



ASCE's Resources for Sustainable and Resilient Infrastructure

April 8, 2021

Denise Nelson
P.E., CFM, ENV SP, LEED AP, M.ASCE

Fariborz M. Tehrani
PhD, P.E., ENV SP, PMP, SAP, F.ASCE



Why Do We Need Sustainable Solutions?

- **Growth**
 - Lack of services
 - Inadequate capacity
- **Aging infrastructure**
 - Inadequate function / type
 - Infrastructure failure
- **Increasing community resilience**
 - Climate change and other risks



2

Sustainability is...

a set of **economic, environmental and social conditions** in which all of society has the capacity and opportunity to **maintain and improve its quality of life** indefinitely.

Sustainable development is...

the application of these resources to **enhance the safety, welfare, and quality of life** for all of society.

Resilience is...

the capability to **mitigate against significant all-hazards risks** and incidents and to expeditiously **recover and reconstitute critical services**.

A sustainable infrastructure project...

- Addresses the consequences of a non-sustainable operating environment
- Makes meaningful, real progress in improving performance

A resilient infrastructure project...

- Has the ability to accommodate hazard-related impacts and continue providing services or limit service outage times

Important steps for success:

- Perform life cycle assessment from planning to reuse
- Use resources wisely
- Plan for resiliency
- Validate application of principles




Traditional Development of Infrastructure

Traditional Development

- Focus on growth and constructing solutions
- Environmental “constants”
- Compliance
- Risk avoidance




5



Development of Sustainable Solutions


Traditional Development

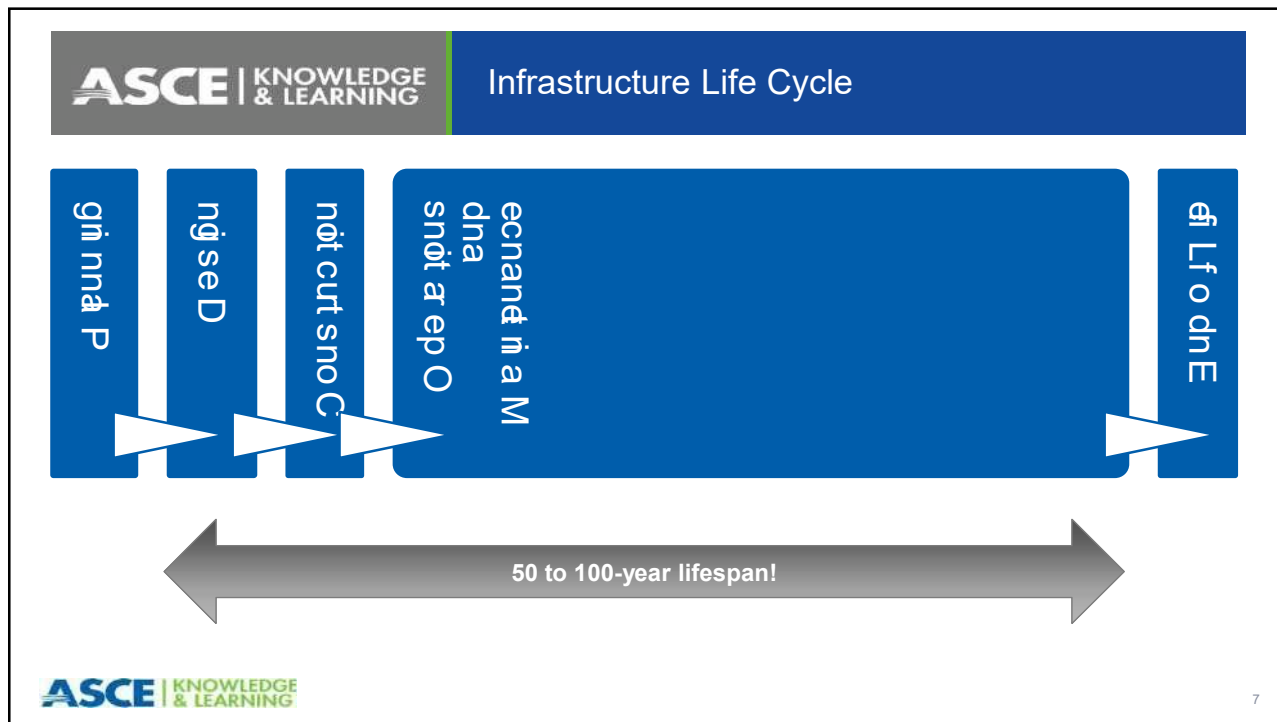
- Focus on growth and constructing solutions
- Environmental “constants”
- Compliance
- Risk avoidance

Policy Statement 418
The Role of the Civil Engineer in Sustainable Development

Sustainable Development

- The *right* project
- The project *right*
- Non-stationarity in environmental parameters
- Resilience, innovation, co-benefits, synergies
- Risk mitigation and adaptation


6



ASCE | KNOWLEDGE & LEARNING Sustainable Thinking

Sustainability is a Continuum

- Improvement over current, local practices
- Incremental improvement

Standard water use → 20% conserved → 40% conserved

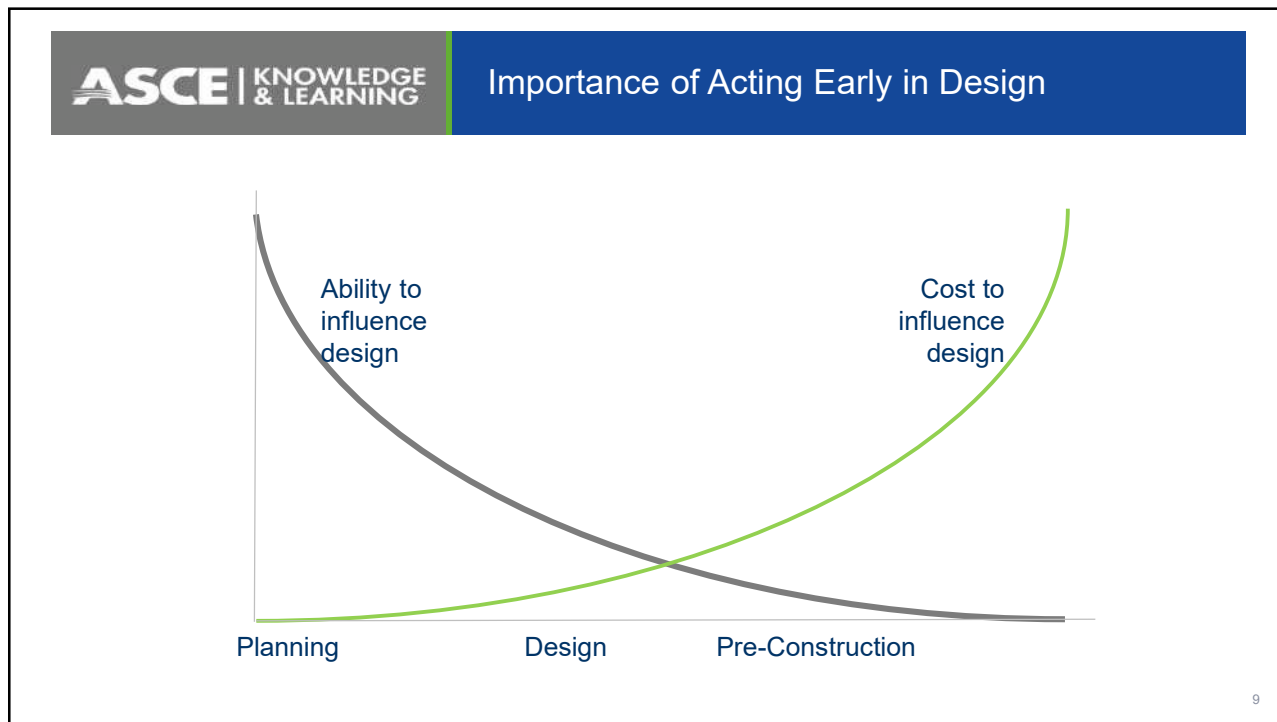
Sustainability is a Balancing Act

- Many options to consider and balance

Local Materials vs Recycled Content Materials

Vegetated Roof vs Solar Roof

8



ASCE | KNOWLEDGE & LEARNING Benefits of Sustainable Infrastructure

Social – Environmental – Economic

- Enhance quality of life
- Create jobs and improve productivity
- Protect cultural and historical assets
- Preserve and enhance the environmental
- Prevent pollution and improve air and water quality
- Conserve natural resources
- Reduce global warming

The Venn diagram shows three overlapping circles: Social (orange), Environmental (green), and Economic (blue). The intersections are labeled: Social-Environmental (Socio-Environmental), Social-Economic (Socio-Economic), and Environmental-Economic (Eco-Economy). The central intersection of all three is labeled 'Sustainable Development'.



Civil Engineers Must Prepare for the Future

BY Thomas Smith III

July 9, 2019 [ASCE Working for You](#) [Career Booster Webinars](#) [Power Skills](#) [YMLS](#)

Civil engineers

- are essential
- serve as systems integrators
- must be competent, collaborative, and ethical
- must be innovators, environmental stewards, managers of risk, and active in public policy
- must be effective leaders



ASCE Executive Director Tom Smith. PHOTO: Jason Dixon Photography



The Engineer's Responsibility

ASCE's Code of Ethics (revised 2020)

Preamble

Fundamental principles:

- Create **safe, resilient, and sustainable** infrastructure
- Treat all persons with respect, dignity, and fairness
- Consider the current and anticipated needs of society
- Utilize their knowledge and skills to **enhance the quality of life** for humanity

2. NATURAL AND BUILT ENVIRONMENT


Engineers:

- a. adhere to the principles of sustainable development;
- b. consider and balance societal, environmental, and economic impacts, along with opportunities for improvement, in their work;
- c. mitigate adverse societal, environmental, and economic effects; and
- d. use resources wisely while minimizing resource depletion.



***.asce.org/code-of-ethics/

13




The Engineer's Role

**POLICY STATEMENT 418
THE ROLE OF THE CIVIL ENGINEER
IN SUSTAINABLE DEVELOPMENT**

- Innovate
- Plan, design, construct
- Bridge science and society
- Lead multidisciplinary teams

**POLICY STATEMENT 500
RESILIENT INFRASTRUCTURE**

- Assess hazards and risk
- Develop performance criteria
- Incorporate resiliency in decision-making
- Understand impact of loss and restoration



***.asce.org/public_policy_statements/

14

ASCE | KNOWLEDGE & LEARNING
 The Owner's Role


**POLICY STATEMENT 556
OWNERS COMMITMENT TO SUSTAINABILITY**

- Incorporate sustainability principles and practices in the development of infrastructure
- Provide leadership in initiation and development of sustainable and resilient projects
- Raise their level of awareness and implementation of sustainability




15

ASCE | KNOWLEDGE & LEARNING
 ASCE Resources




MEMBERSHIP

- 🔗 Renew My Membership
- 🔗 Join ASCE
- 🔗 Manage My Membership
- 🔗 Section Member Drive




CONTINUING EDUCATION

- 🔗 Search Courses
- 🔗 Browse Guided Online Courses
- 🔗 Prepare for the PE Exam
- 🔗 Register for ASCE Week




PUBLICATIONS

- 🔗 Search ASCE Library
- 🔗 Shop Books and Standards
- 🔗 Discover ASCE 7
- 🔗 Find a Journal




CONFERENCES & EVENTS

- 🔗 View the Calendar
- 🔗 Submit a Paper or Session
- 🔗 Sponsor or Exhibit
- 🔗 View Free Virtual Events




INITIATIVES

- 🔗 View the Infrastructure Report Card
- 🔗 Future World Vision
- 🔗 Sustainability
- 🔗 Innovation Contest



CAREERS

- 🔗 Career Connections
- 🔗 Early Career Resources
- 🔗 Salary Survey
- 🔗 Ethics


16

ASCE | KNOWLEDGE & LEARNING **ASCE Free References**

The slide displays three book covers under the heading "ASCE Free References".

- Civil Engineering Body of Knowledge: Preparing the Future Civil Engineer, Third Edition**. Prepared by the Civil Engineering Body of Knowledge 3 Task Committee. ASCE logo.
- Adapting Infrastructure and Civil Engineering Practice to a Changing Climate**. Committee on Adaptation to a Changing Climate. Edited by J. Rolf Olsen, Ph.D. ASCE logo.
- LIFE CYCLE COST ANALYSIS: MAXIMIZING THE VALUE OF INVESTMENTS USING**. ASCE logo and ENR logo.

ASCE | KNOWLEDGE & LEARNING 17

ASCE | KNOWLEDGE & LEARNING **ASCE Key Books**

The slide displays three book covers under the heading "ASCE Key Books".

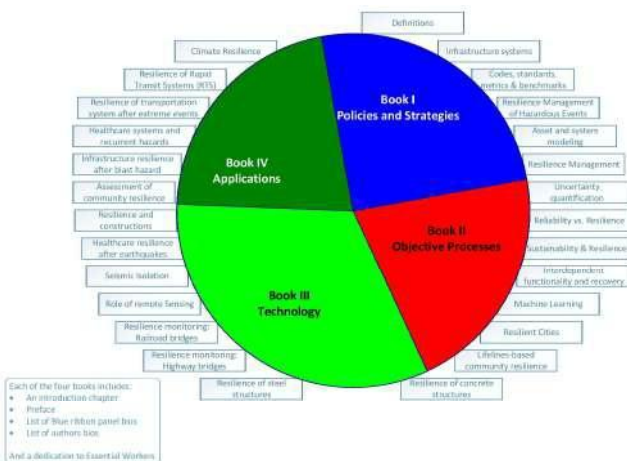
- ENGINEERING FOR Sustainable Communities: PRINCIPLES AND PRACTICES**. Edited by William E. Kelly, Ph.D., Richard M. Puzoski, Ph.D., and Richard N. Wright, Ph.D. ASCE logo.
- Climate-Resilient Infrastructure: ADAPTIVE DESIGN AND RISK MANAGEMENT**. Committee on Adaptation to a Changing Climate. Edited by Bilal M. Ayoub, Ph.D., P.E. ASCE logo.
- Resilience-Based Performance: Next Generation Guidelines for Buildings and Lifeline Standards**. Infrastructure Resilience Publication No. 3. Risk and Resilience Measurement Committee. ASCE logo.

ASCE | KNOWLEDGE & LEARNING 18

Objective Resilience Manual of Practice (OR-MOP), Expected Summer 2021

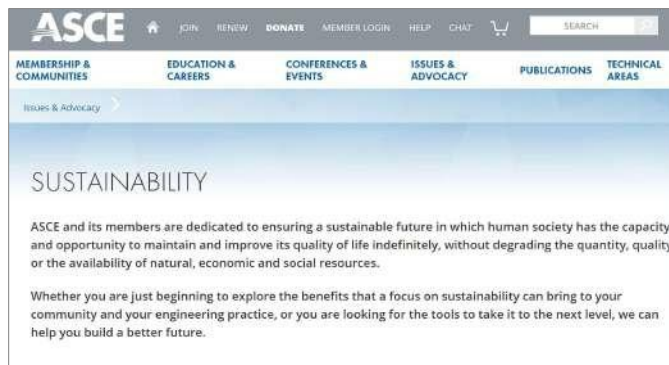
Ed. Dr. Mohammed M. Ettouney, Sc.D, P.E., M.B.A., F.AEI, Dist.M.ASCE

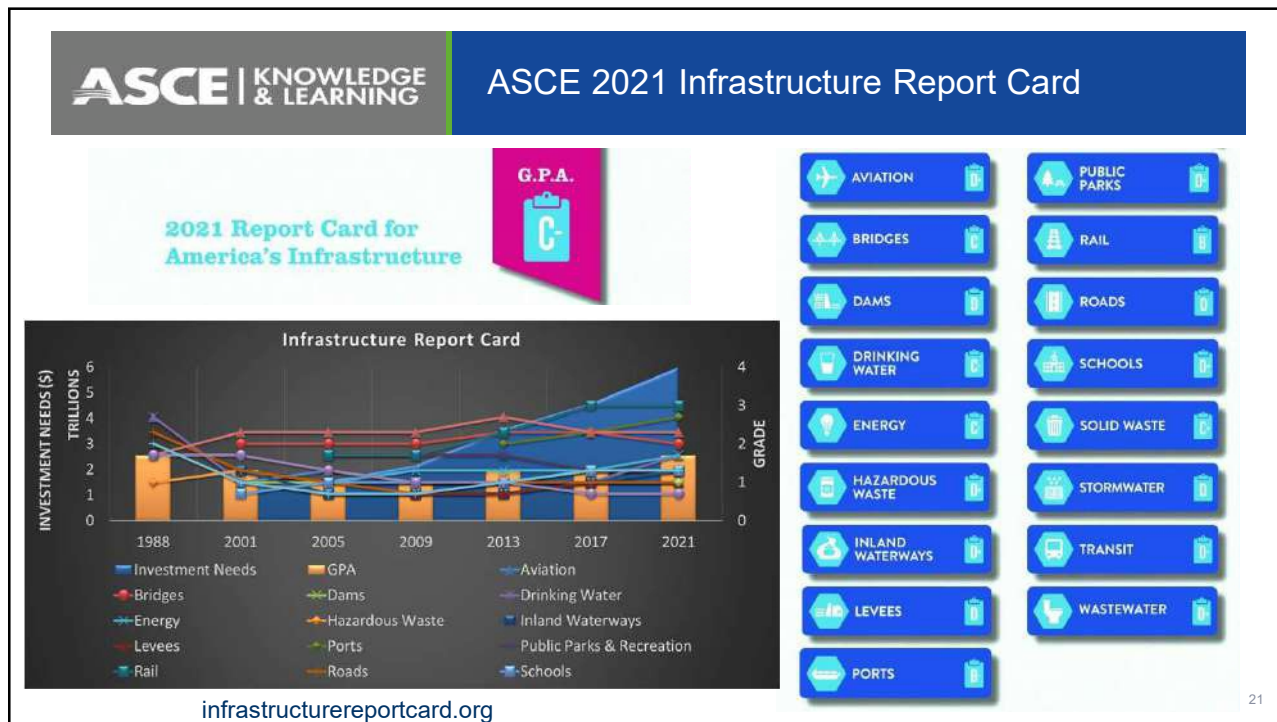
-  Policies and Strategies
-  Objective Processes
-  Technology
-  Applications



- www.asce.org/sustainability
- www.asce.org/infrastructure-resilience/infrastructure-resilience
- www.asce.org/climate-change/climate-change

- ASCE Collaborate
 - collaborate.asce.org
- ASCE Source
 - source.asce.org
- ASCE Advocacy
 - www.asce.org/advocacy





ASCE | KNOWLEDGE & LEARNING ASCE Key Initiatives

ASCE GRAND CHALLENGE Rethink What's Possible

FOCUS: RESILIENCE

FOCUS: LIFE CYCLE COST ANALYSIS

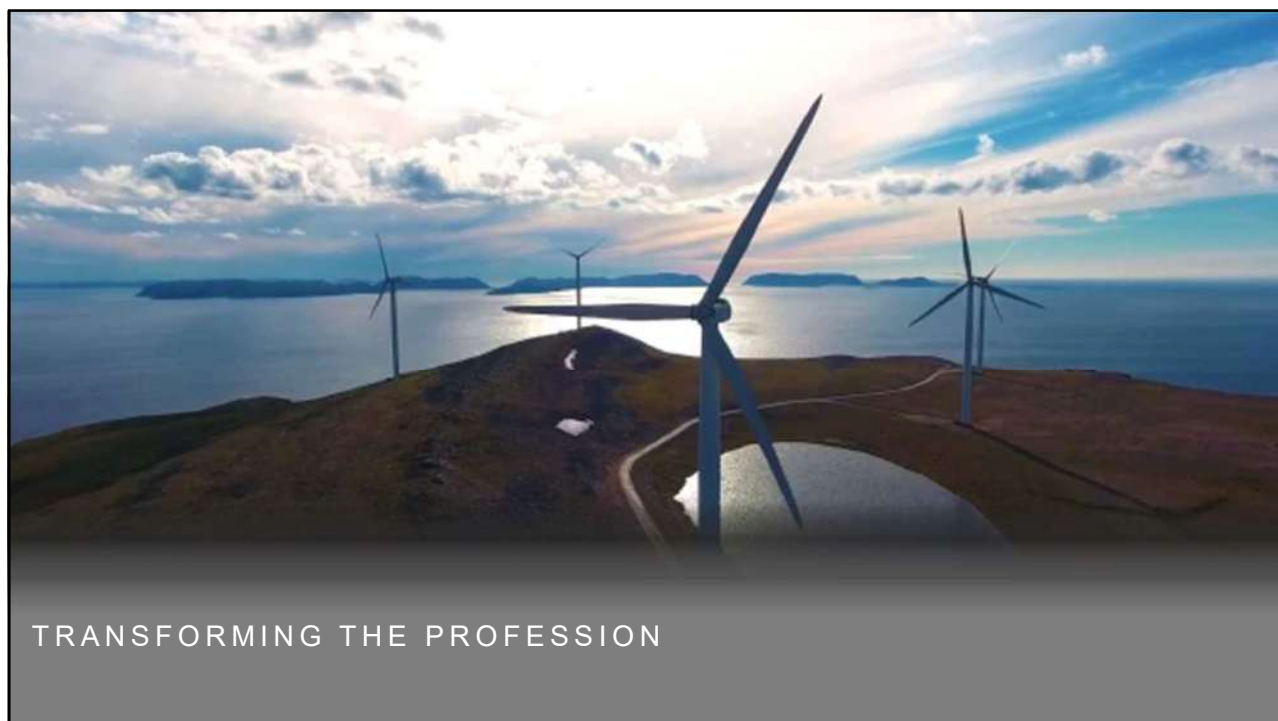
FOCUS: INNOVATION

FOCUS: PERFORMANCE BASED STANDARDS

ASCE | KNOWLEDGE & LEARNING ***.ascegrandchallenge.com

22

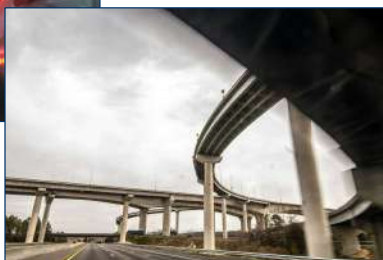
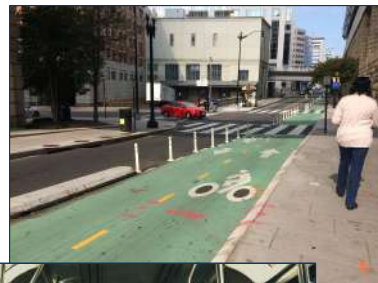
1. Sustainable Project Development
(Do the Right Project)
2. Standards and Protocols
(Do the Project Right)
3. Transform the Profession
(Expand Practitioner Capacity)
4. Communicate and Advocate
(Make The Case)



1. **Sustainable Project Development**
(Do the Right Project)
2. Standards and Protocols
(Do the Project Right)
3. Transform the Profession
(Expand Practitioner Capacity)
4. Communicate and Advocate
(Make The Case)



Traffic congestion?
How about....





Understand the Problem / Need

Location	Operating Context	Community Expectations
<ul style="list-style-type: none"> ■ Regional Connectivity ■ Environment ■ Alignment with existing plans 	<ul style="list-style-type: none"> ■ Owner's priorities ■ Market capacity ■ Economic viability ■ Functionality ■ Technologies ■ Regulatory profile 	<ul style="list-style-type: none"> ■ Community Welfare ■ Community Building ■ Cultural Preservation ■ Social Equity

Context sensitive solutions


27



Determine the *Right* Project

Basis for design	Options
<ul style="list-style-type: none"> ■ Growth <ul style="list-style-type: none"> ■ Lack of services ■ Inadequate capacity ■ Aging infrastructure <ul style="list-style-type: none"> ■ Inadequate function / type ■ Infrastructure failure ■ Increasing community resilience <ul style="list-style-type: none"> ■ Climate change and other risks 	<ul style="list-style-type: none"> ■ New ■ Repair ■ Upgrade ■ Replace ■ Expand ■ Remove




28

- 131 - Growth and Development
- 218 - Improvement and Maintenance of Ports, Harbors and Waterways
- 470 - Dam Repair and Rehabilitation
- 283 - Periodic Inspection of Existing Facilities
- 495 - Operations and Management of Transportation Systems
- 504 - Rehabilitation of Historic Bridges
- 500 - Resilient Infrastructure

ASCE supports:

- **Preparation** for impacts of climate change
- **Revisions** to engineering design standards, codes, regulations
- Research, development, and **demonstration**
- **Cooperative research** among engineers and climate, weather, and life scientists
- **Informing** practicing engineers, project stakeholders, policy makers and decision makers
- Developing a **new paradigm** for engineering practice
- Identifying **critical** infrastructure

- 437 - Risk Management
- 389 - Mitigating the Impacts of Natural and Man-Made Disasters
- 390 - Earthquake Hazards Mitigation
- 530 - Windstorm Impact Mitigation
- 421 - Floodplain Management
- 545 - Flood Risk Management



- 488 - Greenhouse Gases
- 500 - Resilient Infrastructure
- 541 - Post-Disaster Reconstruction of Infrastructure
- 408 - Planning and Management for Droughts
- 540 - Resilient Water Resource Infrastructure



ASCE | KNOWLEDGE & LEARNING ASCE Resources



Journal of Environmental Engineering



Journal of Geotechnical and Geoenvironmental Engineering



Journal of Cold Regions Engineering



Natural Hazards Review

ISSN (print): 1527-6988 | ISSN (online): 1527-6996
 Frequency: Quarterly | Sponsored by the Infrastructure Resilience Division

CURRENT ISSUE
ALL ISSUES ▾

ASCE 7 Hazard Tool

One Site. Precise Data. Fast Results.




NEW UPGRADES

ASCE



33

ASCE | KNOWLEDGE & LEARNING ASCE Books




Quantitative Risk Management and Decision Making in Construction

Amarjit Singh, Ph.D., P.Eng., C.Eng.
 ASCE Press • 2017




Risk and Reliability Analysis: A Handbook for Civil and Environmental Engineers

By Vijay P. Singh, Ph.D., P.E.; Sharad K. Jain, Ph.D.; and Aditya Tyagi, Ph.D., P.E.
 ASCE Press • 2007



Flood Risk Management: Call for a National Strategy

Task Committee on Flood Safety Policies and Practices; Edited by Robert Traver, Ph.D., P.E., D.WRE, F.EWRI, F.ASCE
 2014





Flood Resistant Design and Construction

American Society of Civil Engineers
 ASCE/SEI 24-14 | Book set: ASCE 24 | ISBN (print): 9780784413791 | ISBN (PDF): 9780784478721

TOOLS ▾

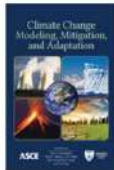
BUY E-BOOK
BUY PRINT BOOK


34




KNOWLEDGE & LEARNING

ASCE Books



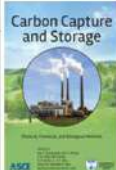
Climate Change Modeling, Mitigation, and Adaptation

Edited by Rao Y. Surampalli, P.E., Dist.M.ASCE; Tian C. Zhang, P.E.; C. S. P. Ojha, Ph.D., M.ASCE; B. Gurjar, Ph.D.; R. D. Tyagi, Ph.D., M.ASCE; and C. M. Kao, Ph.D., P.E., F.ASCE
2013




Adapting Infrastructure and Civil Engineering Practice to a Changing Climate

Committee on Adaptation to a Changing Climate; Edited by J. Rolf Olsen, Ph.D.
2015




Carbon Capture and Storage: Physical, Chemical, and Biological Methods

Edited by Rao Y. Surampalli, Ph.D., P.E.; Tian C. Zhang, Ph.D., P.E.; R. D. Tyagi, Ph.D.; Ravi Naidu, Ph.D.; B. R. Gurjar, Ph.D.; C. S. P. Ojha, Ph.D.; Song Yan, Ph.D.; Satinder K. Brar, Ph.D.; Anushuya Ramakrishnan, Ph.D.; and C. M. Kao, Ph.D., P.E.
2015




Structural Materials and Global Climate: A Primer on Carbon Emissions for Structural Engineers

Carbon Task Group; Edited by Mark D. Webster, P.E.
2017




35




KNOWLEDGE & LEARNING

ASCE Roadmap to Sustainable Development

1. Sustainable Project Development
(Do the Right Project)
2. Standards and Protocols
(Do the Project Right)
3. Transform the Profession
(Expand Practitioner Capacity)
4. Communicate and Advocate
(Make The Case)





[***.asce.org/sustainability-roadmap/](http://www.asce.org/sustainability-roadmap/)

36

ASCE | KNOWLEDGE & LEARNING

Standards and Protocols

BREADTH OF KNOWLEDGE

SOCIAL

ENVIRONMENTAL

ECONOMIC

Depth of Knowledge:

(Specific Solutions to Specific Problems)

- 9 Institutes
- 8 Technical Groups
- Academies & Certifications

Breadth of Knowledge:

(Planning, Goals, etc.)

- Committee on Sustainability
- International
- National
- Regions
- Sections
- Branches

ASCE

 | KNOWLEDGE & LEARNING
 37

ASCE | KNOWLEDGE & LEARNING

Project Certification

- Institute for Sustainable Infrastructure: Envision
- Green Business Certification Inc.
 - SITES
 - Parksmart
 - PEER
 - LEED for Cities & Communities
- GreenRoads
- CEEQUAL
- Eco Districts

ENVISION

PERFORMANCE EXCELLENCE IN ELECTRICITY RENEWAL

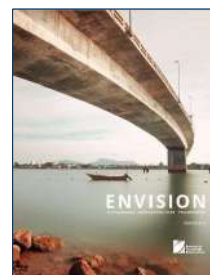
ASCE

 | KNOWLEDGE & LEARNING
 38

- Guidance on best practices
- Quantifying sustainability, including soft benefits
- Create a baseline
- Create a benchmark
- Optimize benefits
- Document approach and results
- Defensible certification



1. Quality of Life
2. Leadership
3. Resource Allocation
4. Natural World
5. Climate and Resilience




Award Levels: Verified, Silver, Gold, Platinum

1. Life cycle cost analysis
2. Energy efficiency
3. Water conservation
4. Surface and ground-water protection
5. Air pollution management
6. Reuse, repurpose, and recycle non-renewable resources
7. Public health and safety improvement
8. Public involvement
9. Plan for resiliency
10. Sustainability Management System

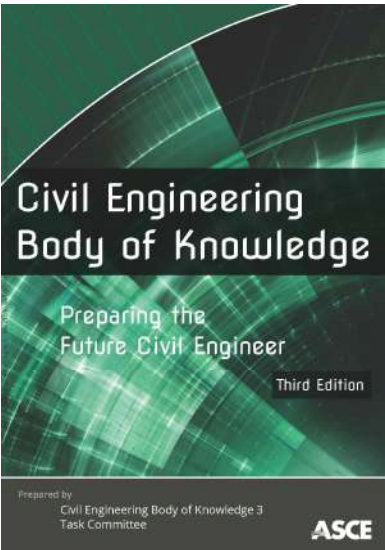


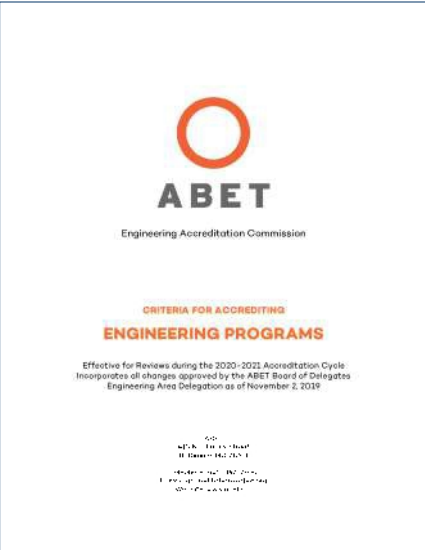
1. Sustainable Project Development
(Do the Right Project)
2. Standards and Protocols
(Do the Project Right)
3. **Transform the Profession**
(Expand Practitioner Capacity)
4. Communicate and Advocate
(Make The Case)






Sustainability in Engineering Curriculum





43

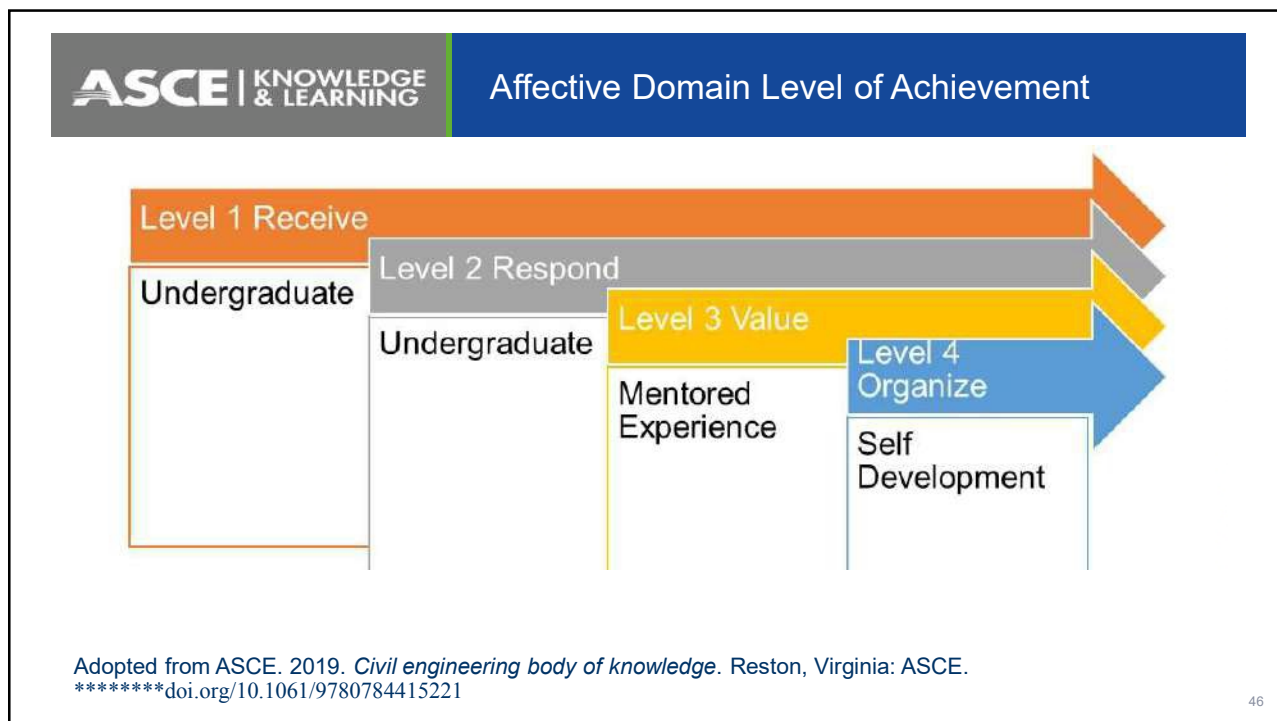
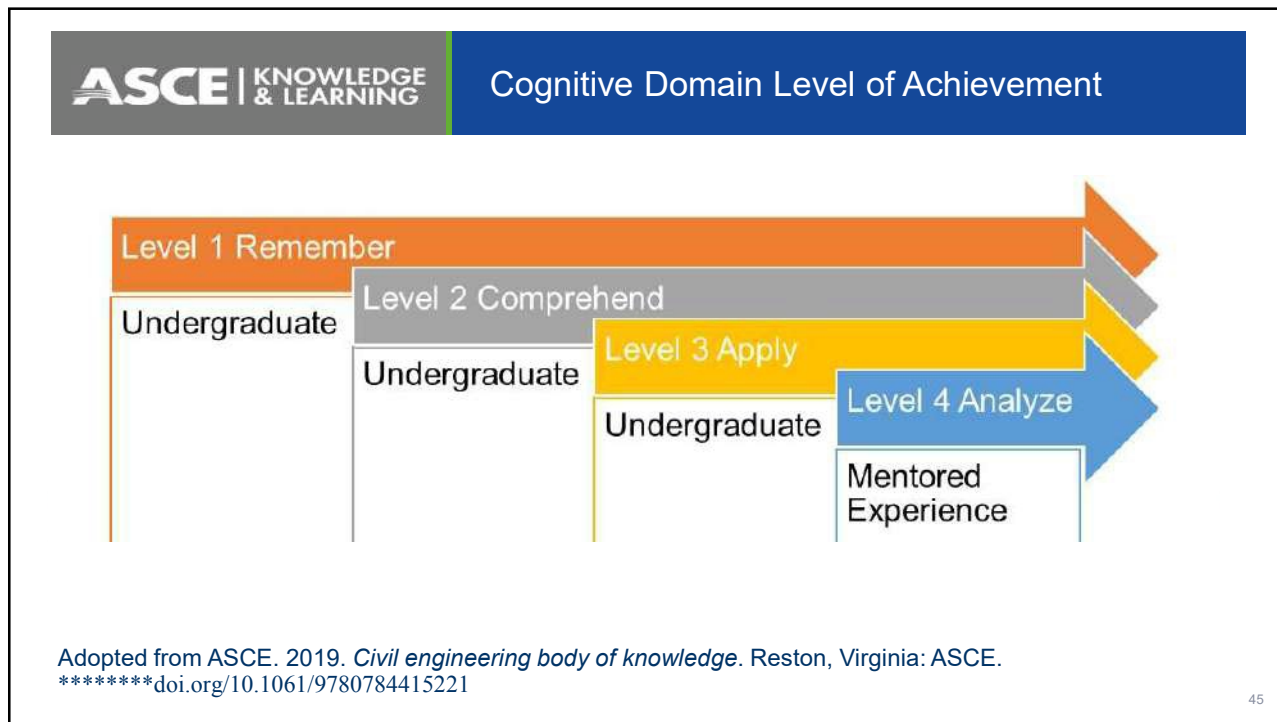


Selected ABET Student Outcomes

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Adopted from ABET. 2019. *Criteria for Accrediting Engineering Programs*. Baltimore, MD: ABET. : www.abet.org

44



- Whole Building Lifecycle Assessment: Quantifying Impacts of Construction Materials
- An Introduction to Life Cycle Cost Analysis for Sustainability and Green Building Design
- Climate Resilience for Critical Infrastructure
- Flood Design for a Changing Climate
- Life Cycle Assessment for Transportation Facilities
- Complete Streets Design
- Disaster Resilience of Infrastructure Systems: Quantification and Economic Valuation for Decision and Policy Making
- Mitigation of Carbon Emissions from Construction Projects
- Permeable Pavement - Design Considerations and Tips for Avoiding Failures
- Sustainable Infrastructure Using Envision to Plan, Design and Rate Infrastructure Projects

- An Introduction to Life Cycle Cost Analysis for Sustainability and Green Building Design
- Benefits of Pavement Reclamation: How In-Place Recycling has Worked for National Parks/Forests
- Building Structures and Sustainability
- Complete Streets Design
- Connected Vehicles, Smarter Cities, & Modern Signal Timing - How Traffic Engineering Strategies Will Change in the Years Ahead
- Cost Justification for Sustainable and Resilient Infrastructure: Data Driven Economic Analysis for Project Decision Support - Part I
- New ASCE Standard - Design, Construction and Maintenance of Permeable Interlocking Concrete Pavements
- Preparing Our Infrastructure for a Changing Climate

- Engineering for a Sustainable Future (16 hours)
- Community Participation (5 hours)
- Life Cycle Analysis for Sustainability (16 hours)
- Sustainable Project Management (8 hours)
- One elective
 - Access and Mobility for the 21st Century (5 hours)
 - Ecological Systems (5 hours)
 - Sustainable Land Use (4 hours)



Earn up to 50 PDHs!

1. Sustainable Project Development
(Do the Right Project)
2. Standards and Protocols
(Do the Project Right)
3. Transform the Profession
(Expand Practitioner Capacity)
4. **Communicate and Advocate**
(Make The Case)



POLICY STATEMENT 139 - PUBLIC INVOLVEMENT IN THE DECISION-MAKING PROCESS

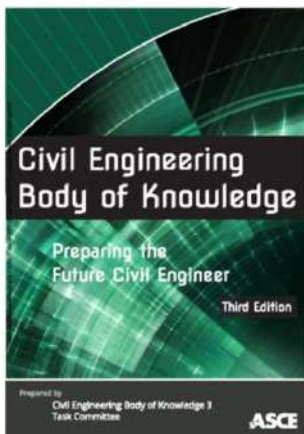
- Inform, educate, engage the public and public officials
- Be a trusted resource
- Aid in decision-making process

POLICY STATEMENT 437 - RISK MANAGEMENT

- Encourage and facilitate public participation
- Develop tools to effectively communicate risks to the public

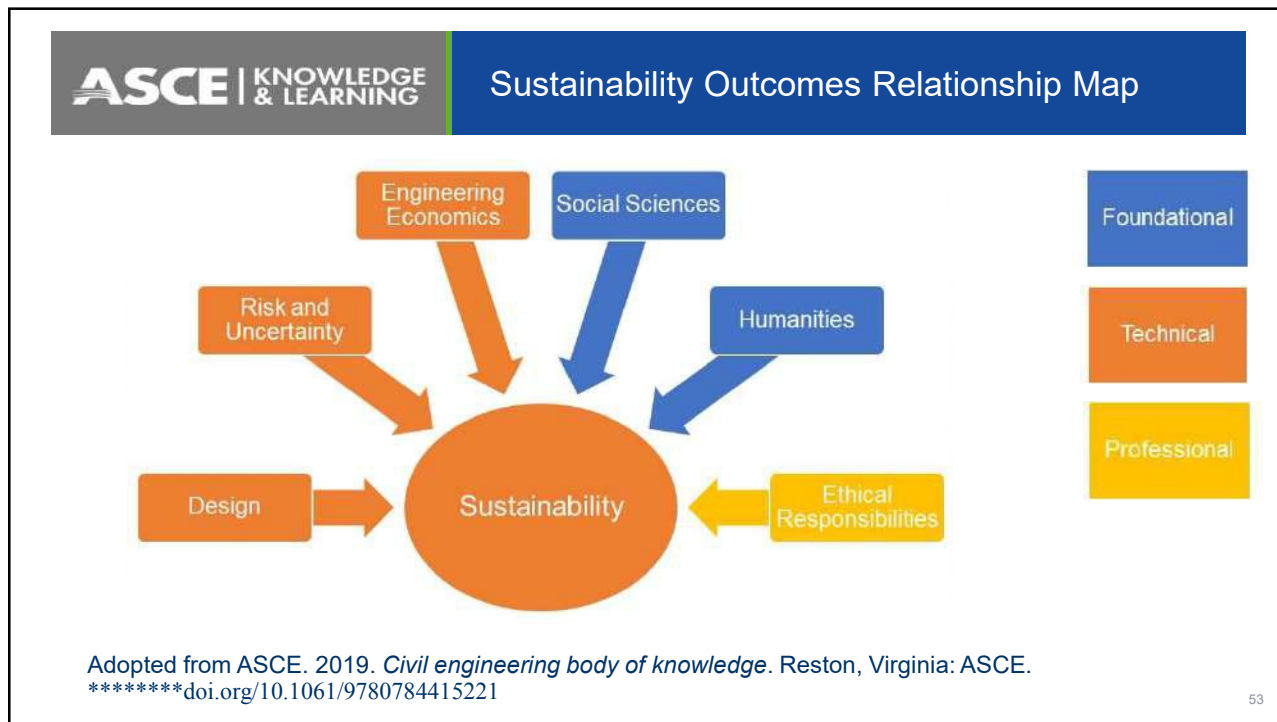
Mechanisms

- Public meetings
- Presentations
- Discussions
- Social media
- Advocacy



Civil Engineering Body of Knowledge

- Communication
 - Effective transfer resulting in understanding
 - Intentional persuasion resulting in change
- Humanities
- Teamwork and Leadership
- Professional Attitudes



ASCE | KNOWLEDGE & LEARNING Work in a Social Framework

Civil Engineering Body of Knowledge


- Make connections between technical and social sciences
 - Anthropology, geography
 - Economics
 - Law, political science
 - Sociology, psychology

ASCE’s Committee on Adaptation to a Changing Climate

Social Science, Policy, Economics, Education, and Decision-making Committee


ASCE | KNOWLEDGE & LEARNING


54




Basics of Stakeholder Engagement

- Starts early
- Continues across life cycle
- Encourages feedback
- Considers feedback in decision making
- Is honest and fair
- Is documented and disclosed



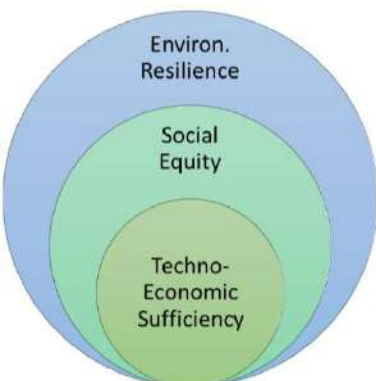

55




Promote Sustainable Thinking

Ask about

- Changes they've seen over time
- If the infrastructure is still serving its purpose
- If it can be replaced the same way or if they'd recommend a new approach
- If they want more value for their money



- Nelson & Tehrani. *APWA Reporter*, 85(8): 53-56, 2018
- Tehrani & Nelson. *Int. Conf. on Sustainable Infrastructure*, 2019


56

Choose universal messages

- Disgust for wasting resources
- Neutralizing a threat
- Maintaining our current system
- The opportunity to save money, create profits, and compete internationally
- Risks



- Nelson & Tehrani. *APWA Reporter*, 85(8): 53-56, 2018
- Tehrani & Nelson. *Int. Conf. on Sustainable Infrastructure*, 2019


- U.S. Climate Resilience Toolkit
- Climate Reality Project (Al Gore)
- Climate Outreach (UK)
- Center for Climate Change Communication (George Mason)
- Climate Change Communication (Yale)
- Environmental Resilience Institute (UVA)
- Outreach materials from
 - EPA
 - FEMA
 - FHWA
 - USACE
 - NOAA
- Other professional societies
 - APWA – public works
 - ACEC – engineering companies
 - ISI – sustainable infrastructure
 - ASCE Institutes (9)



Tailor Your Message


Stakeholder	Trusted Resource
Mayor	National League of Cities, US Conference of Mayors
County Administrator	National Association of Counties
Planning Director	American Planning Association
Public Utilities Director	American Water Works Association
Public Works Director	American Public Works Association
Parks and Recreation Director	National Recreation and Parks Association
Social Worker	American Public Health Association
Architect	American Institute of Architects
Citizens	Climate Change Communication (Yale)


59




ASCE Videos (YouTube)

- 3 Ways Sustainability Is Good For Business
- Engineers: Leaders in Sustainable Infrastructure Development
- Sustainability and Resilience in Our Engineered World
- Sustainable Infrastructure
- Creating Sustainable Communities - Part I
- Creating Sustainable Communities: The Role of the Civil Engineer - Part II
- Sustainability: A Profit Producer
- Driving Investment in Sustainable Infrastructure with Innovation
- Save the Rain Program: Creating Infrastructure for a Sustainable World


***.youtube.com/channel/UCriMdyJ4zLJflaNZSQKgABQ
60

ASCE | KNOWLEDGE & LEARNING
 ASCE Tools

- ASCE Collaborate
 - collaborate.asce.org
- ASCE Source
 - source.asce.org
- ASCE Advocacy
 - www.asce.org/advocacy
- ASCE Newsroom
 - www.asce.org/newsroom
- Official Statements
- Press Releases
- Multimedia Library
- Story Ideas
- Media Contact


61

ASCE | KNOWLEDGE & LEARNING
 Making the Case For Sustainable Infrastructure

- 6 week guided online course
 - New content released Mondays
 - 8 video lectures (10-20 minutes each)
 - 2 interactive activities
 - Journaling and discussion forum
 - 2 live webinars
 - 2 tests
- Launches May 2021
 - Members: \$645, Non-Members: \$795
 - Credits: CEU: 1, PDH: 10

Week 1: The State of the Industry

In this week, you will learn to define "sustainable infrastructure", list at least three drivers for adopting a sustainable approach, discuss internal and external efforts to promote sustainable infrastructure, summarize the integration into higher education degrees and curricula, and research and list additional sustainability resources from ASCE.

Introduction

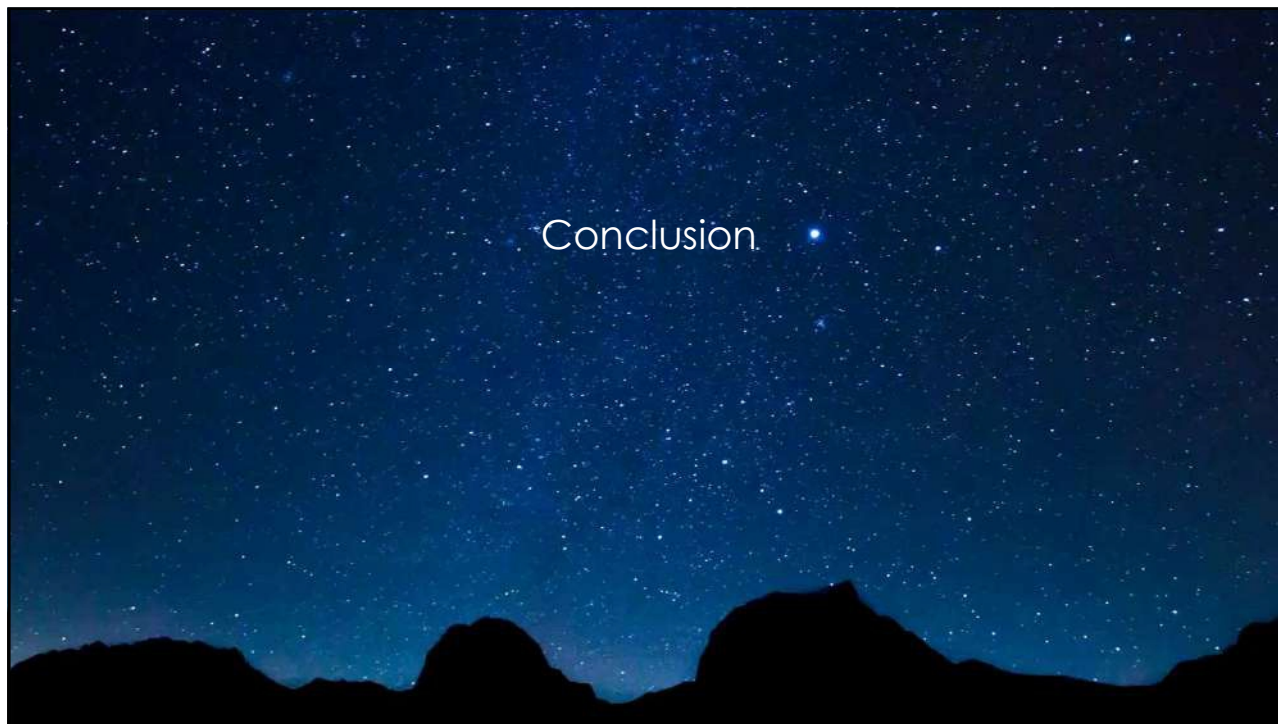


Explore ASCE's Policy Statements Next >

This week we discussed ASCE Policy Statement: #418 [The Role of Civil Engineers in Sustainable Development](#). Statement 418 states that civil engineers should be committed to the principles of sustainable development. All of ASCE's nearly 600 policy statements are regularly reviewed and updated to stay current on the issues and reflect changes in science and policies, including the paradigm shift in sustainable development. Several policy statements are directly relevant to sustainable infrastructure. Let's take some time to review a few.

CONTINUE > 1/13


*** [asce.org/making-the-case-for-sustainable-infrastructure/](https://www.asce.org/making-the-case-for-sustainable-infrastructure/)
62



ASCE | KNOWLEDGE & LEARNING ASCE Resources

- MEMBERSHIP**
 - Renew My Membership
 - Join ASCE
 - Manage My Membership
 - Section Member Drive
- CONTINUING EDUCATION**
 - Search Courses
 - Browse Guided Online Courses
 - Prepare for the PE Exam
 - Register for ASCE Week
- PUBLICATIONS**
 - Search ASCE Library
 - Shop Books and Standards
 - Discover ASCE 7
 - Find a Journal
- CONFERENCES & EVENTS**
 - View the Calendar
 - Submit a Paper or Session
 - Sponsor or Exhibit
 - View Free Virtual Events
- INITIATIVES**
 - View the Infrastructure Report Card
 - Future World Vision
 - Sustainability
 - Innovation Contest
- CAREERS**
 - Career Connections
 - Early Career Resources
 - Salary Survey
 - Ethics

ASCE | KNOWLEDGE & LEARNING 64



**ASCE's
Resources for
Sustainable and
Resilient
Infrastructure**

Denise Nelson
P.E. M.ASCE, CFM, ENV SP, LEED AP
denise@bgllc.net
[@DeniseNelsonPE](https://twitter.com/DeniseNelsonPE)

Fariborz M. Tehrani,
PhD, P.E., ENV SP, PMP, SAP, F.ASCE
ftehrani@csufresno.edu