Unit 09: Electrical and Mechanical HVAC Systems

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 4**
Length: **5 Weeks**
Status: **Published**

Brief Summary of Unit

Introduction:

Students will develop knowledge and understanding of the electrical and mechanical systems used in residential and commercial buildings. Through the study of building systems, students will examine how electrical, lighting, HVAC, and related mechanical components contribute to the safety, comfort, functionality, and efficiency of the built environment. Students will refine previously acquired drafting and design skills while developing new technical competencies required to accurately represent and coordinate these systems using Computer-Aided Design (CAD). Emphasis will be placed on industry-standard drawing practices, system integration, and the effective communication of technical information through architectural and engineering drawings.

Revision Date: July 2026

Essential Questions/Enduring Understandings

Essential Questions:

What information must be communicated to different audiences through construction and design documents?

How can CAD be used as a productivity tool to create technical drawings for different trades, professions, and building systems?

What are the primary components of electrical and mechanical systems used in buildings?

Enduring Understandings:

Construction documents communicate the information, requirements, and specifications necessary for the successful construction of a building.

CAD is a powerful productivity and communication tool used to create accurate, efficient, and professional technical drawings.

Engineers develop drawings and specifications within their areas of expertise and collaborate as members of an integrated design team.

The accuracy, completeness, and clarity of construction documents directly influence the quality and outcome of the finished project.

Students Will Know/Students Will Be Skilled At

Students will know:

That construction documents are used by contractors and building professionals to guide the construction of buildings.

That large buildings include multiple engineering systems that must be coordinated during the design and construction process.

The vocabulary associated with electrical and mechanical systems in buildings.

That drawings are organized by profession, trade, discipline, and specialty.

That construction documents are used by contractors to determine estimates, quotes, and project costs, and may serve as legally binding documents.

That not all drawings in a building project are prepared by an architect.

That different trades and professions use different units, symbols, conventions, and drawing standards.

That CAD tools, especially layers, allow complex building systems and technical information to be organized more efficiently.

That CAD tools, especially paper space, allow drawings to be printed and presented in ways that communicate trade-specific information clearly.

What information is contained in mechanical and electrical plans.

That information shown in engineering drawings must be coordinated with architectural drawings.

How to communicate industry-specific information clearly and accurately to each trade.

Students will be skilled:

Using layers to represent and organize different systems within buildings.

Developing plans for mechanical and electrical systems.

Reading plan drawings that communicate mechanical and electrical information.

Developing and presenting work through a professional digital portfolio.

Learning Plan

- Preview the essential questions and establish connections to the concepts, skills, and learning

objectives that will be explored throughout the unit.

- Examine guiding questions, including:
    - What information does a mason, carpenter, roofer, plumber, HVAC installer, electrician, and other construction professionals need to successfully complete their work?
    - How can a construction project be organized to communicate all required information clearly and accurately?
    - What types of drawings and documents are necessary for the successful construction of a building?
    - What are the respective roles and responsibilities of architects and engineers within the design and construction process?
    - How do construction documents facilitate communication among the various trades involved in a project?
    - Why is coordination between architectural, mechanical, electrical, and plumbing systems critical to project success?
- Participate in lectures, class discussions, and demonstrations focused on HVAC, electrical, mechanical, and plumbing systems used in buildings.
- Analyze how building systems are integrated within a structure and how construction documents communicate system requirements to different trades and professions.
- Create a model of an office building to serve as the basis for the development of construction drawings. Emphasis will be placed on space planning, systems coordination, and the integration of building systems.
- Formative assessments will be conducted throughout the modeling and design process to monitor student understanding and provide ongoing feedback.
- Summative assessment of the model project will be conducted collaboratively by the student and teacher using a rubric aligned with the project objectives and design criteria.
- Study and reproduce selected details from a professional set of office building construction drawings for analysis and use as design prototypes.
- Examine industry-standard construction documents to develop an understanding of drafting conventions, detailing practices, and technical communication methods.
- Formative assessments will be conducted throughout the drawing and analysis process to assess technical understanding and skill development.
- Summative assessment of the drawing analysis project will be conducted collaboratively by the student and teacher using a rubric specific to the design problem.
- Develop a comprehensive set of construction drawings for an office building of the student's own design.

- Create coordinated architectural, mechanical, and electrical drawings that communicate design intent and technical requirements clearly and accurately.
- Formative assessments will be conducted throughout the construction drawing process to evaluate progress, technical proficiency, and application of course concepts.
- Summative assessment of the construction document project will be conducted collaboratively by the student and teacher using a rubric aligned with project objectives and industry standards.
- Complete a unit test or quiz assessing understanding of building systems, construction documents, technical drawing conventions, and related course content.
- Complete a written response or writing prompt demonstrating understanding of key concepts, industry practices, and project outcomes.

Assessment

Formative Assessment:

Appropriate use and application of subject-specific vocabulary.

Teacher feedback, class discussions, and guided critiques.

Student reflection notes documenting learning, progress, and design development.

Summative Assessment:

Answer the essential questions.

Successfully complete quizzes and tests assessing understanding of required vocabulary and course content.

Design and develop engineering subsystem drawings for a building, including mechanical, electrical, and plumbing systems. These drawings will be assessed using project-specific rubrics.

Demonstrate how building systems are integrated and coordinated within a structure through technical drawings and design documentation. Performance will be evaluated using established rubrics.

Design and create presentation drawings for a building that demonstrate an understanding of means of egress, curtain wall systems, and steel construction.

The presentation will include a written description explaining the technical aspects of the proposal.

The completed presentation will be included in an electronic portfolio.

The presentation will be evaluated using teacher- and student-designed rubrics.

Maintain a design log documenting the evolution of the project, including sources of information, research, feedback, revisions, and critiques.

Successfully complete written quizzes and tests assessing understanding of course content and subject

materials.

Write a response to one or more writing prompts. Possible prompts may include:

Mechanical engineers are responsible for the design of building heating, ventilation, and air-conditioning systems. What factors must be considered when designing these systems?

Electrical engineers design systems that distribute power throughout a building. What factors must be considered to ensure a safe, efficient, and reliable electrical system?

Alternative Assessment:

Presentation on heating, ventilation, and air-conditioning (HVAC) systems used in buildings.

Benchmark Assessment:

Final Exam

Materials

The CADD LAB-computers equipped with up-to-date AutoCAD and/or other design and drafting software, presentation software, productivity software, a scanner and printers/plotters.

Traditional drafting equipment and supplies-vellum, colored and graphite pencils, pen and ink, drawing boards, tape, scissors, t-squares, triangles etc.

Chip-board, X-acto knives and other model making supplies.

A computer with INTERNET based presentation software (i.e. Prezi and Google Slides) and Microsoft Powerpoint.

3-D printer and supplies

Safety glasses

INTERNET resources and tutorials on how to use CAD software.

Teacher e-board.

SmartBoard use for teacher presentation and interactive lessons

SmartBoard use for student presentations.

Model making materials, dependant on projects that used.

Standards

9.4.12.CI	Creativity and Innovation
9.2.12.CAP	Career Awareness and Planning
TECH.K-12.1.1	Empowered Learner
L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
	There are strategies to improve one’s professional value and marketability.
TECH.K-12.1.1.a	articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
	Innovative ideas or innovation can lead to career opportunities.
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.
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.K-12.1.1.c	use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
9.4.12.CT	Critical Thinking and Problem-solving
TECH.K-12.1.2	Digital Citizen
L.KL.9–10.2	Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
TECH.K-12.1.2.c	demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.
TECH.K-12.1.2.d	manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.
L.VL.9–10.3	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, including technical meanings, choosing flexibly from a range of strategies.
TECH.K-12.1.3	Knowledge Constructor
TECH.K-12.1.3.a	plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
LA.RST.9-10	Reading Science and Technical Subjects

TECH.K-12.1.3.c	curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
TECH.K-12.1.3.d	build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
TECH.K-12.1.4	Innovative Designer
TECH.K-12.1.4.a	know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
TECH.K-12.1.4.b	select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
TECH.K-12.1.4.c	develop, test and refine prototypes as part of a cyclical design process.
9.4.12.GCA	Global and Cultural Awareness
	Range of Reading and Level of Text Complexity
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 others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
LA.RST.9-10.10	By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
TECH.K-12.1.6	Creative Communicator
TECH.K-12.1.6.a	choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
TECH.K-12.1.6.b	create original works or responsibly repurpose or remix digital resources into new creations.
TECH.K-12.1.6.c	communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
TECH.K-12.1.6.d	publish or present content that customizes the message and medium for their intended audiences.
9.4.12.TL	Technology Literacy
	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
	Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
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.
	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
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.

	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
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).
ETW	Effects of Technology on the Natural World
	Development and modification of any technological system needs to take into account how the operation of the system will affect natural resources and ecosystems. Impacts of technological systems on the environment need to be monitored and must inform decision-making. Many technologies have been designed to have a positive impact on the environment and to monitor environmental change over time.
HS-ETS1	Engineering Design
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
	Asking Questions and Defining Problems
	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
ETS1.A	Delimiting Engineering Problems
	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
	Constructing Explanations and Designing Solutions
ETS1.C	Optimizing the Design Solution

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk Students, Gifted and Talented students, Career Education, and those with 504s