

# Civil Engineering and Architecture (CEA)

## Lesson 1.1

### Common Core State Standards for English Language Arts

#### AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

#### AS.W.7 - Writing

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

#### AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research.

#### AS.SL.4 - Speaking and Listening

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

#### AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

#### AS.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

#### AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

#### AS.L.6 - Language

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**11-12.RI.7 - Reading Informational**

Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

**9-10.L.6 - Language**

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**9-10.RST.4 - Reading Science/Technical**

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# **Civil Engineering and Architecture (CEA)**

## **Lesson 1.1**

### **Next Generation Science Standards**

DCI - ESS3.A - Earth and Human Activity - Natural Resources

Resource availability has guided the development of human society.  
(HS-ESS3-1)

Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.

# Civil Engineering and Architecture (CEA)

## Lesson 1.1

### Standards for Technological Literacy

1.6-8.F Students will develop an understanding of the characteristics and scope of technology.

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

1.6-8.G Students will develop an understanding of the characteristics and scope of technology.

G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative.

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

6.9-12.H Students will develop an understanding of the role of society in the development and use of technology.

H. Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

8.6-8.E Students will develop an understanding of the attributes of design.

E. Design is a creative planning process that leads to useful products and systems.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

20.6-8.F Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

# Civil Engineering and Architecture (CEA)

## Lesson 1.2

### Common Core State Standards for English Language Arts

#### 9-10.SL.1 - Speaking and Listening

Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

#### 9-10.SL.1.a - Speaking and Listening

Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

#### 9-10.SL.1.c - Speaking and Listening

Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

#### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 1.2

### Next Generation Science Standards

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### DCI - ETS1.B - Engineering Design - Developing Possible Solutions

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

#### Science and Engineering Practice - Developing and Using Models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

#### Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.

# **Civil Engineering and Architecture (CEA)**

## **Lesson 1.2**

### **Standards for Technological Literacy**

9.6-8.G Students will develop an understanding of engineering design.

G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.

# Civil Engineering and Architecture (CEA)

## Lesson 2.1

### Common Core State Standards for English Language Arts

#### AS.R.1 - Reading

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

#### AS.R.4 - Reading

Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

#### AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

#### AS.R.10 - Reading

Read and comprehend complex literary and informational texts independently and proficiently.

#### AS.W.7 - Writing

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

#### AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research.

#### AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

#### AS.L.6 - Language

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**9-10.L.6 - Language**

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**9-10.RST.4 - Reading Science/Technical**

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 2.2

### Common Core State Standards for English Language Arts

#### AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

#### AS.L.4 - Language

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

#### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 2.2

### Common Core State Standards for Mathematics

#### N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

#### G.MG.2 - Modeling with Geometry

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

#### G.MG.3 - Modeling with Geometry

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

# Civil Engineering and Architecture (CEA)

## Lesson 2.2

### Next Generation Science Standards

#### MS.PS3.3 - Energy

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or

maximizes thermal energy transfer.\*

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m<sup>3</sup>, acre-feet, etc.)

#### Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

# Civil Engineering and Architecture (CEA)

## Lesson 2.2

### Standards for Technological Literacy

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

20.6-8.G Students will develop an understanding of and be able to select and use construction technologies.

G. Structures rest on a foundation.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

# Civil Engineering and Architecture (CEA)

## Lesson 2.3

### Common Core State Standards for English Language Arts

#### AS.R.1 - Reading

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

#### AS.R.4 - Reading

Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

#### AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

#### AS.R.10 - Reading

Read and comprehend complex literary and informational texts independently and proficiently.

#### AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

#### AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

#### AS.W.8 - Writing

Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

#### AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research.

#### AS.W.10 - Writing

Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

**AS.SL.1 - Speaking and Listening**

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

**AS.SL.2 - Speaking and Listening**

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

**AS.SL.4 - Speaking and Listening**

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

**AS.SL.5 - Speaking and Listening**

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

**AS.SL.6 - Speaking and Listening**

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

**AS.L.1 - Language**

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

**AS.L.2 - Language**

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

**AS.L.6 - Language**

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**9-10.W.2 - Writing**

Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

**9-10.W.2.d - Writing**

Use precise language and domain-specific vocabulary to manage the complexity of the topic.

**9-10.W.4 - Writing**

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

**9-10.L.6 - Language**

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**9-10.RST.3 - Reading Science/Technical**

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

**9-10.RST.4 - Reading Science/Technical**

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

**9-10.RST.7 - Reading Science/Technical**

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

# Civil Engineering and Architecture (CEA)

## Lesson 2.3

### Common Core State Standards for Mathematics

#### A.CED.1 - Creating Equations

Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

#### A.CED.2 - Creating Equations

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

#### A.CED.3 - Creating Equations

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

#### F.IF.7.b - Interpreting Functions

Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

#### F.BF.1 - Building Functions

Write a function that describes a relationship between two quantities.

#### F.BF.1.a - Building Functions

Determine an explicit expression, a recursive process, or steps for calculation from a context.

#### G.MG.2 - Modeling with Geometry

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

#### G.MG.3 - Modeling with Geometry

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

# Civil Engineering and Architecture (CEA)

## Lesson 2.3

### Next Generation Science Standards

#### MS.ETS1.1 - Engineering Design

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

#### MS.ETS1.2 - Engineering Design

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

#### MS.ETS1.4 - Engineering Design

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

#### HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### HS.ETS1.3 - Engineering Design

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.

#### HS.ETS1.4 - Engineering Design

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.

#### DCI - ETS1.A - Engineering Design - Defining and 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. (secondary to HS-PS2- 3)

DCI - ETS1.B - Engineering Design - Developing Possible Solutions

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

DCI - ETS1.C - Engineering Design - Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS1-6)

DCI - LS4.D - Biological Evolution: Unity and Diversity - Biodiversity and Humans

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

DCI - ESS3.A - Earth and Human Activity - Natural Resources

All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

DCI - ESS3.C - Earth and Human Activity - Human Impacts on Earth Systems

The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)

DCI - ESS3.C - Earth and Human Activity - Human Impacts on Earth Systems

Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

Science and Engineering Practice - Asking questions and defining problems

Ask questions

- o that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
- o that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

- o to determine relationships, including quantitative relationships, between independent and dependent variables.

- o to clarify and refine a model, an explanation, or an engineering problem.

#### Science and Engineering Practice - Developing and Using Models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

#### Science and Engineering Practice - Developing and Using Models

Develop a complex model that allows for manipulation and testing of a proposed process or system.

#### Science and Engineering Practice - Developing and Using Models

Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m<sup>3</sup>, acre-feet, etc.)

#### Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

#### Science and Engineering Practice - Constructing Explanations and Designing Solutions

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

# Civil Engineering and Architecture (CEA)

## Lesson 2.3

### Standards for Technological Literacy

2.6-8.R Students will develop an understanding of the core concepts of technology.

R. Requirements are the parameters placed on the development of a product or system.

2.6-8.S Students will develop an understanding of the core concepts of technology.

S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

5.6-8.D Students will develop an understanding of the effects of technology on the environment.

D. The management of waste produced by technological systems is an important societal issue.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.6-8.G Students will develop an understanding of the role of society in the development and use of technology.

G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.

8.6-8.G Students will develop an understanding of the attributes of design.

G. Requirements for design are made up of criteria and constraints.

8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype.

8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.6-8.H Students will develop an understanding of engineering design.

H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

11.6-8.H Students will develop the abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

11.6-8.J Students will develop the abilities to apply the design process.

J. Make two-dimensional and three-dimensional representations of the designed solution.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

17.6-8.J Students will develop an understanding of and be able to select and use information and communication technologies.

J. The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message.

17.6-8.K Students will develop an understanding of and be able to select and use information and communication technologies.

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

20.6-8.F Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

20.6-8.G Students will develop an understanding of and be able to select and use construction technologies.

G. Structures rest on a foundation.

20.6-8.I Students will develop an understanding of and be able to select and use construction technologies.

I. Buildings generally contain a variety of subsystems.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

# Civil Engineering and Architecture (CEA)

## Lesson 3.1

### Common Core State Standards for English Language Arts

#### AS.R.1 - Reading

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

#### AS.R.4 - Reading

Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

#### AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

#### AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

#### AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

#### AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

#### AS.L.4 - Language

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

#### AS.L.6 - Language

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### 9-10.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

#### 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic.

### 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 3.1

### Common Core State Standards for Mathematics

#### G.MG.3 - Modeling with Geometry

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

# Civil Engineering and Architecture (CEA)

## Lesson 3.1

### Next Generation Science Standards

#### MS.ETS1.2 - Engineering Design

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

#### MS.ETS1.4 - Engineering Design

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### HS.ETS1.3 - Engineering Design

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.

#### HS.ETS1.4 - Engineering Design

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.

#### DCI - ETS1.A - Engineering Design - Defining and 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. (secondary to HS-PS2- 3)

#### DCI - ETS1.B - Engineering Design - Developing Possible Solutions

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

#### DCI - ETS1.C - Engineering Design - Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS1-6)

#### DCI - LS4.D - Biological Evolution: Unity and Diversity - Biodiversity and Humans

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

#### Science and Engineering Practice - Developing and Using Models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

#### Science and Engineering Practice - Developing and Using Models

Develop a complex model that allows for manipulation and testing of a proposed process or system.

#### Science and Engineering Practice - Constructing Explanations and Designing Solutions

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

#### Science and Engineering Practice - Engaging in Argument from Evidence

Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

#### Crosscutting Concepts - Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

# Civil Engineering and Architecture (CEA)

## Lesson 3.1

### Standards for Technological Literacy

6.6-8.F Students will develop an understanding of the role of society in the development and use of technology.

F. Social and cultural priorities and values are reflected in technological devices.

6.6-8.G Students will develop an understanding of the role of society in the development and use of technology.

G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.

8.6-8.G Students will develop an understanding of the attributes of design.

G. Requirements for design are made up of criteria and constraints.

8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype,

8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.6-8.F Students will develop an understanding of engineering design.

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.

9.6-8.H Students will develop an understanding of engineering design.

H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

11.6-8.H Students will develop the abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

11.6-8.I Students will develop the abilities to apply the design process.

I. Specify criteria and constraints for the design.

11.6-8.J Students will develop the abilities to apply the design process.

J. Make two-dimensional and three-dimensional representations of the designed solution.

11.6-8.K Students will develop the abilities to apply the design process.

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

17.6-8.J Students will develop an understanding of and be able to select and use information and communication technologies.

J. The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message.

17.6-8.K Students will develop an understanding of and be able to select and use information and communication technologies.

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

20.6-8.F Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

20.6-8.G Students will develop an understanding of and be able to select and use construction technologies.

G. Structures rest on a foundation.

20.6-8.I Students will develop an understanding of and be able to select and use construction technologies.

I. Buildings generally contain a variety of subsystems.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

20.9-12.M Students will develop an understanding of and be able to select and use construction technologies.

M. Structures require maintenance, alteration, or renovation periodically to improve them or to alter their intended use.

20.9-12.N Students will develop an understanding of and be able to select and use construction technologies.

N. Structures can include prefabricated materials.

# Civil Engineering and Architecture (CEA)

## Lesson 3.2

### Common Core State Standards for English Language Arts

#### AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

#### AS.L.6 - Language

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

#### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 3.2

### Common Core State Standards for Mathematics

#### N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

#### N.VM.1 - Vector and Matrix Quantities

(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g.,  $\mathbf{v}$ ,  $|\mathbf{v}|$ ,  $\|\mathbf{v}\|$ ,  $v$ ).

#### N.VM.3 - Vector and Matrix Quantities

(+) Solve problems involving velocity and other quantities that can be represented by vectors.

#### N.VM.4 - Vector and Matrix Quantities

(+) Add and subtract vectors.

#### A.SSE.1 - Seeing Structure in Expressions

Interpret expressions that represent a quantity in terms of its context.

#### A.CED.1 - Creating Equations

Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

#### A.CED.4 - Creating Equations

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law  $V = IR$  to highlight resistance  $R$ .

#### A.REI.3 - Reasoning with Equations and Inequalities

Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

#### A.REI.4 - Reasoning with Equations and Inequalities

Solve quadratic equations in one variable.

**A.REI.6 - Reasoning with Equations and Inequalities**

Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

**G.MG.2 - Modeling with Geometry**

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

**G.MG.3 - Modeling with Geometry**

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

# Civil Engineering and Architecture (CEA)

## Lesson 3.2

### Next Generation Science Standards

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### HS.ETS1.4 - Engineering Design

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.

#### Science and Engineering Practice - Developing and Using Models

Develop a complex model that allows for manipulation and testing of a proposed process or system.

#### Science and Engineering Practice - Developing and Using Models

Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m<sup>3</sup>, acre-feet, etc.)

#### Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

### Crosscutting Concepts - Structure and Function

The way an object is shaped or structured determines many of its properties and functions.

### Crosscutting Concepts - Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

# Civil Engineering and Architecture (CEA)

## Lesson 3.2

### Standards for Technological Literacy

2.6-8.R Students will develop an understanding of the core concepts of technology.

R. Requirements are the parameters placed on the development of a product or system.

2.6-8.S Students will develop an understanding of the core concepts of technology.

S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

11.6-8.H Students will develop the abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

11.6-8.I Students will develop the abilities to apply the design process.

I. Specify criteria and constraints for the design.

11.6-8.J Students will develop the abilities to apply the design process.

J. Make two-dimensional and three-dimensional representations of the designed solution.

11.6-8.K Students will develop the abilities to apply the design process.

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

20.6-8.F Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

20.6-8.G Students will develop an understanding of and be able to select and use construction technologies.

G. Structures rest on a foundation.

20.6-8.I Students will develop an understanding of and be able to select and use construction technologies.

I. Buildings generally contain a variety of subsystems.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

20.9-12.M Students will develop an understanding of and be able to select and use construction technologies.

M. Structures require maintenance, alteration, or renovation periodically to improve them or to alter their intended use.

20.9-12.N Students will develop an understanding of and be able to select and use construction technologies.

N. Structures can include prefabricated materials.

# Civil Engineering and Architecture (CEA)

## Lesson 3.3

### Common Core State Standards for English Language Arts

#### AS.R.1 - Reading

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

#### AS.R.4 - Reading

Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

#### AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

#### AS.R.10 - Reading

Read and comprehend complex literary and informational texts independently and proficiently.

#### AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

#### AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

#### AS.W.5 - Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

#### AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

#### AS.W.7 - Writing

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

### AS.W.8 - Writing

Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

### AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research.

### AS.W.10 - Writing

Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

### AS.SL.1 - Speaking and Listening

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

### AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

### AS.SL.4 - Speaking and Listening

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

### AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

### AS.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

### AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

### AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

### AS.L.4 - Language

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

#### AS.L.6 - Language

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# **Civil Engineering and Architecture (CEA)**

## **Lesson 3.3**

### **Common Core State Standards for Mathematics**

#### **N.Q.3 - Quantities**

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

#### **A.CED.1 - Creating Equations**

Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

# Civil Engineering and Architecture (CEA)

## Lesson 3.3

### Next Generation Science Standards

#### MS.ESS3.3 - Earth and Human Activity

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.\*

#### HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

#### HS.ESS3.6 - Earth and Human Activity

Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### DCI - ETS1.A - Engineering Design - Defining and Delimiting Engineering Problems

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-ETS1-1)

#### DCI - ESS3.A - Earth and Human Activity - Natural Resources

All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

# Civil Engineering and Architecture (CEA)

## Lesson 3.3

### Standards for Technological Literacy

2.6-8.R Students will develop an understanding of the core concepts of technology.

R. Requirements are the parameters placed on the development of a product or system.

2.6-8.S Students will develop an understanding of the core concepts of technology.

S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

5.6-8.E Students will develop an understanding of the effects of technology on the environment.

E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

8.6-8.G Students will develop an understanding of the attributes of design.

G. Requirements for design are made up of criteria and constraints.

8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.6-8.F Students will develop an understanding of engineering design.

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

11.6-8.H Students will develop the abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

11.6-8.I Students will develop the abilities to apply the design process.

I. Specify criteria and constraints for the design.

11.6-8.K Students will develop the abilities to apply the design process.

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

17.6-8.K Students will develop an understanding of and be able to select and use information and communication technologies.

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

20.6-8.F Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

20.6-8.I Students will develop an understanding of and be able to select and use construction technologies.

I. Buildings generally contain a variety of subsystems.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

# Civil Engineering and Architecture (CEA)

## Lesson 3.4

### Common Core State Standards for English Language Arts

#### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 3.4

### Next Generation Science Standards

#### MS.ESS3.3 - Earth and Human Activity

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.\*

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### HS.ETS1.4 - Engineering Design

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.

#### Science and Engineering Practice - Developing and Using Models

Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

#### Science and Engineering Practice - Analyzing and Interpreting Data

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

#### Science and Engineering Practice - Analyzing and Interpreting Data

Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

#### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m<sup>3</sup>, acre-feet, etc.)

### Crosscutting Concepts - Structure and Function

The way an object is shaped or structured determines many of its properties and functions.

### Crosscutting Concepts - Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

# Civil Engineering and Architecture (CEA)

## Lesson 3.4

### Standards for Technological Literacy

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

20.6-8.I Students will develop an understanding of and be able to select and use construction technologies.

I. Buildings generally contain a variety of subsystems.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

# Civil Engineering and Architecture (CEA)

## Lesson 4.1

### Common Core State Standards for English Language Arts

#### AS.R.1 - Reading

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

#### AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

#### AS.R.10 - Reading

Read and comprehend complex literary and informational texts independently and proficiently.

#### AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

#### AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

#### AS.W.5 - Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

#### AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

#### AS.W.7 - Writing

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

#### AS.W.8 - Writing

Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

**AS.W.9 - Writing**

Draw evidence from literary or informational texts to support analysis, reflection, and research.

**AS.W.10 - Writing**

Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

**AS.SL.1 - Speaking and Listening**

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

**AS.SL.2 - Speaking and Listening**

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

**AS.SL.5 - Speaking and Listening**

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

**AS.L.1 - Language**

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

**AS.L.2 - Language**

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

**AS.L.3 - Language**

Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

**AS.L.4 - Language**

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

**AS.L.6 - Language**

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### 9-10.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

### 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic.

### 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

### 9-10.SL.1.b - Speaking and Listening

Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.

### 9-10.L.6 - Language

Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### 9-10.RST.4 - Reading Science/Technical

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

# Civil Engineering and Architecture (CEA)

## Lesson 4.1

### Common Core State Standards for Mathematics

; "A; " !'A cXY]b[ 'k]h ; Yca Yfm

5dd`m[ Yca Yf]Wa Yh cXg]c`j YXYg[ b`dfcVYa gff["zXg[ b]b[ 'Ub`cV`Mcf`  
gfi W fYlc`gUgZrd`ng]W`WbgfU]bg`cf`a ]b]a ]nYWg]k`cf\_]b[ 'k]h`  
hdc[ fUd\]Wf]Xgng]Ya g`Ug]Xcb`fU]cg`

# Civil Engineering and Architecture (CEA)

## Lesson 4.1

### Next Generation Science Standards

#### MS.ETS1.1 - Engineering Design

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

#### MS.ETS1.2 - Engineering Design

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

#### MS.ETS1.3 - Engineering Design

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

#### MS.ETS1.4 - Engineering Design

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

#### MS.ESS3.3 - Earth and Human Activity

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.\*

#### HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

#### HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

### HS.ETS1.3 - Engineering Design

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.

### HS.ETS1.4 - Engineering Design

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.

### DCI - ETS1.A - Engineering Design - Defining and 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. (secondary to HS-PS2-3)

### DCI - ETS1.B - Engineering Design - Developing Possible Solutions

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

### DCI - ETS1.C - Engineering Design - Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS1-6)

### Science and Engineering Practice - Asking questions and defining problems

Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

### Science and Engineering Practice - Asking questions and defining problems

Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

### Science and Engineering Practice - Developing and Using Models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

### Science and Engineering Practice - Developing and Using Models

Develop a complex model that allows for manipulation and testing of a proposed process or system.

### Science and Engineering Practice - Planning and Carrying Out Investigations

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

### Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

### Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

### Science and Engineering Practice - Constructing Explanations and Designing Solutions

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

### Science and Engineering Practice - Engaging in Argument from Evidence

Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

# Civil Engineering and Architecture (CEA)

## Lesson 4.1

### Standards for Technological Literacy

2.6-8.R Students will develop an understanding of the core concepts of technology.

R. Requirements are the parameters placed on the development of a product or system.

2.6-8.S Students will develop an understanding of the core concepts of technology.

S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

2.9-12.EE Students will develop an understanding of the core concepts of technology..

EE. Management is the process of planning, organizing, and controlling work.

8.6-8.E Students will develop an understanding of the attributes of design.

E. Design is a creative planning process that leads to useful products and systems.

8.6-8.G Students will develop an understanding of the attributes of design.

G. Requirements for design are made up of criteria and constraints.

8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype.

8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.6-8.F Students will develop an understanding of engineering design.

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.

9.6-8.G Students will develop an understanding of engineering design.

G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.

9.6-8.H Students will develop an understanding of engineering design.

H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

11.6-8.H Students will develop the abilities to apply the design process.

H. Apply a design process to solve problems in and beyond the laboratory-classroom.

11.6-8.I Students will develop the abilities to apply the design process.

I. Specify criteria and constraints for the design.

11.6-8.J Students will develop the abilities to apply the design process.

J. Make two-dimensional and three-dimensional representations of the designed solution.

11.6-8.K Students will develop the abilities to apply the design process.

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.

11.6-8.L Students will develop the abilities to apply the design process.

L. Make a product or system and document the solution.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.6-8.H Students will develop the abilities to use and maintain technological products and systems.

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

17.6-8.K Students will develop an understanding of and be able to select and use information and communication technologies.

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

20.6-8.F Students will develop an understanding of and be able to select and use construction technologies.

F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.

20.6-8.G Students will develop an understanding of and be able to select and use construction technologies.

G. Structures rest on a foundation.

20.6-8.I Students will develop an understanding of and be able to select and use construction technologies.

I. Buildings generally contain a variety of subsystems.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

# Civil Engineering and Architecture (CEA)

## Lesson 4.2

### Common Core State Standards for English Language Arts

#### AS.SL.1 - Speaking and Listening

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

#### AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

#### AS.SL.4 - Speaking and Listening

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

#### AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

#### AS.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

#### AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

#### AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

#### AS.L.3 - Language

Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

#### AS.L.4 - Language

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

### AS.L.6 - Language

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### 9-10.SL.4 - Speaking and Listening

Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

### 9-10.SL.5 - Speaking and Listening

Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

# Civil Engineering and Architecture (CEA)

## Lesson 4.2

### Standards for Technological Literacy

11.6-8.J Students will develop the abilities to apply the design process.

J. Make two-dimensional and three-dimensional representations of the designed solution.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

12.6-8.J Students will develop the abilities to use and maintain technological products and systems.

J. Use computers and calculators in various applications.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

17.6-8.J Students will develop an understanding of and be able to select and use information and communication technologies.

J. The design of a message is influenced by such factors as intended audience, medium, purpose, and the nature of the message.

17.6-8.K Students will develop an understanding of and be able to select and use information and communication technologies.

K. The use of symbols, measurements, and drawings promotes a clear communication by providing a common language to express ideas.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.