CENTER FOR CURRICULUM REDESIGN

Draft Civil Engineering Standards

Standards design philosophy: These standards are designed to produce students who can plan the development of land for human occupation, including provisioning for roads, water, sewage, stormwater drainage, the weight of planned structures, and environmental protections.

Subjects	Topics	Standards	Grades K-2 Benchmarks	Grades 3-5 Benchmarks	Grades 6-8 Benchmarks	Grades 9-12 Benchmarks
Structures	Types of Structures	CCR-CE STR 1. Understand there are different types of structures (e.g., bridges, foundations, etc.) and the reasons for these having similar or different design features.	CCR-CE STR K-2, 1.1. List the reasons common structures and buildings are made differently. CCR-CE STR K-2, 1.2 Identify there are reasons for the differences and different types of common structures and buildings (e.g., car bridges are bigger than pedestrian bridges, classrooms are much bigger than bedrooms, office buildings vary in size and height, houses have different types of roofs, etc.) (Grade 2). CCR-CE STR K-2, 1.3. Build a small paper tent and discover features that help it stand up. CCR-CE STR K-2, 1.4. Build a small structure and tell what allows it to be able to stand up. (Grade 2).	CCR-CE STR 3-5, 1.1. List as many structural features in the local neighborhood/city as possible (e.g., buildings, fire hydrant, storm drain, roads, bridges, etc.) and then classify them (e.g. transportation, buildings/structural, water-related features). CCR-CE STR 3-5, 1.2. Review images of common structural features that are engineered (i.e., designed) but may not be obviously so (e.g., a retention pond, a gutter, a parking lot, etc.) and identify the reasons they look similar or different to nature. CCR-CE STR 3-5, 1.3. Build, test, and evaluate structures built following an open-creative or specified plan, and then modify the structure (e.g., build a structure out of different materials (e.g., paper, blocks, or interlocking pieces), place the built structure in front of a fan, and explore how the structure could be made stronger, stiffer, and more stable).	CCR-CE STR 6-8, 1.1. Describe the evolution of roads, aqueducts, stadiums, and water treatment systems from ancient times to the present. CCR-CE STR 6-8, 1.2. Explain how the infrastructure of arteries (i.e., an important route in a system of roads, rivers, or railroad lines) is the underlying base or basic framework of a system and give examples of infrastructure. [US-ITEEA CON 9-12, 20-J] CCR-CE STR 6-8, 1.3. Research and explain the types of infrastructure designed by civil engineers. CCR-CE STR 6-8, 1.4. Describe examples of modern building design that were heavily influenced by climate, unusual functional requirements, or unusual cultural requirements. [US-ITEEA CON 6-8, 20-F (modified)] CCR-CE STR 6-8, 1.5. Brainstorm the different types of features that a building needs in order to function and hand sketch the building on paper (e.g. an elementary school building has classrooms, a gym, outside play areas, a fire hydrant, a way for a fire truck and food trucks to drive on site, trees, etc.) CCR-CE STR 6-8, 1.6. Build model structures from provided materials and explore how the structural components hold up against common stresses (e.g., snow loads on roof, soil expanding and pushing up on a foundation) and extreme environmental conditions (e.g., high winds simulated with a fan, earthquakes simulated with a shaker table, flood simulated with water filling up a surrounding basin). CCR-CE STR 6-8, 1.7. Redesign a model structure to better withstand loads or extreme environmental conditions.	
	Buildings	CCR-CE BL 2. Understand and distinguish the typical systems and components buildings include and the need to maintain them.	CCR-CE BL K-2, 2.1. Identify common physical characteristics of different types of buildings: houses, apartments, office buildings, and schools (e.g., roofs, walls, doors, windows, basements). [US-ITEEA CON K-2, 20-A. (modified)].	CCR-CE BL 3-5, 2.1. Restate and explain that structures rest on a foundation. [US-ITEEA CON 6-8, 20-G] CCR-CE BL 3-5, 2.2. Describe how structures need to be maintained and observe workers conducting building maintenance. [US-ITEEA CON 3-5, 20-D (modified)] CCR-CE BL 3-5, 2.3. Explore how water and outside air get inside buildings through foundation walls, cracks, and windows.	CCR-CE BL 6-8, 2.1. Identify and summarize the exposed features of a house or building at various stages of construction. CCR-CE BL 6-8, 2.2. Investigate and determine the major construction materials and methods used for buildings and identify what drives the use of each (e.g., wood frame construction, reinforced concrete construction, steel frame construction). [US-ITEEA CON 9-12, 20-K (modified)] CCR-CE BL 6-8, 2.3. Describe and explain the use of the various subsystems found in built structures, including lighting; heating, ventilating, and air-conditioning (HVAC); mechanical; electrical; plumbing; communication; security; and vertical transportation systems. CCR-CE BL 6-8, 2.4. Analyze a construction design and construct a cost estimate from materials, land, and labor. CCR-CE BL 6-8, 2.5. List and summarize examples of periodic maintenance for homes and buildings (e.g., changing air filters in furnaces, repainting exteriors, replacing roof shingles, cleaning gutters). CCR-CE BL 6-8, 2.6. Research and calculate the annual cost to maintain a home or apartment, from the internet, friends, family, and landlords.	
	Legal Requirements	CCR-CE LG 3. Understand that the design and placement of structures is constrained by regulations and codes.		CCR-CE LG 3-5, 3.1. Research, summarize, and report that the physical location of shopping centers, houses, and factories in many neighborhoods is governed by zoning ordinances.	CCR-CE LG 6-8, 3.1. Identify the national, regional, and local organizations and agencies whose rules and regulations influence the design and building of a civil engineering project (e.g., in the US: US Environmental Protection Agency for water and runoff, State Department of Transportation for road access, State Department of Health for septic systems and wells). CCR-CE LG 6-8, 3.2. Identify non-regulatory information used to inform building requirements (e.g., financial, environmental, or traffic impact studies). CCR-CE LG 6-8, 3.3. Describe examples of modern building design that was heavily influenced by building codes or laws. [US-ITEEA CON 6-8, 20-F (modified)]	CCR-CE LG 9-12, 3.1. Compare sections of building codes from two different geographic regions, covering the same topic, and suggest explanations for similarities or differences.
	Structural mechanics, Material selection	CCR-CE MM 4. Understand structural mechanics and how material selection aids or impedes structural forces and stresses.		CCR-CE MM 3-5, 4.1. Document several materials used in the home and where each are used (e.g., plaster-walls, wood-floor, brick-exterior, glass-windows, vinyl-siding). CCR-CE MM 3-5, 4.2. Identify and explain the possible reasons why each material is used for a specified application (e.g., glass was used for windows because one can see through it). CCR-CE MM 3-5, 4.3. Determine which of the materials used in a home or other structure needs to bear weight or force and where the weight or force comes from (e.g., in most cases, the downward force comes from the weight of what rests above; for example, a foundation has to support the weight of all walls, floors and roof above it, while the topmost section of wall needs only to support the roof).	CCR-CE MM 6-8, 4.1. Explain and restate the concepts of elastic deformation/elastic modulus; plastic deformation/yield strength, and fracture/fracture strength. CCR-CE MM 6-8, 4.2. Sketch and explain what stresses look like inside of a beam exposed to a) pure tension and b) pure compression, by drawing arrows. CCR-CE MM 6-8, 4.3. Calculate the stresses inside a beam experiencing a) pure tension or b) pure compression, given an applied force. CCR-CE MM 6-8, 4.4. Dramatize or demonstrate how the stresses vary inside of a simply supported beam (i.e., one support at each end) undergoing pure bending (e.g., typically via a weight suspended from the middle), compression on one face, tension on the other, neutral axis in-between. CCR-CE MM 6-8, 4.5. Calculate the maximum compressive and tensile stresses inside a simply supported beam undergoing bending given an applied force at the midpoint. CCR-CE MM 6-8, 4.6. Test the ability of common building materials to support loads in bending (e.g., using small test bars and suspended weights, wearing safety goggles). CCR-CE MM 6-8, 4.7. Research listed values of elastic modulus, yield stress, and fracture stress for tested materials and document what the values suggest about how a material should behave in practice.	CCR-CE MM 9-12, 4.1. Conduct a cross-comparison of the cost (both upfront and maintenance), stiffness (modulus), strength (yield or fracture), weight, and aesthetics for common structural materials (e.g., wood, adobe, reinforced concrete, cinder block, brick, stone, plastic, steel, aluminum, composite materials). CCR-CE MM 9-12, 4.2. Identify structural designs or applications that are the best match for each material type.
	Flooding, Hurricanes, Earthquakes, and other Natural Disasters	CCR-CE ND 5. Understand how hurricanes, snow, floods, and earthquakes impact structures and how the structures are designed to accommodate these impacts.			CCR-CE ND 6-8, 5.1. Explain how most building design assumes the load comes from the weight of the building components (and is therefore directed mostly downward), while hurricane winds and earthquakes apply loads in unexpected directions that, historically, most buildings weren't designed to support. CCR-CE ND 6-8, 5.2. Research and report using current or historical examples how the loss of life in a hurricane, flood, or earthquake is often directly tied to the way buildings are constructed. CCR-CE ND 6-8, 5.3. Experiment and calculate the pressures experienced by a building panel, tree trunk, or other structure due to different levels of hurricane wind velocity. CCR-CE ND 6-8, 5.4. Research and document the methods used in the design of buildings to withstand the flooding that may accompany hurricanes and heavy rain. CCR-CE ND 6-8, 5.5. Calculate the approximate weight per unit area of snow on a roof and determine how snow weight can add stress to a roof structure. CCR-CE ND 6-8, 5.6. Dramatize or sketch when roofs blow off of buildings during hurricanes due to wind flowing over the roof corner it creates a low pressure region and the suction-pulls the roof up (e.g., this phenomenon is similar to how air flow over a plane wing causes airplanes to fly). CCR-CE ND 6-8, 5.7. Demonstrate the difference between compression, tension, bending, and shear forces and explain how earthquakes largely generate shear forces. CCR-CE ND 6-8, 5.8. Distinguish how shear walls (i.e., solid walls with no doors or windows) are different from other walls and why they are designed to prevent structures from twisting or bending. CCR-CE ND 6-8, 5.9. Research, document, and explain the multiple ways in which buildings are designed to withstand earthquakes.	
Geotechnical (Soil and Rock)	Soil Classification, Soil Properties, Soil Mechanics	CCR-CE SL 6. Understand that soil can be strong or weak, depending on the type of soil, how densely it is packed, and how much water it contains.		CCR-CE SL 3-5, 6.1. Summarize how soil is created (i.e., through the erosion of rock). CCR-CE SL 3-5, 6.2. Classify examples of dirt as to what type of soil it is (e.g., clay, sand, and gravel). CCR-CE SL 3-5, 6.3. Explore and experiment to determine the optimum amount of water to add to dry sand, to make strong sand castles.	CCR-CE SL 6-8, 6.1. Research, organize, and use the Unified Soil Classification System. CCR-CE SL 6-8, 6.2. Experiment and determine that water content (i.e., liquidity index) and relative density dictate soil strength and thus the weight of the structure the soil can support. CCR-CE SL 6-8, 6.3. Test the shear strength of soil samples and record findings. CCR-CE SL 6-8, 6.4. Research, experiment, and document clays and silts undergo dramatic changes in properties demarcated by Atterberg Limits (i.e., liquid, plastic, and shrinkage limit) and explain how these would influence building plans in an area with high rainfall. CCR-CE SL 6-8, 6.5. Experiment and demonstrate soils can shrink or swell as they absorb water and this may cause structural components to heave, crack, or buckle unless compensated by introducing gaps or special materials into the design of underground structures (e.g., basement walls, foundations).	
	Naturally Occurring Soil and Rock Movements	CCR-CE SLM 7. Understand the role soils play in land displacement phenomena (e.g., landslides, sink holes, sedimentation) that occur either naturally or as a result of human activities (e.g. natural gas extraction, mining).		CCR-CE SLM 3-5, 7.1. Experiment and observe how soil erosion occurs (e.g., by watching and explaining water flowing through a prepared soil cutaway). CCR-CE SLM 3-5, 7.2. Research and report how soil erosion impacts humans, animals, and buildings (e.g., making land unstable for buildings, harming aquatic life by polluting streams with agricultural pesticides or pollutants). CCR-CE SLM 3-5, 7.3. Identify and describe methods of preventing soil erosion. CCR-CE SLM 3-5, 7.4. Research, reference, and explain sinkholes are typically caused by eroded soil or dissolved rock underneath the ground surface. CCR-CE SLM 3-5, 7.5. Experiment, observe, and report that water from wells contains dissolved minerals from the soil (e.g., cyanide, iron), which can be good or bad.	CCR-CE SLM 6-8, 7.1. Demonstrate some conditions that trigger landslides (e.g., heavy rain, steep slopes, earthquakes, undercutting of rock cliffs, removal of vegetation root structures, excavation) and the mechanism that underlies each trigger (e.g., heavy rain produces shear stresses from rolling water, removal of plant and tree roots weakens soil mechanical strength). CCR-CE SLM 6-8, 7.2. Research and explain the means in which human-made activities exacerbate the tendency for landslides to occur. CCR-CE SLM 6-8, 7.3. Document how soil slides under shear stresses and list examples of phenomena that produce shear stresses (e.g., raindrops, water runoff, earthquakes, earthmoving equipment). CCR-CE SLM 6-8, 7.4. Demonstrate, sketch, or dramatize that soil (i.e., sediment) can be transported via a rolling action, created by the shear stresses in moving wind, rivers, glaciers, and oceans. CCR-CE SLM 6-8, 7.5. Compare and contrast the results of sediment flow into an ecosystem can be positive or negative (e.g., important for sustaining marine life or providing nutrient-rich soil for farmers, such as the flooding of Nile river or cause problems for humans by transporting contaminants to new areas or silting up reservoirs and navigation channels). CCR-CE SLM 6-8, 7.6. Experiment and explain that rocks crack under tensile stresses. CCR-CE SLM 6-8, 7.7. Explain how wedges create local tensile stresses that can be used to force rocks apart and how fracking operations use fluid as a wedge. CCR-CE SLM 6-8, 7.8. Research some of the impacts of fracking on surface terrain and structural stability and why it is important in civil engineering projects.	

Water Resources	Water Cycle, Types of Water, Human Uses of Water	CCR-CE WA 8. Understand the water cycle, types of water, human uses of water, and the fact that water use has to be managed.	CCR-CE WA K-2, 8.1. Recall where rain comes from. CCR-CE WA K-2, 8.2. Name the different ways water is used by people (e.g., drinking, showers, energy generation, cleaning, water balloon fights, toilet flushing) CCR-CE WA K-2, 8.3. List the different methods people use to get across water bodies (e.g., boats, bridges, tunnels, etc.) CCR-CE WA K-2, 8.4. Recognize that not all water is drinkable (e.g., sewage, ocean water, agricultural water). CCR-CE WA K-2, 8.5. Reproduce and tell that water can change form (i.e., ice->water->steam).	CCR-CE WA 3-5, 8.1. List examples of different geographical features where water is found (e.g., lakes, swamps, rivers, glaciers, mountain snow), recall which provide saltwater vs. freshwater, and identify those sources that have been used to provide drinking water. CCR-CE WA 3-5, 8.2. Restate and describe that many bodies of water are located underground, providing drinking water for cities or homes but also complicating the siting of buildings and structures. CCR-CE WA 3-5, 8.3. Describe how weather is different in different places (e.g., it rains more in Britain and Canada than in Saudi Arabia) and ways this might impact local water supply. CCR-CE WA 3-5, 8.4. Determine what can be done if the water source for a city or town does not have enough water for everyone to be able to drink. CCR-CE WA 3-5, 8.5. Explain and compare the differences between black water, grey water, tap water, fresh water, and salt water. CCR-CE WA 3-5, 8.6. Restate and explain why not all water coming out of a faucet is drinkable (e.g., some outside faucets deliver grey water to water lawns).	CCR-CE WA 6-8, 8.1. Describe what happens in the water cycle (e.g., condensation, evaporation, precipitation, collection) and extrapolate what this implies for how old water is. CCR-CE WA 6-8, 8.2. Express the human consequences of droughts and floods. CCR-CE WA 6-8, 8.3. Explain and compare aquifers and watersheds. CCR-CE WA 6-8, 8.4. Explain and contrast that in many regions of the world (e.g., including the US until 1970), waste generated onsite during construction or use was buried onsite and explain the potential consequences (e.g., leading to water pollution and other hazards generations later). CCR-CE WA 6-8, 8.5. Identify the chemical and biological characteristics, sources, and human uses of black water, grey water, tap water, freshwater, and saltwater (e.g., where each comes from, how it's treated, what it contains, what it's used for).	
	Water Engineering	CCR-CE WE 9. Understand how water is managed by humans including the use of engineered structures to alter the paths tap, sewage, and storm water takes between humans and the environment.	CCR-CE WE K-2, 9.1. Recall how the water from a faucet was originally rain but that it could have been a lot of other places in-between. CCR-CE WE K-2, 9.3. Experiment with pouring water on a flat porous surface vs. a non-porous surface vs. a sponge and discuss how water is likely to behave when if falls on various human-made features in the neighborhood (e.g., roads, buildings, lawns, etc.)	CCR-CE WE 3-5, 9.1. List physical features in the neighborhood and community that relate to water (e.g., storm drain, water tower, fire hydrant, pond, lake, river, dam, bridge, culvert) and explain their purpose and function. CCR-CE WA 3-5, 9.2. Compare and explain a septic system and well and list examples of each. CCR-CE WE 3-5, 9.3. Identify the different ways water is collected and moved around naturally or by human intervention (e.g., dams, channels, rivers, lakes, pipes, tanks, barrels, bottles culverts, storm drain inlets.) CCR-CE WE 3-5, 9.4. Diagram or illustrate the path taken by a drop of rain after it falls on a grassy hillside, following it all the way to the ocean. CCR-CE WE 3-5, 9.5. Compare and list examples of how the path of a raindrop might be different if the drop of rain fell on a city block instead of a grassy hillside. CCR-CE WE 3-5, 9.6. Classify the means that water can be managed when it runs off of a land surface (e.g., storm drains, curb gutters, stormwater ponds, etc.).	CCR-CE WE 6-8, 9.1. Diagram the full path of where a drop of municipal drinking water comes from, beginning with where it falls as rain, through all stops in between (e.g., collected behind a dam, travelling through a river or channel to a treatment plant, going through city water system to a residential pipe) to its final destination in a water fountain or faucet. CCR-CE WE 6-8, 9.2. Illustrate and label the parts of where excess water goes after it falls as rain on a local city block, following the water's trail all the way out to sea or sky. CCR-CE WE 6-8, 9.3. Explain and summarize the implications of paved or covered (e.g., with buildings) surfaces for flood management and pollution control. CCR-CE WE 6-8, 9.4. Describe methods by which excess water is managed for urban areas having a lot of pavement (e.g., storm sewers, ditches, detention ponds, watershed dams). CCR-CE WE 6-8, 9.5. Diagram or illustrate with labels three paths of toilet water (i.e., blackwater) can take after flushing: a) to eventual reuse as drinking water and b) to wastewater refinement for further use in industry, or c) allowed to flow freely to contaminate other water ways (e.g., contaminating the ocean). CCR-CE WE 6-8, 9.6. Relate examples of how the same water structural feature can be used for different means, (e.g. a dam can be used for drinking water or to generate power) CCR-CE WE 6-8, 9.7. Research and present one or more water resource management methods (e.g., floodplains for flood prevention, ponds for sediment reduction, etc.) CCR-CE WE 6-8, 9.8. Research, document, and report on the challenges of turning sea water into drinking water. CCR-CE WA 6-8, 9.9. Investigate how water management challenges (e.g., shortages and scarcities, groundwater, aquifers, recharge, flooding, excess precipitation, water pollution) vary by geography, weather, and population density and compare and contrast examples of means specific regions or municipalities have dealt with those challenges. CCR-CE WA 6-8, 9.10. Identify a current water-related challenge in a specific locale and research and report on possible solutions to the challenge. CCR-CE WA 6-8, 9.11. Compare and contrast water usage per capita for various countries and describe possible reasons usage differs.	
	Water quality	CCR-CE WQ 10. Understand the varied processes for improving water quality.			CCR-CE WQ 6-8, 10.1. Distinguish the relationship between water quality and disease. CCR-CE WQ 6-8, 10.2. Summarize how underground water can be purified of macro-level particles (e.g., debris, large bacteria) as a result of filtration through soil and that soil bacteria will also help purify water by digesting many (though not all) organic contaminants. CCR-CE WQ 6-8, 10.3. Explain and describe how dissolved minerals (e.g., dissolved lime) and organisms too small to be filtered (e.g., Giardia protozoans, viruses) are often left in municipal or well-supplied drinking water and that special procedures need to be taken if it is desired to remove them. CCR-CE WQ 6-8, 10.4. Describe why well water is typically safer to drink than groundwater. CCR-CE WQ 6-8, 10.5. Explain or demonstrate how wastewater is purified in wastewater treatment plants (e.g., filtration, sedimentation, bacterial decomposition of organics, and disinfection). CCR-CE WQ 6-8, 10.6. Describe that while tap water and bottled water may be safe to drink, neither is completely pure: both may contain minerals, dissolved organic material, and small biologic organisms. CCR-CE WQ 6-8, 10.7. Explain why massive flooding can make tap water temporarily unsafe to drink.	
	Fluid Mechanics	CCR-CE FM 11. Understand basic fluid mechanics as it relates to the design of buildings and water management systems.			CCR-CE FM 6-8, 11.1. Compare and contrast the difference between an open and closed water system. CCR-CE FM 6-8, 11.2. Calculate the volume of water in an aquifer or water tower and determine how many households the water could support and for how long without replenishment. CCR-CE FM 6-8, 11.3. Calculate hypothetical water bills using volumetric flow rate and use this concept to design the number and diameters of pipes for a hypothetical water supply system. CCR-CE FM 6-8, 11.4. Explain that static pressure increases with depth underwater, illustrate using arrow diagrams the stresses acting on an object underwater, and explain what this implies for structures built underwater. CCR-CE FM 6-8, 11.5. Describe and illustrate the concept of hydraulic head. CCR-CE FM 6-8, 11.6. Predict, without mathematics, the qualitative relationship between pressure, velocity, and height in liquids (e.g., by conducting experiments using varying heights of liquid in a bucket with a hole at the bottom, placing holes at different heights in buckets, changing the relative height of siphons or hoses connected to buckets, changing the velocity of water through hoses or varying cross-sectional area and height of hoses).	CCR-CE FM 9-12, 11.1. Use Bernoulli's equation to explain common phenomena (e.g., why putting a thumb over part of a hose end causes the water to squirt out farther, or why the velocity of water out of a shower head can decrease as the shower goes longer). CCR-CE FM 9-12, 11.2. Explain and demonstrate Bernoulli's equation and use it to solve water flow, water supply, and wastewater problems involving changes in elevation, changes in pipe cross-sectional area, and other related issues. CCR-CE FM 9-12, 11.3. Describe and sketch the velocity profile of water a) when it enters a pipe and b) after it has moved through a pipe for a while under "no slip" boundary conditions.
Drafting	Sketches, Technical drawings	CCR-CE DR 12. Understand and create technical drawings of land features and human-made structures.	CCR-CE DR K-2, 12.1. Sketch a home or other familiar building.	CCR-CE DR 3-5, 12.1. Sketch and label a home or other familiar building. CCR-CE DR 3-5, 12.2. Research and explain the concept of a building footprint. CCR-CE DR 3-5, 12.3. Sketch and label the footprint of buildings or structures on a piece of land.	CCR-CE DR 6-8, 12.1. Identify and explain the elements of plans and drawings. [CAN-BC DR 6-7, 14.2.] CCR-CE DR 6-8, 12.2. Interpret and evaluate topographical maps and images. [US-CTE 9-12, D3.6] CCR-CE DR 6-8, 12.3. Create a simple topographical map. CCR-CE DR 6-8, 12.4. Interpret civil engineering drawings of a site (i.e., site map). CCR-CE DR 6-8, 12.5. Draw structures to scale using manual and computer-aided drafting techniques. [CAN-BC DR 8, 14.1.]	CCR-CE DR 9-12, 12.1. Create a technical drawing (i.e., including labels, symbols, and other techniques) of a structure to scale using manual and computer-aided drafting techniques. [CAN-BC DR 8, 14.1.]
	Legal Requirements	CCR-CE LR 13. Understand and identify the legal criteria and constraints for developing a proposed site.				CCR-CE LR 9-12, 13.1. Identify a land site to meet the defined needs and requirements (e.g., design criteria). CCR-CE LR 9-12, 13.2. Research and determine the municipal zoning ordinances and regulations for a site (i.e., municipal regulations, impact study conclusions, archaeological considerations, environmental limitations, and covenants, deeds, and zoning restrictions) CCR-CE LR 9-12, 13.3. Research and determine the regional and national legal requirements for a site (e.g., the design of energy systems, waste treatment systems, mandatory environmental preservation). CCR-CE LR 9-12, 13.4. Research the process and requirements for municipal site plan review. CCR-CE LR 9-12, 13.5. Document potential site development issues related to legal concerns (e.g., zoning does not permit building type; environmental impact study must be completed before construction can be approved) CCR-CE LR 9-12, 13.6. Revise or modify site selection as necessary, to meet legal requirements.
	Contour Maps, Site Survey	CCR-CE CM 14. Understand how to develop a preliminary contour map, site survey, and site map.				CCR-CE CM 9-12, 14.1. Research and determine if an existing contour map exists or draw a contour map of the proposed site. CCR-CE CM 9-12, 14.2. Conduct a site survey, documenting the locations of the electrical, water, and sewage access points and setbacks. CCR-CE CM 9-12, 14.3. Sketch a rudimentary site plan including outlines of proposed structures and existing utility access points.
	Soil Mechanics, Drainage, Grading, Stormwater Management	CCR-CE DRN 15. Understand how to develop a drainage plan for accommodating stormwater from the site.				CCR-CE DRN 9-12, 15.1. Conduct soil experiments to identify soil types. CCR-CE DRN 9-12, 15.2. Calculate the amount of stormwater that will collect on the planned impervious and open areas of a site to determine runoff flow rates including calculations for runoff flow rates, consider effects of soil type, climate, topography, and subsurface conditions. CCR-CE DRN 9-12, 15.3. Determine the necessary site topography and runoff water control devices (e.g., retention ponds, culverts) needed to ensure the stability of slopes and soil under water accumulation conditions combined with proposed loads. CCR-CE DRN 9-12, 15.4. Identify and determine if a stormwater treatment facility (or facilities) must be constructed according to municipality guidelines. CCR-CE DRN 9-12, 15.5. Describe the potential site development issues related to stormwater drainage (e.g., insufficient acreage of permeable surfaces, soil instability, need for treatment facility, need to re-grade land slopes, etc.). CCR-CE DRN 9-12, 15.6. Revise or modify site selection or concept as necessary, to meet stormwater drainage requirements. CCR-CE DRN 9-12, 15.7. Determine and calculate the amount of work required to alter the topography of a site to fit stormwater drainage needs. CCR-CE DRN 9-12, 15.8. Design and create a cut and fill plan for the proposed foundation. CCR-CE DRN 9-12, 15.9. Modify the existing contour map to show proposed new elevations to accommodate stormwater runoff. CCR-CE DRN 9-12, 15.10. Design and develop a separate stormwater drainage plan that includes such features as culverts and swales, catch basins, and pipes. CCR-CE DRN 9-12, 15.11. Revise the site plan by adding building foundations drawn to scale, as well as any structures associated with the stormwater drainage plan.

Site Planning	Water Access	CCR-CE WS 16. Understand how to develop a water supply plan for the site.				CCR-CE WS 9-12, 16.1. Estimate the water demand (e.g., gallons per minute) needed for a site using tables that provide the water pressure and flow rates needed for all appliances and services (e.g., sprinkler systems, dishwashers, toilets, etc.). CCR-CE WS 9-12, 16.2. Determine if the source of water to the site is adequate for the needs and modify the site selection if necessary. CCR-CE WS 9-12, 16.3. Calculate, from the total water demand, the pipe diameter and water pressure needed to supply a site for the proposed project. CCR-CE WS 9-12, 16.4. Document potential site development issues related to water availability (e.g., poor or seasonal access to potable water, insufficient water pressure at site without adding a pump, etc.) CCR-CE WS 9-12, 16.5. Revise or modify site selection or concept as necessary, to meet water availability requirements. CCR-CE WS 9-12, 16.6. Document final water plan by sketching water utility lines on the existing site plan.
	Wastewater Management	CCR-CE WWM 17. Understand how to develop a wastewater management plan for the site.				CCR-CE WWM 9-12, 17.1. Select and determine access to a method of managing wastewater for a selected site (e.g., city sewer, septic tank, sewage lift station). CCR-CE WWM 9-12, 17.2. Calculate the flow of wastewater, and determine the layout of the wastewater management system to be used. CCR-CE WWM 9-12, 17.3. Document potential site development issues related to wastewater management (e.g., need to build a septic tank or need to lift sewage to height of municipal sewage system) CCR-CE WWM 9-12, 17.4. Revise or modify site selection or concept as necessary, to meet wastewater requirements CCR-CE WWM 9-12, 17.5. Sketch structures associated with the wastewater management plan on the site plan.
	Energy Utilities	CCR-CE EU 18. Understand how and when to develop a plan for providing energy to the site.				CCR-CE EU 9-12, 18.1. Calculate building energy losses and propose ways in which the design could be altered to minimize energy use. CCR-CE EU 9-12, 18.2. Research, compute, and summarize the energy utility needs for a project. CCR-CE EU 9-12, 18.3. Research, calculate, and determine the size of the energy utility supply lines to meet current needs and predict need for future expansion. CCR-CE EU 9-12, 18.4. Analyze and quantify the size of the energy utility supply lines required in the event of a natural disaster. CCR-CE EU 9-12, 18.5. Document potential site development issues related to energy supply (e.g., on-site generator needed to cover peak or emergency energy needs). CCR-CE EU 9-12, 18.6. Revise or modify site concept as necessary, to meet energy requirements CCR-CE EU 9-12, 18.7. Draw the utilities plan by adding schematic symbols and connections to the site plan.
	Communications Access	CCR-CE COM 19. Understand how and when to develop a plan for the site to have access to communication services.				CCR-CE COM 9-12, 19.1. Research and determine the capacity of communications utilities (e.g., phone, internet) available to a site. CCR-CE COM 9-12, 19.2. Document potential site development issues related to communications availability supply (e.g., lack of existing internet requires ISP to agree to extend fiber or cable connection from the neighboring street.) CCR-CE COM 9-12, 19.3. Revise or modify site concept as necessary, to meet communications requirements
	Public Ingress/Egress	CCR-CE RD 20. Understand how to design roads and parking lots.				CCR-CE RD 9-12, 20.1. Research, analyze, and plan how a site will accommodate the movement of people, material, utilities, or equipment to be able to move from one area of the site to another. CCR-CE RD 9-12, 20.2. Revise the site plan to show the vertical and horizontal transit lines and station points necessary to lay out a properly aligned road. CCR-CE RD 9-12, 20.3. Research and apply federal, regional, and local codes and parameters to design a suitable and accessible parking lot. CCR-CE RD 9-12, 20.4. Revise and document the site plan to include a parking lot. CCR-CE RD 9-12, 20.5. Revise and draw the cut and fill plan for the foundation to include any grading needed for roads and parking lot.
	Landscaping, Erosion Control	CCR-CE LS 21. Understand the process to prepare a landscaping plan that meets maintenance, regulatory, budget, and aesthetic requirements.				CCR-CE LS 9-12, 21.1. Analyze the ordinance and regulations for landscaping a particular site. CCR-CE LS 9-12, 21.2. Organize and describe processes and procedures to control soil erosion (e.g., plantings, geotextiles, retaining walls). CCR-CE LS 9-12, 21.3. Identify and determine the flora and existing structures that will remain on the site. CCR-CE LS 9-12, 21.4. Research and select new flora to meets the needs of the site. CCR-CE LS 9-12, 21.5. Quantify what processes and procedures are required to provide healthy maintenance of landscaping (e.g., is the terrain too steep for grass to be mowed? Is the soil too acidic to support certain plants? Is there a place for snow to be placed after removal? Is the water supply adequate to support the landscaping?). CCR-CE LS 9-12, 21.6. Design, develop, and document a landscaping strategy that meets maintenance, regulatory, budget, and aesthetic requirements. CCR-CE LS 9-12, 21.7. Draw a landscaping plan, showing flora and landscaping structures to be retained, added, and removed. CCR-CE LS 9-12, 21.8. Diagnose and describe any measures that might be needed to protect the nearby environment from impacts caused by the site modification, site structures, stormwater and wastewater management.
	Site Plan Approval Process	CCR-CE RP 22. Understand how to develop a comprehensive reference document to support the creation of a site development plan.				CCR-CE RP 9-12, 22.1. Use the site survey information and municipality requirements to write a property description (i.e., terrain, barriers, size limitations, resource availability, utility availability). CCR-CE RP 9-12, 22.2. Research, organize, and create a GANTT Chart to document what is required to be completed to meet municipality, state, and federal regulations while meeting the project site requirements. CCR-CE RP 9-12, 22.3. Research and organize the steps required to request a variance for a site, if necessary, and use the survey information to explain why adjustments/revisions need to be made. CCR-CE RP 9-12, 22.4. Modify the existing contour map as necessary to show proximity and connections between proposed structures, utility systems, and other site elements. CCR-CE RP 9-12, 22.5. Integrate all previously written plans and drawings for management of stormwater, grading, siting of structures, management of waste and stormwater, ingress/egress, and landscaping into a comprehensive document describing the planned site development.
		CCR-CE SP 23. Understand the specific documentation required to obtain local or municipal approval of a site development plan.				CCR-CE SP 9-12, 23.1. Research an example of a local (municipal) site plan and a site plan checklist. CCR-CE SP 9-12, 23.2. Write a site development plan that meets most of the requirements for municipal site plan review. CCR-CE SP 9-12, 23.3. Review other plans to determine which municipality requirements (e.g., permanent stormwater control plan; erosion and sediment control plan, specifications for stormwater facilities) are met and offer suggestions for how the missing requirements could be revised.