# Ethics in Sustainable Development for Civil and Structural Engineers

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## Meet Your Instructor

- Education:
  - B.S. "Structural Engineering" from University of California, San Diego (1990)
- Experience:
  - 2012 - Present: Structural Principal Associate at BWE (San Diego, CA)
  - 1990 – 2012: Structural engineer at Lane Engineers, Inc. (Tulare, CA)
- Affiliations/Registrations:
  - California and Illinois licensed structural engineer
  - Subject matter expert (structural) for California Board of Registration for Professional Engineers, Land Surveyors and Geologists
  - Adjunct Professor, University of California, San Diego (UCSD)
  - NOT an attorney!

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## Webinar Learning Outcomes

- Understand the importance of sustainability in engineering designs
- Define some of society's expectations for engineers on sustainability
- Discover related issues in engineering ethics
- Describe responsible approaches to sustainability in engineering practice

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## What is Sustainable Development?

- Sustainable development is associated with the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development
  - *Code of Ethics*, National Society of Professional Engineers (NSPE)
- Sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their own needs
  - Social equity for all generations
  - Strong economic growth without exploitation of others
  - Does not endanger natural systems essential for life on Earth
  - "*Our Common Future*", United Nations World Commission on Environment and Development, 1987

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## Engineering Ethics and Sustainability

- Sustainable development cannot be properly advanced without a sober consideration of ethics
- What is "morality"?
  - A set of rules by which human beings live with one another
  - Commands that help us make decisions, independent of emotion or desire


- What is "ethics"?
  - Ethics defines a foundation upon which rules of morality are built, defined by general principles that help us evaluate moral rules
  - Ethics asks us whether or not to take into account the interests and desires of others when deciding what we should do ourselves

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## Engineering Ethics and Sustainability

- The framework of engineering ethics is defined primarily by engineering societies to enhance the image of engineers through recognized characteristics of behavior and professionalism

- Common elements:
  - Protect the health, safety, and welfare of the public
  - Be truthful and do not misrepresent self or others
  - Perform services only in your area of competence
  - Treat others with dignity, respect, and fairness
  - Avoid conflicts of interest

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## Engineering Ethics and Sustainability

- More specific principles:
  - "Engineering professionals should present and review theory, evidence, and interpretation honestly, accurately, objectively and without bias, while respecting reasoned alternative views." (*The Engineering Council and the Royal Academy of Engineering, United Kingdom*)
  - "If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate." (*National Society of Professional Engineers, United States*)
  - "In addition to maintaining their own competence, registrants have an obligation to strive to contribute to the advancement of the body of knowledge within which they practice, and to the profession in general … they are expected to participate in providing opportunities to further the professional development of their subordinates and colleagues." (*Engineers Canada, Canada*)

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## Engineering Ethics and Sustainability

- Angela R. Bielefeldt (University of Colorado, Boulder) describes two distinct perspectives for engineering ethical frameworks when it comes to responsibility for the environment and sustainability (https://www.intechopen.com/books/social-responsibility/professional-social-responsibility-in-engineering):
  - Anthropocentric perspective:
    - Preservation of the environment is ultimately self-preservation for human life
  - Biocentric perspective:
    - Preservation of the environment is part of human responsibility due to the intrinsic right to life of all organisms on the planet

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## Engineering Ethics and Sustainability

- Society requires that licensed professional engineers have SOME perspective on sustainability and physical issues related to the environment, biosystems, and species
  - Construction codes (legally enforceable as minimum standards) are slowly transitioning from "optional" to "mandated" sustainability requirements, depending on how jurisdictions adopt them
  - By granting a license to practice, society (through governing bodies) recognizes the special knowledge and skill of an engineer with relation to the development of new things

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## Engineering Ethics and Sustainability

- Development requires human intervention in natural systems that may have short- and long-term environmental effects
  - Agriculture
  - Diversion of water ways
  - Extraction of minerals
  - Emission of heat and noxious gasses into the environment
  - Commercial forestry
  - Genetic manipulation
- Both perspectives (self-preservation, right to life) are equally valid in identifying the importance of considering the impact of development on the environment
  - The "ethical engineer", therefore, will consider the impact of his/her work on the environment, which includes landscapes, seascapes, life, and atmosphere
    - There is legitimate leeway in the extent and execution of that consideration

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## Codes, Board Rules, Canons of Practice

- Construction codes are published to identify minimum standards and qualities required for protection of the public
  - "The purpose of this code is to establish minimum requirements to provide a reasonable level of safety, public health, and general welfare …" (2018 International Building Code, Section 101.3)
  - Model codes (written and published by private agencies) require adoption from state and/or local governments before they can take the effect of LAW
    - The U.S. Constitution delegates regulation of construction to the states, except for federally-owned properties

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## Codes, Board Rules, Canons of Practice

- The latest edition of the International Green Construction Code, or "IgCC" (International Code Council) may be the most direct legally-enforceable sustainability code
  - Remember – it must first be adopted by governing jurisdictions
  - It incorporates ANSI/ASHRAE 189.1-2017, "*Standard for the Design of High-Performance Green Buildings*"


- A "whole systems" approach to design
- Better indoor environments, lower impact on natural resources
- Mission objectives of the publishing agencies:
  - Provide for health, life and safety in construction
  - Increase economic and resource efficiency
  - Reduce effects of climate change through more resilient buildings, communities, and cities
  - Provide quality today without compromising the needs of future generations

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## Codes, Board Rules, Canons of Practice

- The International Green Construction Code introduces regulations that can be wholly or individually adopted, creating a hybrid of sorts that include mandatory and optional guidelines for high-performance designs
  - It is coordinated with documents produced by voluntary certification agencies, such as the U.S. Green Building Council
  - Many of the regulations may already be addressed by local ordinances, such as for floodplain management, but new information may precipitate revisions or additional requirements
    - Stuart Kaplow, environmental attorney in Baltimore: "*I believe that many, if not most, of the adoptions of the IgCC will be as a voluntary code with an alternate compliance path.*"
    - Kaplow: "It's difficult to justify cutting-edge science in a mandatory code."
  - Reference: Kilkelly, Michael. "*IgCC 2018: What Architects and Clients Need to Know*". Journal of the American Institute of Architects, December 2018.

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## Codes, Board Rules, Canons of Practice

- Common mandated environmental considerations for construction:
  - Clean Water Act regulates storm water runoff from a construction site
    - Applies when at least 1 acre of land is disturbed
    - Requires a "Notice of Intent" that certifies you will not harm federally-listed endangered species
    - Requires a Storm Water Pollution Prevention Plan (SWPPP)
  - Clean Water Act also regulates dredged and fill materials in waterways

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## Codes, Board Rules, Canons of Practice

- Common mandated environmental considerations for construction:
  - Resource Conservation and Recovery Act regulates the allowed concentrations of hazardous wastes for managing, treating, and disposing
  - Clean Air Act imposes restrictions on mobile and stationary sources that apply to construction activities
  - National Environmental Policy Act of 1969 may impose a need for an Environmental Assessment (EA) or an Environmental Impact Report (EIR)
  - Endangered Species Act requires that federally-listed species and habitat not be adversely affected

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## Codes, Board Rules, Canons of Practice

- Regulations issued by the Environmental Protection Agency are primarily focused on development activities of federally-regulated lands or systems
- However, individual states and localities typically adopt and enforce the same standards and impose the same (or additional) requirements on development within their boundaries
- For example, the *Climate Change and Coast Smart Construction Executive Order* in the State of Maryland (December 27, 2012) required State agencies to consider the risk of coastal flooding and sea level rise when they design capital projects (State projects)

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## Codes, Board Rules, Canons of Practice

- State boards that issue licenses to practice engineering oftentimes include *codes of conduct/ethics*, including both requirements and encouragements
- Pennsylvania Code of Ethics, Section III.2(4): "Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations."
- Texas Administrative Code, Title 22, Part 6, Rule 137.55(d): "Engineers should strive to adequately examine the environmental impact of their actions and projects, including the prudent use and conservation of resources and energy, in order to make informed recommendations and decisions."

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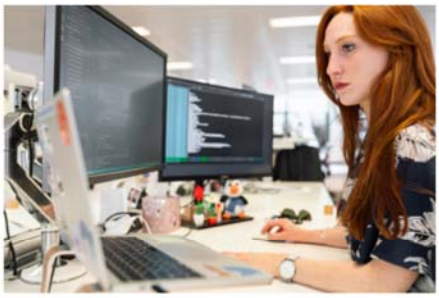
## Codes, Board Rules, Canons of Practice

- Canons of expected behavior are published by a number of agencies, which are not typically enforceable, but are instrumental in describing how licensed engineers uphold the integrity of the profession
- State licensing boards can adopt these canons and enforce them accordingly



- World Federation of Engineering Organizations: In the course of engineering practice, professional engineers will …
  - Create and implement engineering solutions for a sustainable future
  - Be mindful of the economic, societal, and environmental consequences of actions or projects
  - Promote and protect the … well-being of the environment

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## Codes, Board Rules, Canons of Practice

- American Society of Civil Engineers: Engineers govern their professional career on the following fundamental principles:
  - Create safe, resilient, and sustainable infrastructure
  - Consider the current and anticipated needs of society
  - Utilize their knowledge and skills to enhance the quality of life for humanity

- Japan Society of Civil Engineers:
  - Respect nature indispensable to the survival and development of humanity while holding in esteem diverse civilizations and cultures
  - Contribute by means of their wisdom, skills, and virtues to both the peace and prosperity of the people and the nation and to the welfare and sustainable development of humanity

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## The Responsible Engineer

- Principles of sustainability are essential to engineering, but how those principles are acted upon can be different (and acceptable)
- The ethical engineer will consider the impact …
- The Passive Approach
  - Be aware of current events and trends in sustainable development
    - *Civil Engineering*, ASCE
    - *Environmental Science & Engineering* (Ontario, Canada)
  - Be aware of general ways sustainability can be implemented in your field
  - Be aware of mandates (legal requirements)
  - Be able to evaluate optional sustainability measures when recommended or requested

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## The Responsible Engineer

- The Passive-Aggressive Approach
  - Be aware of current events and trends in sustainable development
    - Take note of how these events or trends could be incorporated into your own projects
      - It becomes more personal and effective
- Be aware of more specific ways you can incorporate design elements that trend towards a region's sustainability goals (not just your individual project)
  - Know how to specify products and the benefits/limitations of their use
  - Recognize the benefit to your own projects and open a discussion
- Be able to evaluate and promote the use of alternative designs that will better meet sustainability goals, though they might not be the least expensive

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## The Responsible Engineer

- The Aggressive Approach
  - Find ways to implement relevant events and trends in sustainable development into your own projects and procedures

- Actively promote sustainable solutions to your clients that are specific to the project, even if they are not requested
- Consider "optional" sustainability measures to be mandatory
- Participate in the development or promotion of sustainability goals for your region
- Develop your ability to promote and defend sustainable choices in design
- Obtain certification as a recognized sustainability design professional, such as through the U.S. Green Building Council (LEED AP)
- Train others to do the same

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## The Responsible Engineer

- Practical recommendations for promoting sustainability in design by the World Federation of Engineering Organizations, *Code of Ethics*
- An overall approach to engineering solutions:
  1. Be aware that the principles of (1) eco-systemic interdependence, (2) diversity maintenance, (3) resource recovery, and (4) inter-relational harmony form the basis of humankind's continued existence
  2. Discuss consequences of proposals and actions (direct or indirect, immediate or long-term) upon the health of people, social equity and the local system of values
  3. Promote a clear understanding of the actions required to restore and, if possible, to improve the environment that may be disturbed, and include them in your proposals

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## The Responsible Engineer

- Practical recommendations for promoting sustainability in design by the World Federation of Engineering Organizations, *Code of Ethics*
- Proactive approaches to recognize and promote sustainability:
  1. Make sure your own perception of environmental issues is as accurate as possible
  2. Strive to complete designs having the lowest possible consumption of raw materials and energy, and the lowest possible production of waste/pollution
  3. Study the environment and ecosystems affected by your project (urbanized and natural) -- as well as pertinent socioeconomic systems -- and select the best alternative
  4. Reject any kind of commitment that involves unfair damages to human surroundings and aim for the best possible technical, social, and/or political solution
  5. Be aware of employer and client awareness of societal and environmental consequences, and interpret issues in an objective and truthful manner

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## The Responsible Engineer

- Encouraging industries to act for the common good is a challenge
  - Education
  - Institutional development (technological advances)
  - Economic incentive
  - Law enforcement
- Engineers can play an active role in each of these areas to promote sustainability
  - Education – know the facts and teach the truth
  - Technology – know what's available and develop what you need
  - Economics – specify alternatives and include efficiency
  - Law Enforcement – whistleblowing when appropriate or crucial

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## The Responsible Engineer

- Elements of sustainability in civil engineering:
  - Alternative products
    - Manufactured sand instead of river or mined rock and gravel
    - Recycled materials
    - Local materials (reduce transportation distance)
  - Alternative systems
    - Pervious concrete pavements
    - Usage of greywater

- It isn't just a matter of adding "green" features to a project – it is a holistic approach that involves an overall assessment and strategy
  - See ASCE Policy Statement 418 – "*The Role of the Civil Engineer in Sustainable Development*"

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## The Responsible Engineer

- Elements of sustainability in structural engineering:
  - Specify more offsite constructible elements and systems
    - Controlled environment
    - Reduces $CO_2$, noise, and dust at the construction site
    - More repeatability saves time and expenditure of energy
  - Maximize the use of available materials
    - Specify recycled content where possible
      - Fly ash (concrete), wood (laminated beams, sheathing), steel
    - Understand toxic material effects
  - Enhance the durability of primary structural systems
    - Additives, special coating or covering
    - Robust connections


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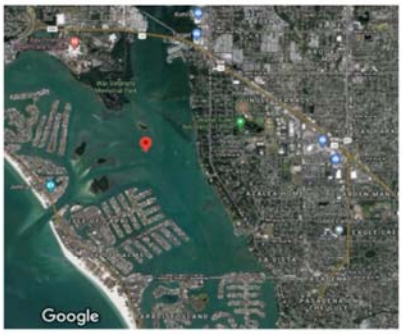
## Example: Engineer's Discretion

- Owners of land on the banks and adjacent underlying land of Boca Ciega Bay near St. Petersburg, Florida petitioned local authorities to dredge and fill in order to create a mobile home park
- Landowners then applied to the Army Corps of Engineers for a federal permit to dredge and fill in navigable waters




- On December 30, 1966, the District Engineer recommended to his superiors that the application be denied.
  - He found that the proposed work would have no adverse affect on navigation
  - However, he recommended denial due to strong public opposition, the opposition of the U.S. Fish & Wildlife Service and the Florida Conservation Board

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## Example: Engineer's Discretion

- The application was denied, and the landowners filed a suit claiming that the Corp of Engineers could only deny the application on grounds related to navigation, flood control, or the production of power in accordance with the Rivers and Harbors Act
  - On February 17, 1969, the District Court agreed and ordered the permit be issued. The United States and other defendants appealed the decision.

- On July 16, 1970, the U.S. Court of Appeals reversed the District Court's ruling and upheld the denial of the application
- The ruling took account of undisputed findings and affirmed that the Corp of Engineers have the right to base their decision on relevant circumstances outside the Rivers and Harbors Act

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## Example: Engineer's Discretion

- Additional background and conclusions:
  - Local and state authorities were compelled by the District Court's ruling to allow the project to proceed
    - Pinellas County Water & Navigation Control Authority, Trustees of the Internal Improvement Fund of the State of Florida, Central and South Florida Flood Control District, Board of Pilot Commissioners for the Port of St. Petersburg
  - The landowners agreed that there was some impact on fish and wildlife, and they had some design changes made to reduce the damage
    - The U.S. Fish and Wildlife Service still opposed the project
  - The U.S. Court of Appeals decided that system ecology does have an effect on interstate commerce
    - The purpose of the Fish and Wildlife Act of 1958 extends to commerce and may be used for assessing projects in navigable waters
    - Other relevant statutes: The Fish and Wildlife Coordination Act (1934), The National Environmental Policy Act (1969)

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## Example: Engineer's Discretion

- "*When the House Report and the National Environmental Policy Act of 1969 are considered together with the Fish and Wildlife Coordination Act and its interpretations, there is no doubt that the Secretary (of the Army Corps of Engineers) can refuse on conservation grounds to grant a permit under the Rivers and Harbors Act.*"
- *Zabel v. Tabb*, 430 F.2d 199 – Court of Appeals, 5th Circuit (1970)

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## Closing Comments


- Ethics and moral rules are intended to help us make decisions that maximize the "good" and minimize the "bad"
- Codes of ethics published by engineering societies define the "good" and "bad" that we should pay attention to
- Sustainability can be elusive and emotionally-charged
  - Engineering societies universally declare sustainability to be "good"
  - We should at least be aware of findings, conclusions, goals, and developments
    - A "standard of care" in engineering knowledge and practice must include some attention to sustainability, whether passive or aggressive (or somewhere in-between)

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## Additional References

- Independent Group of Scientists appointed by the Secretary-General. *Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development*. United Nations, New York: 2019
- Kestner, Dirk M. et al. (editors). "*Sustainability Guidelines for the Structural Engineer*". American Society of Civil Engineers, Reston, VA: 2010
- Kriebel, David et al. The Precautionary Principle in Environmental Science. *Environmental Health Perspectives*, Vol. 109, No. 9: September 2001

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## Additional References

- Larson, Eric et al. *Net-Zero America: Potential Pathways, Infrastructure, and Impacts (Interim Report)*. Princeton University, New Jersey: 2020.
- https://sustainablecitycode.org
- Mission: "To help all local governments build more resilient, environmentally conscious, economically secure, and socially equitable communities."
- A model "code" that provides concrete ways for communities to amend development codes and adapt to changes as they occur


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