Unit 04: Steel Construction

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 2**
Length: **5 Weeks**
Status: **Published**

Brief Summary of Unit

Introduction

Students will develop an understanding of steel building systems and their role in modern architectural design. They will examine how large buildings are designed to meet health, safety, functional, environmental, societal, and aesthetic requirements. Students will also strengthen their Computer-Aided Design (CAD) skills by creating technical drawings and presentation materials that effectively communicate their knowledge of steel construction systems and design principles.

Revision Date: July 2026

Essential Questions/Enduring Understandings

Essential Questions:

What are the primary systems and subsystems that comprise a large building?

How can the design loop be applied to develop solutions to technological challenges?

How can CAD be used to effectively communicate solutions to architectural design problems?

Enduring Understandings:

Large buildings are composed of interconnected systems and subsystems that work together to support building function, performance, and occupant safety.

The specialized vocabulary of steel construction enables accurate, efficient, and professional communication among individuals involved in the design and construction process.

Life safety is a fundamental consideration in the design and construction of large buildings.

Steel is a primary structural material used in large buildings because it provides strength, efficiency, and flexibility in design.

Engineers are responsible for the design and integration of many of the subsystems found within large buildings.

Students Will Know/Students Will Be Skilled At

Students will know:

The primary structural and architectural components of a steel-framed building.

The terminology and vocabulary associated with steel construction and building systems.

How to create technical drawings of fundamental steel building components using CAD, including elevation heights, columns, girders, and beams.

How to develop plan, section, and elevation drawings of steel-framed buildings using CAD software.

How CAD layers are used to organize and differentiate building systems and construction information.

The characteristics of non-combustible construction and how it is represented in technical drawings.

The purpose and application of long-span structural systems in building design.

The principles of curtain wall construction and non-load-bearing wall systems, and how these systems are represented using CAD.

Fundamental concepts related to multi-story building construction.

Office building design concepts, including building cores, space planning, and vertical and horizontal circulation systems.

The purpose of means of egress systems and the components required to ensure safe building evacuation.

The effects of high temperatures on steel and the implications for structural performance during a fire.

Health, safety, and life-safety considerations associated with the design of large buildings.

Design strategies and building systems used to promote fire safety.

Historically significant steel-framed office buildings and their influence on modern construction practices.

Building systems commonly employed in large structures, including HVAC, elevator, plumbing, electrical, and fire suppression systems.

The requirements of the Americans with Disabilities Act (ADA) and how accessibility standards are incorporated into building design.

The need for heating, cooling, and ventilation systems in buildings, as well as the environmental considerations associated with their operation.

The roles and responsibilities of professionals involved in the design and construction of large buildings, including architects, civil engineers, structural engineers, and mechanical engineers.

Students will be skilled at:

Creating plan, section, and elevation drawings of steel-framed and curtain wall buildings using CAD software.

Organizing building layouts to promote occupant safety through effective means of egress and life-safety

planning.

Developing efficient floor plans that comply with Americans with Disabilities Act (ADA) requirements and accessibility standards.

Producing technical drawings using industry-standard software that clearly communicate design solutions to a defined audience.

Creating, organizing, and presenting project work through a professional digital portfolio.

Learning Plan

- Preview the essential questions and establish connections to the concepts, skills, and learning objectives addressed throughout the unit.
- Explore guiding questions, including:
    - What are the defining characteristics of a steel-framed building?
    - When and why is steel selected as a structural material in building construction?
    - How do commercial restroom requirements differ from those found in residential buildings?
    - Where are heating, ventilation, and air conditioning (HVAC) systems located within large buildings?
    - How can CAD be used to communicate the various systems and components of a large building?
    - What occurs within a building when a fire alarm is activated or during an emergency evacuation drill?
    - What features within our classroom and school relate to fire safety and life-safety systems?
    - What structural elements within our classroom contribute to supporting the building?
    - Why are ramps and other accessibility features incorporated into building design?
    - What are the major components of HVAC systems, and how do they contribute to occupant comfort and building performance?
- Participate in presentations by guest speakers representing engineering, architecture, construction, and related professional disciplines.
- Engage in lectures, discussions, and classroom activities focused on the guiding questions and core concepts of the unit.
- Research, analyze, and report on a historically significant office building or buildings using library resources, online sources, and/or interviews. Students may present their findings through a written report, digital presentation, or other approved format.
- Formative assessments will be conducted throughout the research process to monitor student understanding and provide ongoing feedback.
- Summative assessment of the research project will be conducted by both the student and teacher using a rubric aligned to the project objectives and evaluation criteria.
- Observe teacher demonstrations and participate in guided activities focused on CAD rendering techniques and visual communication methods using instructional technology and projection systems.
- Design and develop a multi-story building project located in Cranford that demonstrates the integration of unit concepts and building systems.
- Create multi-layered CAD drawings that accurately communicate architectural, structural, and building system information.
- Utilize CAD software and traditional drafting techniques to produce professional-quality presentation drawings.

- Develop and include drawings of typical building assemblies, including floor/ceiling systems, ceiling/roof systems, curtain wall systems, partition systems, and foundation/slab systems.
- Formative assessments will be conducted throughout the design process to evaluate progress, technical proficiency, and application of course concepts.
- Summative assessment of the design project will be conducted by both the student and teacher using a rubric specific to the design challenge and project requirements.
- Complete a summative unit assessment, which may include a test, quiz, written response, reflection, or writing prompt designed to assess understanding of unit content and learning objectives.

Assessment

Formative Assessment:

Discussion and writing prompt to assess students' prior knowledge and understanding of steel construction, building systems, and related design concepts.

Summative Assessment:

Answer the essential questions and demonstrate an understanding of the major concepts addressed throughout the unit.

Demonstrate proficiency in the use and application of required industry-specific vocabulary related to steel construction, building systems, and architectural design.

Demonstrate the ability to use CAD software and technical drawing conventions to communicate design solutions accurately, effectively, and professionally.

Summative Assessment:

Design and develop an office building that demonstrates an understanding of structural systems, HVAC systems, and life-safety requirements. The design should also reflect consideration of aesthetic principles and the influence of historically significant buildings.

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. Students will maintain a design log documenting the evolution of the project, including sources of information, research, feedback, and critiques. The completed presentation will be included in an electronic portfolio and evaluated using teacher- and student-developed rubrics.

Complete written quizzes and tests assessing knowledge of unit content, technical concepts, and subject-specific materials.

Respond to one or more writing prompts related to building design, engineering, accessibility, and public policy. Possible prompts may include:

- The Americans with Disabilities Act (ADA) has had a positive or negative impact on building design.
- Government agencies should or should not play a role in regulating the design of public buildings.
- What roles do architects and engineers play in the design and construction of a building?

Students will formally present their digital portfolios and explain the design decisions incorporated into their

projects.

Alternative Assessment:

Presentation on the roles and responsibilities of engineers involved in the design and construction of 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
TECH.K-12.1.1	Empowered Learner
9.2.12.CAP	Career Awareness and Planning
	There are strategies to improve one's professional value and marketability.

L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
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.
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.
	Innovative ideas or innovation can lead to career opportunities.
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
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.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.K-12.1.2	Digital Citizen
9.4.12.CT	Critical Thinking and Problem-solving
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).
9.2.12.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.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
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.
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.
	Key Ideas and Details
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.
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text’s explanation

	or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
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
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).
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.
W.AW.9–10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence.
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.
	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.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 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.
SL.PI.9–10.4	Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
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