- What techniques are used in initial sketching for architectural projects?
- How can initial sketches communicate design intent effectively?
- What role does creativity play in conceptual design?
- How do conceptual designs evolve into detailed plans?

Unit Enduring Understandings:

- Conceptual design sets the foundation for the entire project.
- Initial sketches are vital for visualizing and communicating design ideas.
- Creativity is essential in developing innovative conceptual designs.

Vocabulary: Conceptual design, initial sketching, design intent, creativity, visualization, brainstorming

Students will be able to:

- Conduct environmental analyses for site planning.
- Apply principles of sustainable design to their projects.
- Develop initial design concepts through sketching and brainstorming techniques.
- Apply creative thinking to generate innovative design solutions.
- Use visualization techniques to communicate design ideas effectively.

Learning Activities & Differentiation:

- Sketching exercises incorporating diverse architectural styles.
- Collaborative brainstorming sessions.
- Analysis of conceptual designs from various cultural backgrounds.

Assessment Evidence

Formative Assessments:

- Concept sketches.
- Peer reviews of initial designs.
- Reflective journals on the design process.
- Quizzes on sketching techniques.
- Group discussions on conceptual design ideas.

Summative Assessments:

- Final conceptual design presentations.
- Detailed project plans based on initial sketches.
- Written reports on the evolution of conceptual designs.
- Visual portfolios of sketches and designs.
- Reflective essays on the role of creativity in design.

Common Benchmark Assessments:

- Rubric-based assessment of concept sketches.
- Evaluations of design presentations.
- Analysis of design evolution reports.

Alternative Assessments:

- Visual art projects demonstrating design concepts.
- Multimedia presentations of design ideas.

Core Instructional & Supplemental Materials

GIS software and environmental analysis tools:

- ArcGIS: Monmouth and Ocean County System: https://www.arcgis.com/index.html
- Autodesk Revit, Lumion 3D Rendering, Makerbot 3D Printing, VR Modeling Technology, Autodesk Civil 3D, Onshape 3D Modeling, Adobe Illustrator.

Accommodations and Modifications: Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Specific Strategies and Practices that Support Students with Disabilities:

Students receiving Special Education programming have specific goals and objectives, as well as accommodations and modifications outlined within their Individualized Education Plans (IEP) due to an identified disability and/or diagnosis. In addition to exposure to the general education curriculum, the instruction is differentiated based upon the student's needs. The IEP acts as a supplemental curriculum guide inclusive of instructional strategies that support each learner.

- Small group/One to one - Additional time - Review of directions - Student restates information - Space for movement or breaks - Extra visual and verbal cues and prompts - Preferential seating - Follow a routine/schedule - Rest breaks - Verbal and visual cues regarding directions and staying on task - Checklists - Immediate feedback

Students with Disabilities: Provide hands-on activities and field trips to help with site analysis. Use assistive technology to help students visualize the building site such as VR technology and 3D Modeling / Printing Technology.

English Language Learners : Use bilingual data sheets and digital translation tools to assist with student comprehension. Emphasize kinesthetic learning.

Students at Risk of Failure: Provide a structured observation checklist to simplify the analysis process.

Students with 504 Plans: Provide alternative formats for assignments, such as oral presentations or visual projects.

Gifted & Talented Students: Encourage advanced environmental planning techniques using more complex tools and techniques.

Unit 5

Desired Results

Unit 5 Title: Civil Engineering and Architectural Design

Unit Summary: Students will integrate Civil Engineering principles with Architectural Design to create cohesive projects.

Learning Standards

NJSLS Computer Science & Design Thinking:

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.

8.2.12.ITH.3: Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.

Interdisciplinary Connections
Career Readiness, Life Literacies, & Key Skills *(CLKS)*: Integration of technical and creative skills. 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs
Computer Science & Design Thinking ***(****CS & DT****)*****:** Use of design and engineering software. 8.2.12.ED.5: Use a variety of technologies to create a product that addresses a real-world need. 8.2.12.ETW.3: Develop and implement a plan to address the impact of technology on the environment. 8.2.12.EC.4: Create a computational artifact that addresses a real-world issue. 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers 8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback. 8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience. 8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
Interdisciplinary Connections: RI.CI.11–12.2 Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text. RI.MF.11–12.6 Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.

RL.CR.11–12.1
Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.CI.11–12.2
Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

Learning Targets

Unit Essential Questions:

- How does structural analysis influence design decisions?
- What factors must be considered when selecting materials for a project?
- How do different materials impact the structural integrity of a design?
- What tools and methods are used in structural analysis?
- How can material selection enhance both functionality and aesthetics?

Unit Enduring Understandings:

- Structural analysis ensures the safety and stability of a design.
- Material selection is crucial for both functionality and aesthetics.
- Different materials have unique properties that impact design decisions.

Vocabulary: Structural analysis, material selection, structural integrity, load-bearing capacity, properties, sustainability

Students will be able to:

- Integrate Civil Engineering and Architectural Design principles in their projects.
- Address challenges in combining these disciplines
- Select appropriate materials based on properties, sustainability, and cost considerations.

- Evaluate the impact of material choices on the overall design and structural integrity.

Learning Activities & Differentiation:

- Research on sustainable materials.
- Case studies of structures using innovative materials.
- Group discussions on the impact of material choices on diverse communities.

Assessment Evidence

Formative Assessments:

- Quizzes on structural analysis concepts.
- Material selection reports.
- Reflective journals on analysis findings.
- Group discussions on material properties.
- Peer reviews of material choices.

Summative Assessments:

- Structural analysis projects.
- Material selection portfolios.
- Presentations on the impact of materials on design.
- Written reports on structural integrity.
- Case study analyses.

Common Benchmark Assessments:

- Evaluations of structural analysis projects.
- Reviews of material selection reports.
- Rubric-based assessment of presentations.

Alternative Assessments:

- Visual models demonstrating material properties.

- Multimedia presentations on structural analysis.

Core Instructional & Supplemental Materials

Design and engineering software:
Autodesk Revit, Lumion 3D Rendering, Makerbot 3D Printing, VR Modeling Technology, Autodesk Civil 3D, Onshape 3D Modeling, Adobe Illustrator.

Accommodations and Modifications: Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Support Students with Disabilities: Provide tactile models and visual aids to demonstrate structural concepts. Use smartphone apps to aid in environmental material identification.

English Language Learners: Provide bilingual glossaries and visual dictionaries for material properties

Students at Risk of Failure: Offer additional opportunities and hands-on activities to help students grasp the overall concepts and properties of each material.

Students with 504 Plans: Allow extended time for completing structural analysis and material selection tasks.

Gifted & Talented Students: Encourage research on innovative materials and their applications in structural design. Offer the usage of digital modeling tools that analyze the overall structural design.

Unit 6

Desired Results

Unit 6 Title: Structural Engineering and Advanced Technology

Unit Summary: Students will explore modern technologies in structural design, including the use of Artificial Intelligence (AI), robotics, and other cutting-edge tools. They will learn how these technologies are transforming Civil and Architectural Design, improving efficiency, accuracy, and innovation.

Learning Standards

NJSLS:

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Interdisciplinary Connections

Career Readiness, Life Literacies, & Key Skills *(CLKS)*: Technological literacy, problem-solving.

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs

Computer Science & Design Thinking (*CS & DT***):** AI applications, robotics in design, modern design software.

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

8.2.12.D.6: Use data to make decisions and solve problems.

8.2.12.ETW.4: Evaluate the use of emerging technology to solve a problem or address a global issue.

8.2.12.EC.5: Use a variety of technologies to develop and test a solution to a real-world problem.

Interdisciplinary Connections:

RI.CI.11–12.2
Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text.

RI.MF.11–12.6
Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.

RL.CR.11–12.1
Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.CI.11–12.2
Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

Learning Targets

Unit Essential Questions:	**Unit Enduring Understandings:**
• How are modern technologies like AI and robotics transforming Civil and Architectural Design? • What are the advantages and challenges of using these technologies in design? • How do AI and robotics enhance the design process? • What are the ethical considerations of using AI in design? • How can students prepare for future advancements in design technology?	• Modern technologies such as AI and robotics enhance the design process by increasing efficiency, accuracy, and innovation. • Understanding the use of these technologies prepares students for future advancements in the field. • Ethical considerations are crucial in the application of AI and robotics in design.
Vocabulary: Artificial Intelligence, robotics, modern design technology, automation, BIM (Building Information Modeling)	
Students will be able to: • Explain how AI and robotics are used in Civil and Architectural Design. • Apply modern design technologies to their projects. • Evaluate the benefits and challenges of using advanced technologies in design. • Understand and apply modern structural design technologies and tools. • Integrate artificial intelligence and robotics into the design process. • Evaluate the impact of emerging technologies on civil and architectural design practices.	
Learning Activities & Differentiation: • Discuss how diverse perspectives influence the adoption and application of modern technologies. • Case studies on AI and robotics in design, hands-on projects using design software, guest lectures from industry professionals.	

Assessment Evidence

Formative Assessments:

- Quizzes on modern design technologies.
- Reflective journals on the impact of AI and robotics.
- Peer feedback on technology projects.
- Group discussions on ethical considerations.
- Draft project proposals incorporating modern technologies.

Summative Assessments:

- Final technology-enhanced design projects.
- Written reports on the advantages and challenges of using modern technologies.
- Presentations on AI and robotics applications in design.
- Evaluation of project proposals.
- Comparative analyses of traditional vs. modern design methods.

Common Benchmark Assessments:

- Assessments of final design projects.
- Reviews of written reports on technology use.
- Rubric-based evaluations of presentations.

Alternative Assessments:

- Visual models incorporating AI and robotics.
- Multimedia presentations on modern technology applications.

Core Instructional & Supplemental Materials

Textbooks on modern structural design and AI applications in design.

Design and engineering software:
Autodesk Revit, Lumion 3D Rendering, Makerbot 3D Printing, VR Modeling Technology, Autodesk Civil 3D, Onshape 3D Modeling, Adobe Illustrator, Arduino, Raspberry Pi.

Accommodations and Modifications:
Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Students with Disabilities: Provide tutorials and hands on training with adaptive technology tools. Use Step by step guides for integrating AI and robotics into design tasks.

Support English Language Learners: Offer bilingual resources and visual aids for understanding modern design technologies. Pair ELL students with an advanced understanding of modern technologies.

Students at Risk of Failure: Provide structured and guided activities to build confidence with modern technologies. Offer additional instruction and practice sessions for using AI and Robotic Tools.

Students with 504 Plans: Allow for extended time and alternative formats for technology assignments. Provide one on one check ins and tutorials to guide students through the usage of modern technologies.

Gifted & Talented Students: Encourage exploration of cutting edge technologies and their applications in design. Offer opportunities to develop advanced projects using AI and robotics.

Unit 7

Desired Results

Unit 7 Title: Final Project and Design Collaboration

Unit Summary: Students will work on a final integrated design project that combines Civil Engineering and Architectural Design principles. This project will demonstrate their understanding of the design process, collaboration, sustainability, and technical skills learned throughout the course.

Learning Standards

NJSLS:

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

Interdisciplinary Connections

Career Readiness, Life Literacies, & Key Skills *(CLKS)*: Project management, teamwork.

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs

Computer Science & Design Thinking (*CS & DT***):** Use of integrated design software, project management tools.

8.2.12.ETW.5: Analyze the impact of technology on the environment and develop a plan to address environmental issues.

8.2.12.D.7: Develop a prototype that addresses a real-world environmental issue.

8.2.12.EC.6: Create a computational artifact to support sustainability efforts.

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

Interdisciplinary Connections:

RI.CI.11–12.2
Determine one or more central ideas of an informational text and analyze how it is developed and refined over the course of a text, including how it emerges and is shaped by specific details; provide an objective summary of the text.

RI.MF.11–12.6
Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.

RL.CR.11–12.1
Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.CI.11–12.2
Determine two or more themes or central ideas of a literary text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

Learning Targets

Unit Essential Questions:	**Unit Enduring Understandings:**
• How can Civil Engineering and Architectural Design be effectively integrated in a final project? • What are the key components of a successful final design project?	• Integrating Civil Engineering and Architectural Design requires collaboration, technical skills, and creative problem-solving. • A successful final design project showcases the ability to apply learned concepts and work effectively as a team.
Vocabulary: Project integration, design collaboration, project management, feedback, presentation, synthesis.	
Students will be able to: • Integrate Civil Engineering and Architectural Design principles in a final project. • Demonstrate project management and collaboration skills. • Present their final design project effectively. • Integrate knowledge and skills acquired throughout the course into a comprehensive final project. • Collaborate effectively with peers to develop and refine design projects. • Present final projects clearly and professionally, demonstrating a synthesis of civil engineering and architectural design principles.	
Learning Activities & Differentiation: *(Amistad & Holocaust, Asian American & Pacific Islanders, Climate Change, LGBTQ and People with Disabilities, Diversity, Equity & Inclusion [DEI])* Students will be able to articulate the impact of various cultures both past and present have had an impact on modern day design solutions. Students will be able to design using sustainability design concepts using material science and alternative building techniques. Students will be proficient working with a diverse group of students to be able to achieve a mutually agreeable design solution.	

Assessment Evidence

Formative Assessments:

- Draft Project Proposals: Students will submit initial project proposals for feedback.
- Peer Feedback Sessions: Students will participate in peer review sessions to provide and receive constructive feedback.
- Progress Check-ins: Regular check-ins with instructors to discuss project progress and address any challenges.
- Reflective Journals: Students will maintain journals reflecting on their collaboration and design process.
- Preliminary Design Reviews: Students will present preliminary designs to the class for critique and improvement suggestions.

Summative Assessments:

- Final Project Presentation: Students will present their final design projects to the class.
- Written Report: Students will submit a detailed report outlining the design process and final solution.
- Peer and Instructor Evaluation: Students will be evaluated by peers and instructors using a rubric.

Common Benchmark Assessments:

- Project Rubric Evaluation: Final projects will be assessed using a standardized rubric.
- Team Collaboration Assessment: Team collaboration will be evaluated using a rubric.
- Presentation Skills Assessment: Students' presentation skills will be assessed for clarity and organization.

Alternative Assessments:

- Visual Model Demonstration: Students will create and present a model of their final design project.
- Multimedia Presentation: Students will produce a multimedia presentation showcasing their final design.
- Reflective Portfolio: Students will compile a portfolio with sketches, drafts, and reflections on their learning process.

Core Instructional & Supplemental Materials

- Design and engineering software for project work
  - Autodesk Revit
  - Autodesk Civil 3D
  - Lumion 3D Rendering
- Project management tools and resources.
  - Gantt Chart Diagramming
  - Calendar Management
  -

Accommodations and Modifications: Students with Disabilities, English Language Learners, Students at Risk of Failure, Students with 504s, Gifted & Talented Students

Students with Disabilities: Allow alternative formats for final project presentations such as digital portfolios and models. Provide structured collaboration tools and support for team projects. Provide structured collaboration tools and support for team projects.

English Language Learners: Offer bilingual resources and templates for project documentation. Encourage ELL students to work with bilingual peers for collaborative projects.

Students at Risk of Failure: Provide regular check ins and progress monitoring for final projects. Offer additional support and feedback sessions for project development.

Students with 504 Plans: Allow extended time for final project completion. Provide access to additional modern technology and collaboration tools.

Gifted & Talented Students: Encourage the development of innovative and complex final projects. Offer opportunities for leadership roles in team projects and peer monitoring.

New Jersey Student Learning Standards- Computer Science & Design Thinking
CS&DT Computer science and design thinking education prepares students to succeed in today's knowledge-based economy by providing equitable and expanded access to high-quality, standards-based computer science and technological design education. New approaches necessary for solving the critical challenges that we face as a society will require harnessing the power of technology and computing. Rapidly changing technologies and the proliferation of digital information have permeated and radically transformed learning, working, and everyday life. To be well-educated, global-minded individuals in a computing-intensive world, students must have a clear understanding of the concepts and practices of computer science. As education systems adapt to a vision of students who are not just computer users but also computationally literate creators who are proficient in the concepts and practices of computer science and design thinking, engaging students in computational thinking and human-centered approaches to design through the study of computer science and technology serves to prepare students to ethically produce and critically consume technology.
Dimensions of CS&DT • The **Vision and Mission** serve as the foundation for each content areas' standards. They describe the important role of the discipline in the world and reflect the various statutes, regulations, and policy. • The **Performance Expectations** are the studs and serve as the framework for what students should know and be able to do. They incorporate the knowledge and skills that are most important for students to know in order to be prepared for post-secondary success. • The **Disciplinary Concepts and Core Ideas** are the joists and play an integral role in the framing by making connections among the performance expectations. Core ideas help to prioritize the important ideas and core processes that are central to a discipline and have lasting value beyond the classroom. They provide clear guidance as to what should be the focus of learning by the end of each grade band (i.e., end of grades 2, 5, 8, and 12). • The **Practices** are the roof and represent two key ideas. Positioned as the top of the house, they represent

the apex of learning. The goal is for students to internalize the practices (habits of mind) and be able to apply them to new situations outside the school environment. The practices span across all aspects of the standards and are an integral part of K-12 students' learning of the disciplines.	
Disciplinary Concepts & Core Ideas: ● Networks & the Internet ● Impacts of Computing ● Data & Analysis ● Algorithms & Programming ● Engineering Design ● Interaction of Technology and Humans ● Nature of technology ● Effects of Technology on the Natural World ● Ethics & Culture	**Computer Science & Design Thinking Practices:** ● Fostering an Inclusive Computing and Design Culture ● Collaborating around computing and design ● recognizing and defining computational problems ● Developing and Using Abstractions ● Creating Computational Artifacts ● Testing and Refining Computational Artifacts ● Communicating about Computing and Design