Unit 04: Steel Construction

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 2**
Length: **4 weeks**
Status: **Published**

Summary

Introduction

Students will gain and develop knowledge and understandings related to steel building systems. This will include how large buildings are designed with regard to health, safety, societal, functional and aesthetic criteria. Students will develop CAD skills to communicate their understanding and knowledge of steel building systems.

Revision Date July 2021

MA.A-SSE	Seeing Structure in Expressions
LA.RH.11-12	Reading History
MA.A-SSE.A	Interpret the structure of expressions
	Key Ideas and Details
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
LA.RH.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
LA.RH.11-12.2	Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text.
MA.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
LA.RH.11-12.3	Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
LA.WHST.11-12	Writing History, Science and Technical Subjects
	Text Types and Purposes
LA.WHST.11-12.1	Write arguments focused on discipline-specific content.
CS.9-12.8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
CS.9-12.8.2.12.EC.2	Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.
CS.9-12.8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.
CS.9-12.8.2.12.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.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

CS.9-12.8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.ETW.4	Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints.
CS.9-12.EC	Ethics & Culture
CS.9-12.ED	Engineering Design
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP10.1	Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.

CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
SCI.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.
SCI.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.
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.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.
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
TECH.8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.D	Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.1.12.F.CS1	Identify and define authentic problems and significant questions for investigation.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.A	The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live.
TECH.8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
TECH.8.2.12.A.CS1	The characteristics and scope of technology.
TECH.8.2.12.B	Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.
TECH.8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
TECH.8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
TECH.8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
TECH.8.2.12.B.CS4	The influence of technology on history.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
TECH.8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
TECH.8.2.12.C.CS1	The attributes of design.
TECH.8.2.12.C.CS2	The application of engineering design.
TECH.8.2.12.D.CS1	Apply the design process.
TECH.8.2.12.D.CS2	Use and maintain technological products and systems.
TECH.9.4.12.CI	Creativity and Innovation
TECH.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.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.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).
TECH.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.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
	Innovative ideas or innovation can lead to career opportunities.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	There are strategies to improve one's professional value and marketability.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	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.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.

Essential Questions/Enduring Understandings

Essential Questions:

What are the systems in a large building?

How do we apply the design loop to solve a technological problem?

How do we communicate solutions to architectural problems using CAD?

Enduring Understandings:

Large buildings are made of subsystems.

The specific vocabulary of steel construction allows for more efficient and accurate communication between those working on a structure.

In the design of large buildings, life safety is of paramount importance.

Large buildings are often made of steel and that it is a construction system that permits flexibility in design.

Engineers typically design subsystems in large buildings.

Objectives

Students will know:

The elements of a steel building.

The vocabulary related to steel construction.

How to draw the basic elements in a steel buildings using CAD. These include elevation heights, columns, girders, beams.

How to draw plans, sections and elevations of a steel building using CAD.

How to differentiate between systems using CAD layers.

What non-combustible construction is and how to draw it using CAD.

What long spans are.

Curtain wall construction, and non load bearing wall construction and how to draw it using CAD.

Multi-story construction concepts.

Office building concepts: a core; space planning, vertical and horizontal circulation.

What "means of egress" is and its components.

That steel becomes plastic at low temperatures.

About the health and safety concerns related to larger buildings.

Design strategies for fire safety.

Historically significant steel office buildings

Systems employed in large buildings, including HVAC, elevators, and fire suppression.

About the American With Disabilities Act, and how it manifests itself in the buildings we design.

The need for heating and cooling systems in a building and environmental concerns.

The various occupations and their roles in a large building design and construction: civil engineer, mechanical engineer, architect, etc.

Students will be skilled at:

Creating and planning, sections and elevation drawings of steel/curtain wall buildings.

Organizing buildings so that the occupants are safe with respect to means of egress.

Developing efficient floor plans that comply with Americans With Disabilities Act.

Drafting plan drawings using software that communicate a solution to a defined audience.

Creating presentations in a digital portfolio.

Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Guiding questions: What are the characteristics of a steel building? When and why is steel used in buildings? What are the differences between restrooms at home and in a restaurant? Where is the air conditioning system in a large building? How do we communicate the different systems in a large building using CAD? What happens in our school building when the fire alarm goes off, or during a drill? What in our class room relates to fire safety? What in our class room relates to holding the building up? Why do we have ramps in front of buildings? Where are the systems (HVAC) that heat and cool a building? What are the components of HVAC systems?

Guest speakers to talk about their discipline in engineering or the construction industry

Lecture and discussion about guiding questions

Students will research (library, INTERNET, and/or interview) and report and/or create a presentation on a historically significant office building or buildings.

Formative assessments will be conducted throughout the process.

Summative assessment will be conducted by the student and teacher using a rubric specific to the research problem.

Teacher will demonstrate and involve students in discovering techniques for rendering drawings in CAD. (LCD projector)

Students design and draw a multistory building in Cranford that demonstrates integration of the topics above. Create multilayered drawings. Use CAD and traditional techniques to create presentation drawings. Students will include drawings of typical assemblies-floor/ceiling; ceiling/roof; curtain wall; partition; foundation/slab systems.

Formative assessments will be conducted throughout the design process.

Summative assessments will be conducted by the student and teacher using a rubric specific to the design problem.

Summative assessment: Unit test or quiz and or writing prompt.

Assessment

Formative assessment:
Discussion and Writing Prompt to determine What knowledge do students have regarding steel construction?

Summative assessment:

Answer the essential questions.

Demonstrate understanding of required
vocabulary.

Demonstrate the ability to use software and technical drawing conventions to communicate a design effectively.

Summative assessment:
Draw and design an office building that demonstrates an understanding of structural, HVAC, life safety systems. The building will demonstrate how it relates to aesthetic needs and historical buildings.

Design and create presentation drawings for a building that demonstrates understanding of means of egress, curtain wall and steel construction. The presentation will include a written description that describes the technical aspects of the proposal. Maintain a log to explain how the design evolved, including sources of information and criticism. The presentation will be included in an electronic portfolio. The presentation will be evaluated using teacher and student designed rubrics.

Written quizzes and tests about subject materials.

Write a response to one or more writing prompts. Possible prompts: ADA is a (good/bad) idea. I (think/don't) think the government should be involved with the design of public buildings…. What are the roles different engineers have in the design of a building?

Students will present their digital portfolio.

Alternative Assessment:
Presentation on Engineer Roles when designing a building

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.

Smartboard for demonstrations by the teacher and presentations by students.

Integrated Accommodation and Modifications Spec Ed, ELL, At-Risk, G&T, Career Education, 504's

See the linked document for Integrated Accommodation and Modifications, Special Education, English Language Learners, At-Risk, Gifted and Talented, Career Education and 504s.