

Job Task Analysis (JTA) for ACI Certification of Concrete Construction Sustainability and Resilience Assessor

HOW TO USE THIS JTA:

For the written examination, the Candidate must:

- **Understand** the following general concepts, which may not have specified values, procedures, or measurements; *and*
- **Know** the following specific procedures or values; performance of these items may also be assessed on the performance examination.

RESOURCES IN THIS PROGRAM:

ACI 130R

The Sustainable Concrete Guide, Applications (SCGA)

The Sustainable Concrete Guide, Strategies and Examples (SCG1)

DN33 Sustainability from Precast Concrete Association

Climate Change Evidence Impacts and Choices (CC)

Linking Disaster Resilience and Sustainability (LDRAS)

Disaster Resilience and Sustainability (DRS)

Primary Protection: Enhancing Health Care Resilience for a Changing Climate (PPHC)

Carbon Leadership Forum - Life Cycle Assessment of Buildings (CLF)

Whole Building Design Guide: Life-Cycle Cost Analysis (WBDG)

AIA Guide to Building Life Cycle Assessment in Practice (AIA 2010)

AREAS OF COMPETENCY:

Materials

Ratings

Concrete Production and Delivery

Service Life and LCCA

Design and Construction Practice

Social, Environmental, Economic

Climate Change

Resilience

Life-Cycle Analysis

Materials

- Understand that the majority of a concrete mixture is aggregates
- Know the chemical process of calcination
- Know the relative balance of CO₂ emissions for cement production
- Know the relative annual global amount of CO₂ generated by cement manufacture
- Know the approximate specific CO₂ emissions intensity of cement production
- Understand the historical trend of the specific energy requirement to produce clinker
- Understand cement industry initiatives to reduce the environmental impact of cement production
- Know alternate raw materials used in cement production
- Know conventional raw materials used in cement production
- Know the efforts undertaken by the Cement industry to reduce the environmental impact of cement
- Understand how specifications have helped reduce the environmental impact of cement
- Understand the role white cement plays in improving concrete sustainability
- Understand what a blended cement is

Job Task Analysis (JTA) for ACI Certification of Concrete Construction Sustainability and Resilience Assessor (Continued)

- Understand the emissions of cement manufacture relative to those of other industries
- Understand how the clinker contributes to the carbon footprint of cement
- Understand how portland limestone cements reduce the carbon footprint of concrete
- Understand how grinding aids reduce the carbon footprint of concrete
- Know examples of supplementary cementitious materials
- Know the meaning of the terminology SCM
- Know examples of SCMs
- Know the material performance and durability impacts of using SCMs
- Understand the impact of SCM usage on life cycle
- Understand the "reduce, reuse, recycle" benefits of using industrial byproducts as SCMs
- Understand how Coal Fly Ash acts as an SCM
- Know fly ash sources, usage and properties
- Understand how slag acts as an SCM
- Know slag cement sources, usage and properties
- Understand how silica fume acts as an SCM
- Know silica fume sources, usage and properties
- Understand how alternative supplementary materials (ASCMs) can be considered
- Understand why TiO_2 would improve concrete sustainability
- Know examples of Non-Portland Cement binders
- Understand sustainability aspects of aggregate selection
- Understand the transportation impacts of aggregate selection
- Understand how aggregate selection can impact transportation requirements
- Understand sustainability aspects of using Natural Aggregate
- Know the minimum yield strength of various forms of reinforcement
- Know that nearly all reinforcing steel is composed of recycled material
- Know that the issue of CO_2 emissions from cement production is the most commonly cited reason to criticize concrete as environmentally unfriendly
- Understand the scale of water usage to produce concrete
- Know acceptable qualities of mix water
- Understand the use of reclaimed mixing water
- Know what contributes to the carbon footprint of cement
- Understand approaches to reduce the carbon footprint of cement
- Understand the carbon footprint of cement as a component of concrete
- Understand the embodied energy of cement relative to concrete
- Know conventional raw materials used in cement production
- Know alternate raw materials used in cement production
- Know the chemical process of calcination
- Know the relative balance of CO_2 emissions for cement production (i.e. calcination vs fuel for kilns)
- Know the annual global amount of CO_2 generated by cement manufacture, relative to total anthropogenic emissions
- Understand the emissions of cement manufacture relative to those of other industries
- Understand the contribution of cement specifications to green cements
- Understand blended cements and ternary blended cements
- Know components of blended cements
- Understand CO_2 readsorption over service life
- Know characteristics of white cement

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- Understand the historical trend of the specific energy requirement to produce clinker
- Understand cement industry initiatives to reduce the environmental impact of cement production
- Know the meaning of the terminology SCM
- Know examples of SCMs
- Understand the difference between Recycled Mineral Components and SCMs
- Know fly ash sources, usage, and properties
- Know slag cement sources, usage, and properties
- Know silica fume sources, usage, and properties
- Know the material performance and durability impacts of using SCMs
- Understand the impact of SCM usage on life cycle
- Know the health impacts of SCMs
- Understand the "reduce, reuse, recycle" benefits of using industrial byproducts as SCMs
- Understand how SCM selection can impact transportation requirements
- Understand sustainability aspects of aggregate selection
- Understand the difference between natural and manufactured aggregates
- Understand what recycled concrete aggregates are
- Understand what virgin aggregates are
- Understand the transportation impacts of aggregate selection
- Know the sources, usage, and properties of lightweight aggregates
- Understand the labor impact of concrete made with lightweight aggregates
- Know what is meant by recycled concrete aggregates
- Know the sources, usage, and properties of recycled concrete aggregates
- Understand the impacts of using recycled concrete aggregates
- Understand how aggregate selection can impact transportation requirements
- Understand the relationship between steel strength and viable bar diameter
- Understand the durability impacts of reinforcement selection
- Know ways to improve the durability of steel reinforcement
- Understand the use of non-ferrous reinforcement
- Understand that steel bars contain recycled content
- Understand how reinforcement selection can impact production and labor requirements
- Understand how reinforcement selection can impact transportation requirements
- Understand the potential sustainability impacts of chemical admixtures
- Understand how admixture usage can impact production and labor requirements
- Understand emerging technologies that have been developed

Ratings

- Understand the different rating systems and their applications
- Understand Environmental Product Declarations, their purpose, and use
- Know why ASHRAE 189.1 was developed
- Know the scope of ASHRAE 189.1 (2014)
- Understand conditions to meet the performance option for ASHRAE 189.1
- Know the approaches the LEED v4 toward building performance
- Know the categories for LEED performance evaluation for BD+C
- Know the 6 versions of LEED v4
- Know the purposes of Product Category Rules
- Know topics of focus for the International Green Construction Code

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- Understand the parameters of a Whole Building Life Cycle Assessment according to the IgCC
- Know the scope of the Energy Star rating system
- Know what types of buildings are eligible for Energy Star Certification
- Understand the difference between Green Globes and LEED
- Know qualifying items for durability with respect to service life under rating systems
- Know the impact categories eligible for CO₂ reduction credits
- Understand purpose and options for material resource credits in LEED
- Know concrete resiliency benefits for which LEED credits can be earned
- Understand options for materials and resource Credit 4 on building product disclosures and optimization-sourcing raw materials
- Understand options for materials and resource Credit 4 on building product disclosures and optimization-material ingredients
- Understand the criteria for earning LEED credits on Minimum Energy Performance
- Know the methods for earning LEED credits for Indoor Air Quality

Concrete Production and Delivery

- Know the relative contribution of building operation and building construction to CO₂ emissions
- Understand the approaches that can be implemented to improve the “greenness” of concrete
- Understand which aspects of concrete production contribute the most to CO₂
- Know factors impacting sustainability in transportation of concrete raw materials
- Understand methods for reducing the carbon footprint of concrete
- Understand methods for placement of fresh concrete
- Understand the advantages of pumping fresh concrete
- Identify opportunities for managing waste materials during production and transportation of concrete
- Know the amount and requirements of water used in the production of concrete
- Understand the industry goals to reduce use of potable water in the production of concrete
- Know waste materials that can be used to improve the “greenness” of concrete
- Know the impact of SCC on the properties of concrete
- Understand potential changes in properties of concrete with recycled aggregate
- Know tips for mixture proportioning concrete design mixtures with recycled aggregate
- Understand special requirements for production of concrete with recycled aggregate

Service Life and LCCA

- Understand trade-off between initial and long-term costs
- Know operational and embodied energy of buildings
- Understand the relative carbon footprint of building life phases
- Understand heat transfer through building envelopes
- Know thermal mass
- Understand effect of longevity on total CO₂ emissions
- Understand service life
- Understand maintenance needs of exposed concrete surfaces
- Know beneficial aspects of integrating concrete elements
- Know maintenance and repair of concrete structures
- Understand repair design
- Know adaptive reuse
- Know mechanisms of and solutions to corrosion of reinforcement

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- Know the benefits of pervious concrete for stormwater management
- Know the effects of concrete color on lighting requirements

Design and Construction Practice

- Know the energy performance characteristics of forming systems
- Know how to calculate R-value of building assemblies
- Understand methods for considering the impact of thermal bridging
- Understand the impact of thermal mass on energy performance
- Know the different methods for utilizing solar gain and thermal mass to enhance building performance
- Understand the influence of climate in relation to thermal mass
- Know components that can be considered in building design and their impact
- Know how acceptance age requirements can vary with mix design
- Know about different codes and standards bodies and their sphere of influence
- Understand that ACI 318 is primarily a life safety code with enhancements for critical building types
- Know the five primary measures for assessment of successful sustainable design
- Understand BIM and its application to building design
- Know different forming systems and their characteristics
- Know characteristics for considering form system selection
- Understand how specification of concrete can impact its carbon footprint
- Know how over design can negatively impact concrete's carbon footprint
- Understand the difference between codes and rating systems
- Understand the relationship between standards and codes or law
- Understand that architectural precast panels may be used in blast resistant design to absorb the energy of a blast through cracking and deflection
- Insulated architectural precast panels can use concrete mix designs for the back-up layer of the panel that are specifically chosen to limit environmental impact
- Understand the impact of post-tensioned concrete on member design
- Understand the differences between bonded and unbonded post-tensioning tendons
- Know the differences between prestressed concrete and post-tensioned concrete
- Know the scope of the respective codes and standards

Social, Environmental, Economic

- Understand the meaning and components of the "triple bottom line"
- Know and define the various stakeholders impacted by a structure or a system
- Understand the meaning of VOC
- Understand the impact of Indoor Air Quality on Health and Productivity
- Understand the role of concrete in safety
- Understand the role and function of concrete in aesthetics

Environmental

- Understand the environmental impacts associated with different concrete constituents
- Understand the different phases of the lifecycle of concrete
- Understand the impact of concrete on climate change
- Understand the impact of GHG and CO₂ emissions
- Understand the definition of Heat Island effect
- Understand and identify mitigation means for heat island effect

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- Understand the definition and calculation of SRI
- Understand the impact of material selection on heat island effect
- Understand the role of concrete in water management
- Understand the water consumption components in concrete production and use

Economic

- Understand the importance of durability in construction and the role of concrete thereof
- Understand the definition and functions of thermal mass in energy saving
- Understand U and R values
- Understand various insulation systems
- Understand the difference between initial cost, maintenance cost, and lifecycle cost
- Understand the meaning of service life and design life

Climate Change

- Understand carbon footprint
- Understand effect and mitigation of heat islands
- Know the primary causes of climate change
- Understand global temperature change
- Understand the metrics that are monitored for climate change
- Know the primary greenhouse gasses and their relative impact
- Know current and historic measurement and predictions of atmospheric CO₂
- Know climate feedback loops
- Understand natural climate cycles
- Understand what impacts of climate change have been observed
- Understand the impact of climate change on the oceans
- Understand the impact of climate change on weather events and seasons
- Understand what ice cores reveal about natural climate change
- Understand how scientists project future climate change
- Know the relative impact of climate change on regional temperatures
- Understand the relative impact of climate change on regional precipitation patterns
- Know the impact of changing ice and snow patterns
- Know the impact of rising sea levels on coastlines
- Understand the impact of climate change on ecosystems
- Understand how climate change will impact agriculture and food production
- Know the choices for reducing greenhouse gas emissions
- Know reasons for undertaking climate change mitigation
- Understand the concept of iterative risk management

Resilience

- Understand the definition of disaster resilience
- Know the five ways to characterize durability
- Understand the definition of functional resilience
- Understand aspects of resilience related to disaster resistance
- Understand the attributes of concrete bearing walls and shear walls with respect to disaster resistance
- Know the resilient attributes of exposed concrete finishes
- Understand basic requirements for creating durable concrete structures

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- Understand what constitutes adaptive reuse
- Understand that building codes and sustainability ratings systems do not consider the benefits of functional resilience
- Know the ways that resilient building structures protect during extreme events
- Understand that the most common hazards for a building
- Know the relationship between sustainability and resilience
- Understand the methods for quantifying resilience and sustainability
- Understand fragility curves
- Understand the difference between infrastructure and disaster resilience
- Know the relation between traditional sustainable design, disaster resilience, and sustainability
- Know the general considerations for resilient design
- Know programs that can be used for resilience against hazards
- Know passive survivability and its relation to concrete
- Know strategies for resilient design in developing countries
- Know the definition of vulnerability
- Understand resilience mitigation versus sustainability mitigation
- Know examples of risk
- Know adaptation measures for resilience
- Know the most frequent hazard across the world
- Know the core attributes of a resilient community
- Know resilient design principles

Life-Cycle Analysis

Life Cycle Environmental Impact Assessment (LCA)

- Understand how increased service life with concrete structures impacts an LCA
- Know the impact of material selection on emissions
- Know the life cycle stages to products and buildings and how they differ
- Understand the effect of regular preventative maintenance on the environmental impact of a building
- Know what standards are used in LCAs
- Know what or who determines the reference study period of a building
- Know what steps should be taken if the reference study period and the required service life are not the same
- Know the data sources used to assess impacts
- Know the goals of conducting an LCA
- Understand the difference between embodied (carbon) energy and operating (carbon) energy
- Know carbon sequestration
- Know biogenic carbon
- Know how biogenic carbon is reported in an LCA
- Understand how operational energy can be used to compare buildings
- Know what must be defined in the scope of an LCA
- Know the steps taken in the verification of an LCA
- Understand interchangeable terms for emissions associated with climate change or global warming
- Understand the environmental impact categories used in building initiatives
- Know the five phases of life cycle assessment
- Understand the types or variants of LCA

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- Know the different types of process-based LCA methods
- Be able to establish a functional unit
- Be able to establish a system boundary
- Understand the uses of life cycle assessment
- Know how to perform categorization of inventory results, normalization, aggregation, and weighting
- Be able to calculate carbon equivalence
- Understand the role of iterations in life cycle assessment
- Understand LCI
- Know the role of data quality
- Know the life cycle stages as defined in LCA
- Be able to perform the role of energy mixes, water resources, and transportation in environmental impact assessment
- Know end-of-life options
- Know sensitivity assessment of inventory (and environmental impacts)
- Know uncertainty assessment of environmental impacts (and inventory)
- Understand the working definitions of LCA

Life Cycle Cost Assessment (LCCA)

- Understand Life Cycle Costing
- Know the costs taken into consideration when performing an LCCA
- Know when to conduct an LCCA
- Know how inflation is treated in an LCCA
- Know the parameters for Present-Value Analysis
- Be able to calculate Life Cycle Cost
- Know the supplementary measures of Economic Evaluation
- Understand the detrimental aspects of an LCCA
- Know techniques to assess uncertainty in LCCA