ADVANCING THE DESIGN AND QUALITY OF STRUCTURES

Role Of The Technical Institute

10–28–10

THE TECHNICAL INSTITUTE

The Technical Institute

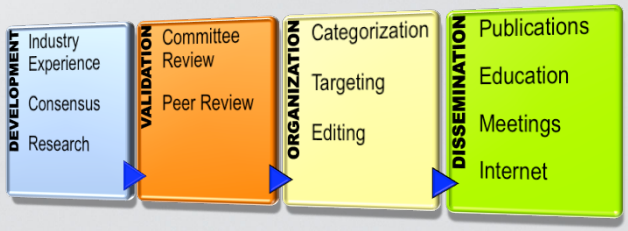
- **Purpose**
  - –Develop & Advance Technology
  - –Set Technical & Professional Standards
  - –Provide Information Exchange Forum
  - –Maintain Industry "Body of Knowledge"
  - –Promote Industry Growth

The Technical Institute

- **Structure**
  - –Legally Chartered
  - –Clearly Stated Purpose
  - –Rational Membership Requirements
  - –Established Governance
  - –Perpetual Commitment

The Technical Institute

- **Knowledge Model**



The Technical Institute

- **Stature**
  - –Industry Standing
  - –Clearly Stated Purpose
  - –Established Governance
  - –Broad Professional Involvement
  - –Perpetual Commitment

The Technical Institute

- **Quality System**
  - –Accreditation
  - –Personnel Certification Program
  - –Fabrication Process Quality Standards
  - –Independent Audits
  - –Feedback and Recourse Process

The Technical Institute

- **Institute-Based Certification**
  - –AISC, PCI Collaboration
  - –Identified 12 Key Attributes

TECHNOLOGY DEVELOPMENT

Technology Development

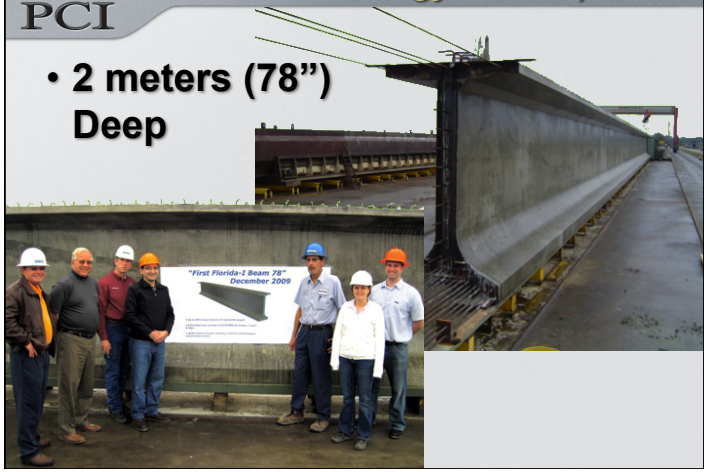
- **Transportation Sector**
  - Need to minimize closure of roads and bridges
  - Precast concrete bridge systems can include piers, girders, deck, railings
  - Total bridge can be built during one weekend

Technology Development

- **High-Performance Concrete I-Beam vs. High-Strength Steel**
  - Same span
  - Same spacing
  - Same depth
  - Lower cost

Technology Development

- **2 meters (78”) Deep**



Technology Development

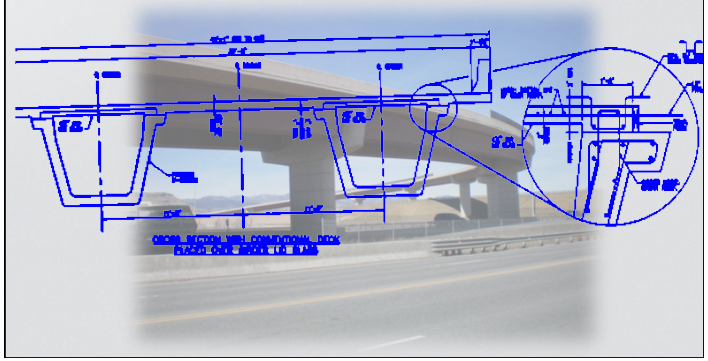
- Precast Concrete Pier Segments

Technology Development

- Precast Concrete Pier Segments

Technology Development

- Precast Concrete Spliced U-Beam



Technology Development

- Precast Concrete Spliced U-Beam

Technology Development

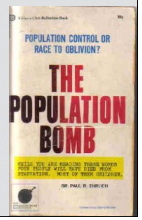
- Precast Concrete Curved Box Beam

SUSTAINABILITY

Sustainability: A Brief History

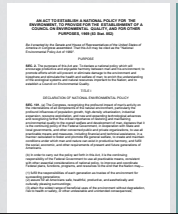
- 1798 Thomas Malthus writes "An Essay on the Principle of Population"
- 1962 Rachel Carson writes "Silent Spring"
- 1966 US Congress passes Endangered Species Act
- 1967 Environmental Defense Fund established
- 1968 Apollo 8 sends back Earthrise photos from space
- Paul R. Ehrlich writes "The Population Bomb"

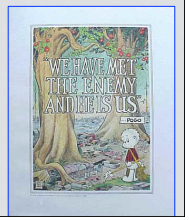




Sustainability: A Brief History

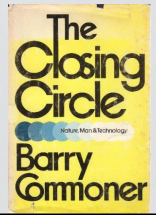
- 1969 Greenpeace founded to protest whale hunting
- US Congress passes National Environmental Policy Act (NEPA)
- US Advanced Research Projects Agency launches ARPANET
- 1970 US Environmental Protection Agency (EPA) established
- First Earth Day (April 22)

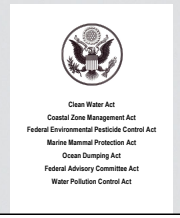


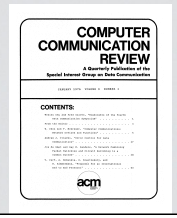



Sustainability: A Brief History

- 1971 Barry Commoner writes "The Closing Circle"
- 1972 James Lovelock introduces "Gaia Hypothesis"
- US enacts 7 major environmental laws
- 1973 US enacts Endangered Species Act, Safe Drinking Water Act
- "Internetwork protocol" (basis of Internet) invented

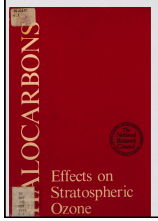


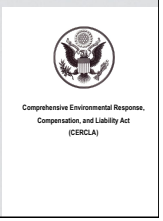




Sustainability: A Brief History

- 1976 National Academy of Sciences reports to ozone layer damage
- US enacts 2 major resource conservation laws
- 1977 Love Canal, New York, identified as chemical waste site
- 1980 US Congress enacts "Superfund" law



Sustainability: A Brief History

- 1983 UN forms World Commission on Environment and Development (WCED)
- 1987 WCED issues "Our Common Future"
  - Concept of Sustainable Development
- 1989 Internet expands globally among universities and research labs
- 1991 Beginning of rapid growth of Internet use by public

Sustainability: A Brief History

- **June 1992: First "Earth Summit" in Rio de Janeiro**
  - Five major environmental agreements signed
  - "Rio Declaration" on Environment and Development
    - Set forth 27 principles of Sustainable Development
  - UN Framework Convention on Climate Change (FCCC)
    - Addressed greenhouse gases
    - Did not set specific limits or targets
    - Provided basis for subsequent "protocols"
    - Took effect in 1994

Sustainability: A Brief History

- **July 1997: Second "Earth Summit" in Kyoto**
  - Kyoto Protocol signed
    - Main update to FCCC
    - Agreement to reduce overall greenhouse gas emissions by 5.2% relative to 1990 baseline
    - Took effect in 2005

Sustainability: What It Is

"Humanity has the ability to make development sustainable:

To ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."

— Report of the 1987 World Commission on Environment and Development: "Our Common Future"

Sustainability: What It Is

Scope of Value

Sustainability: What It Is

- **Economic**
  - Follow best practices
  - Strive for continuous improvement
  - Offer equal opportunity
  - Preserve investment diversity
  - Practice good management of financial capital

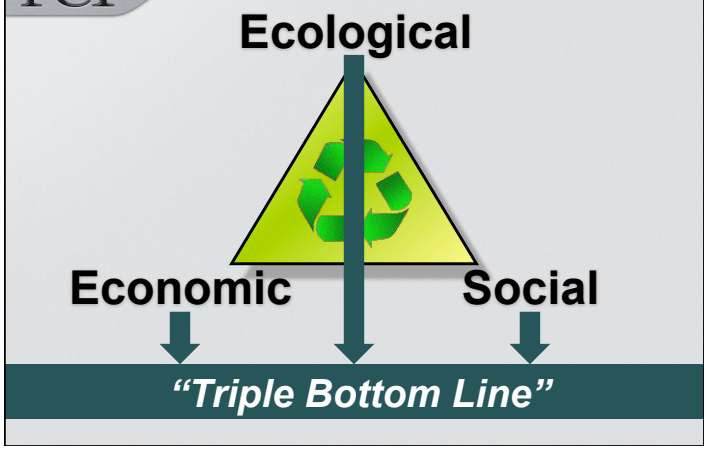
Sustainability: What It Is

- **Ecological**
  - –Value, appreciate, and restore nature
  - –Preserve natural diversity
  - –Practice good stewardship of natural capital

Sustainability: What It Is

- **Social**
  - –Ensure inter-generational equity
  - –Offer equal opportunity
  - –Preserve social diversity
  - –Practice good governance of human capital

Sustainability: What It Is



Sustainability: A Brief History

- **Conceptual**
  - –Recognize the global dimension
  - –Integrate ecological, social, and economic goals
  - –Consider risk, uncertainty, and irreversibility

SUSTAINABLE DESIGN

Sustainable Design

"It should be the highest ambition of every American to extend his views beyond himself, and to bear in mind that his conduct will not only affect himself, his country, and his immediate posterity; but that its influence may be co-extensive with the world, and stamp political happiness or misery on ages yet unborn."

— *George Washington, letter to the Pennsylvania Legislature, September 5, 1789*

Sustainable Design

- **Worldwide:**
  - –People use 20% more resources than can be regenerated
  - –Building construction and operation uses 40% of all raw materials (3 billion tons annually)

Sustainable Design

- **In US:**
  - –More resources consumed, per capita, than any other nation
  - –Buildings consume:
    - 65% of electricity
    - 36% of primary energy
    - 12% of potable water
  - –Buildings produce 30% of greenhouse gas emissions

Sustainable Design

- **Adjusting the Design Process:**
  - Expanded "Perspective Range"
  - Interdisciplinary Collaboration
  - Integrated Design
  - Coordinated Construction
  - Monitoring & Validation

Sustainable Design

SUSTAINABLE STRUCTURES

Sustainable Structures

- **Resource Consumption**
  - Raw Materials
  - Fuels (energy)
- **Environmental Impact**
  - Chemical
  - Thermal
  - Carbon Cycle

Sustainable Structures

- **Construction**
  - 10% of Lifetime Energy Consumption
  - One-time resource consumption
  - Both can be partly reinvested

Sustainable Structures

- **Operation**
  - **90%** of building's energy consumption
  - **Continuing** resource consumption
  - Both can be partly replenished

Sustainable Structures

- **Regeneration**
  - Invested energy can be reclaimed
  - Invested resources can be recycled
  - **Not** part of today's typical analysis

SUSTAINABLE STRUCTURES: Construction

Construction

- **Raw Materials**
  - Wood: Forests
  - Steel: Iron ore
  - Concrete: Limestone, aggregates

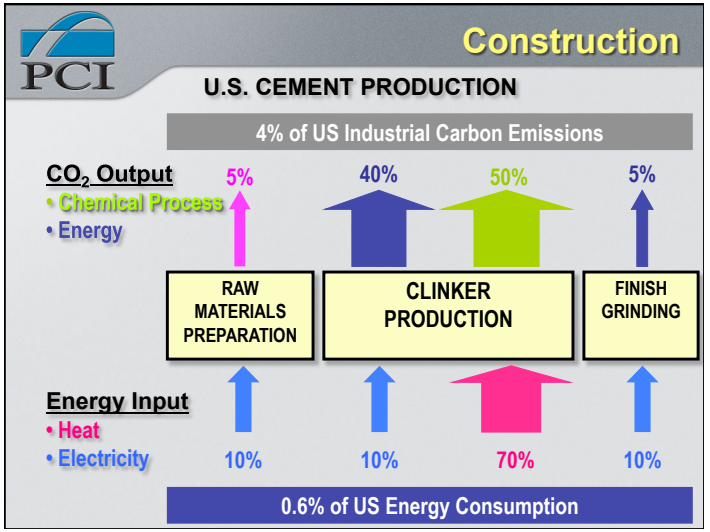
Construction

- **Energy**
  - Wood: Harvesting, milling
  - Steel: Ore grinding, furnace heat
  - Concrete: Mining, prep, kiln heat, grinding

Construction

- **Environmental Impact**
  - Wood: Deforestation (if not managed)
  - Steel: Toxins, particulates, slag, CO_2
  - Concrete: Toxins, particulates, CO_2

Construction



Construction

- **Precast Manufacturing Process**
  - Recycle Materials
    - Water: 45% of all surplus material in production is wastewater
    - Also aggregate, steel, plastic, scrap, trash
  - Reduce energy consumption
    - Lighting, curing, transportation

SUSTAINABLE STRUCTURES: Operation

Operation

PRECAST CONCRETE BUILDING SYSTEMS

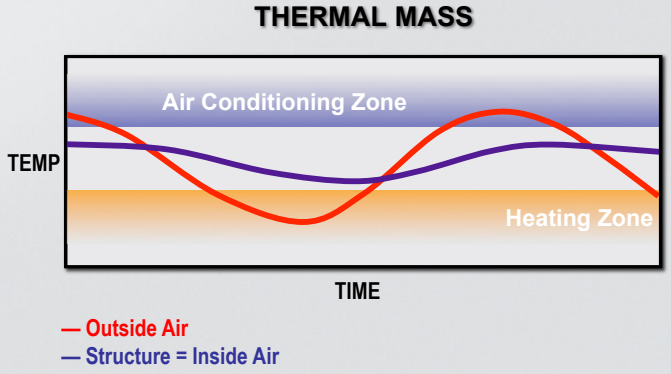
- **Energy Conservation**
  - Insulation: R-Values 20-25
  - Air Infiltration: Among the Lowest
- **Energy Optimization**
  - Thermal Mass

Operation

AIR INFILTRATION
(cfm/ft² @ 0.3 in. H_2O)

1.0 in. (25 mm) expanded polystyrene	1.0
Uncoated concrete block	0.4
0.47 in. (12 mm) fiberboard sheathing	0.3
Uncoated brick wall	0.3
Breather type building membranes (avg)	0.0050

Operation



SUSTAINABLE BUILDING SYSTEMS: Regeneration

Regeneration

- **Durability**
  - Minimize additional resource consumption
  - Minimize waste generation
  - Minimize economic cost
  - Enables Regeneration

BEYOND SUSTAINABILITY

Beyond Sustainability

- **Sustainability is *minimum for survival*, not a sufficient goal**
- **Advocates prosperity, health, abundance, fun**
- **Being "Less Bad" is not the same as being**

Cradle to Cradle: Remaking the Way We Make Things
by William McDonough & Michael Braungart

Beyond Sustainability

- **Beyond *Sustainable*, structures can be *Protective* and *Beautiful***

Beyond Sustainability: Protective

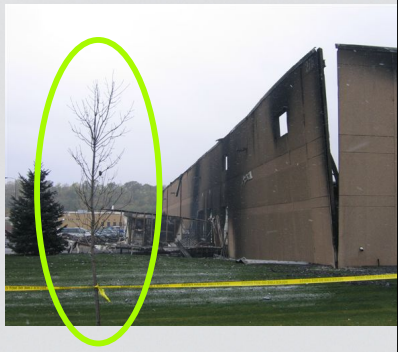
- **Protective Against:**
  - Hurricanes, Tornadoes
  - Floods, Excessive Humidity
  - Earthquakes
  - Solar Damage
  - Noise
  - Chemicals, Radiation

Beyond Sustainability: Protective

- **1967: Deadly tornadoes hit Northern Illinois**
- **57 killed; 484 homes destroyed**
- **Two precast structures (grocery store, high school) in direct path of twin tornadoes**
- **Structural Damage:**
  - Grocery Store: <$200
  - High School: flange of one double-tee; blown out concrete diaphragm end closures

Beyond Sustainability: Protective

- October 2006: Explosion destroyed a chemical plant near Minneapolis, MN
- Structure utilized precast wall panels, metal roof



Beyond Sustainability: Beautiful

- **Beautiful due to:**
  - Design flexibility
  - Broad range of colors and finishes
  - Maintains appearance with age

Beyond Sustainability: Beautiful

Bookends Project / Greenville, SC

- One building designed to look like four
- Fits into downtown area

Beyond Sustainability: Beautiful

Bookends Project / Greenville, SC

- Mixed use residential / retail
- All precast constructi on
- Cast-in electrical

Beyond Sustainability: Beautiful

Bookends Project / Greenville, SC

- Various architectural finishes:
  - Brick
  - Simulated natural stone

Beyond Sustainability: Beautiful

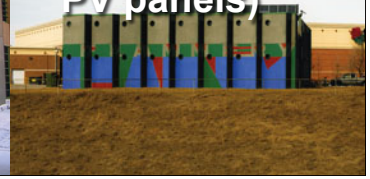
Flannery Construction / St. Paul, MN

- Flannery wanted to make a statement with its headquarters building

Beyond Sustainability: Beautiful

Flannery Construction

- Every employee has outside view
- Uses solar energy (rooftop PV panels)



QUESTIONS?