



## Importance of Certification to Sustainable Development

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09-01-11





- The Technical Institute
- Sustainability
- Sustainable Design
- Quality Process
- PCI Sustainable Plant Program
- Summary



# THE TECHNICAL INSTITUTE

# PCI

#### **The Technical Institute**

- Purpose
  - -General:
    - Improve and advance society
  - Improve and advance industry served —PCI:

Improve the Built Environment with Precast Concrete Structures

# PCI

#### **The Technical Institute**

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

### Functions

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



- -Recognized Inside Industry as Principal Knowledge Authority
- Recognized Outside Industry as
   Primary Industry Representative
- -Preferred Association for Industry Professionals



Knowledge Process



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

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

#### AISC/PCI White Paper on Ouality Systems in the Construction Industry

Chicago, IL 60601 www.ajac.com

PC

Precast/Prestressed Concrete Institute 209 W. Jackson Bl-d., Suite 500 Chicago, IL 60606 www.pci.org

Introduction
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or protection and economic reasons, mere is only one execution institute. When one industry overlaps with or its subset of, another, the technical institutes involved typically have well-stabilished collaborative relationships with one another to effectively combine their bodies of knowledge. Technical institutes are not developed overnight, establishing experises, standard-setting authority, and a reputation for reliability takes time, often decades.

#### Certification Programs

rertification Programs Because their properties may be difficult to verify at the onstruction site, prefabricated engineered components must be samufactured to meet contract requirements and to ensure quality nd reliability. Direct independent observation and assessment of a and reliability. Direct independent observation and assessment of a fubricator's qualify management systems surveits and moneya, and provides assessments that a particular product has met a initiation level of a scepture level star start and the start of the start of technical institute to provide assumes that a fabricator has the pressented, organization, experience, providers, knowledge, equipment, capability, and commitment to produce quality work. In evolve 1 successfoldy and reliably perform this inspirate function, a certification regord and along it is must be prof of a comprehencing quality using neglitic to the engineering addressed. The essential functional elements of chensive quality system are listed in the attached discussion

AISC/PCI White Paper | Page 1 of 3

#### **STEEL ON THE RISE**

#### ARE ALL CERTIFICATION PROGRAMS CREATED EQUAL? Close examination shows certain certification programs stand apart from the rest

A) Alton 746, PE
Construction
Construction read national industry certification programs for personnel, production nd quality control related to fabricated structural bridge components.

merican Institute of Steel Construction (AISC), the non-In 1976, the American Institute or Steel Construction (AEC), the web for profit occhnical institute established in 1921 to serve the U.S. structura also idealign community and construction industry started its certification program to establish an industry standard that would enable fabrication regram to existelina an instanty standard finat world enable habitators to demonstress en kinely inse a quarky system in states. Chail, ABC is the largest nucleonally necessitated quarky certification regram for the steel hearty and has over 305 ABC certification (statest and over 1,000 orgams oratic parts worldwick). In recent years, several new certification programs have surfaced, barrings to only and mithwelp low and store in plotted or ABCS contrillat

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principal body of knowledge, As a national Governance and consensus. A comprehensive cartification pro les the exchange of knowledge across the gram must apply its body of knowledge in a fair and balanced manne that reflects the true consensus of the construction industry. ASC has defined a government of technical methods and provide controlling the teacher of the technical methods and quality technical.

> ever a final "product" that acids value and helps fabricators improv e product of the AISC certification program is an audited and certific volidate key elements of knowledge, particularly new a chrical methods and quality standards, prior to applica stitutes provide consensus-based program developm

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#### INSTITUTE CERTIFICATION sur

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## SUSTAINABILITY



Diatr. General



UNITED NATIONS

#### General Assembly

#### "Humanity has the ability to make development <u>sustainable</u>:

#### To ensure that it meets the needs the needs the station of a special commission that should make without compromising the allowed the establishment of a special commission that should make generations to meet

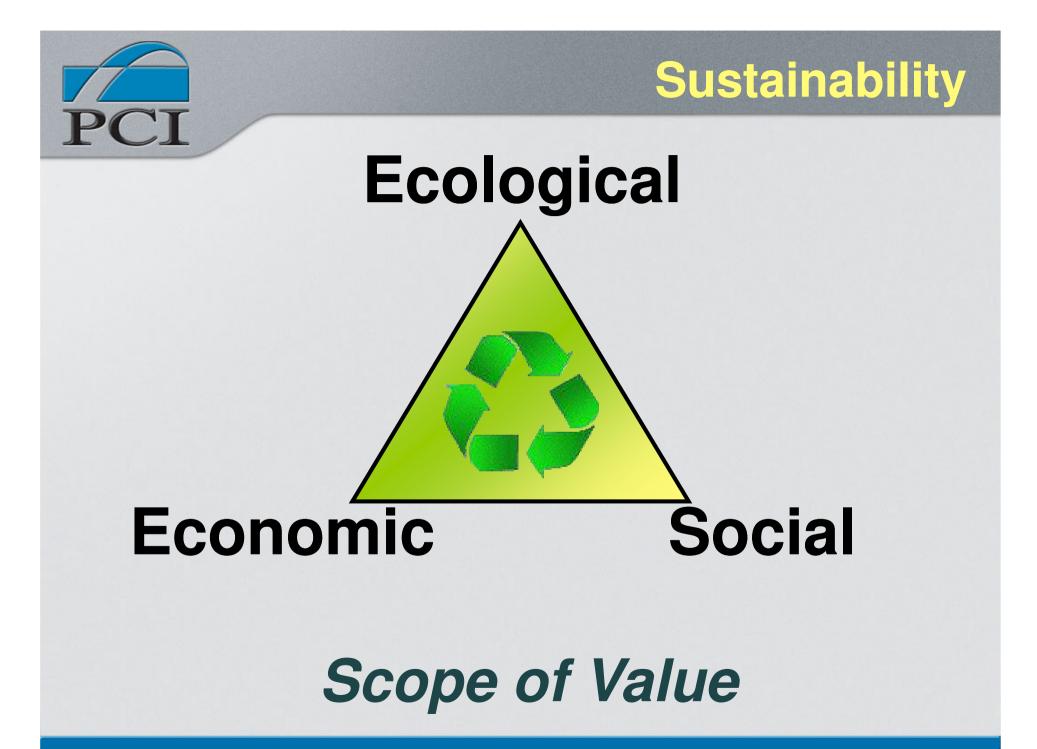
Durview of the United Nations Environment Programme, the report of the special commission should in the first instance be considered by the Governing Council of the Programme, for transmission to the Assembly together with its comments, and for use as basic material in the preparation, for adoption by the Assembly, of the Environmental Perspective to the Year 2000 and Beyond.

- Report of the 1987 World Contraction and Development: "Our Contraction and Second Contraction and the Contraction of the Morld Contraction of the Morld Contraction annexed to the decision for th

3. The report of the World Commission on Environment and Development, entitled "Out Common Future", is heleby transmitted to the General Assembly. Decision 14/14 of the Governing Council, the proposed draft resolution and the comments of the Governing Council on the report of the Commission can be found in the report of the Governing Council on the work of its fourteenth session, 1/2

A/42/150.

87-18467 Z999h (E)



### • Economic

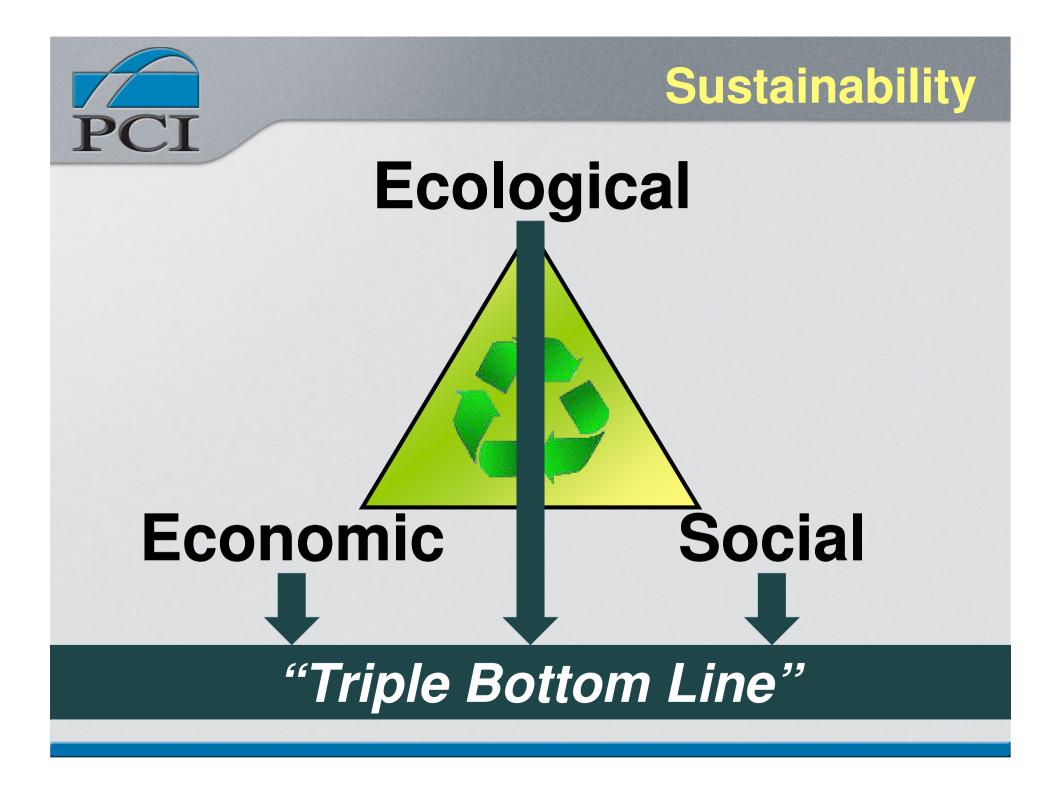
- -Follow best practices
- -Strive for continuous improvement
- -Offer equal opportunity
- -Preserve investment diversity
- Practice good management of financial capital

### Ecological

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

### Social

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



- Conceptual
  - Recognize expanded "Perspective Range" of time and space within which solution applies
  - -Consider ecological, social, and economic dimensions
  - -Consider risk, uncertainty, and irreversibility









# 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 coextensive with the world, and stamp political happiness or misery on ages yet unborn."

PCI



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



-People use 20% more resources than can be regenerated

 <u>Buildings</u> (construction +operation) use 40% of all raw materials (3 billion tons annually)



- In US:
  - -Most resources consumed per capita
  - -Buildings account for:
    - 65% of all electricity
    - 36% of all primary energy
    - 12% of all potable water
    - 30% of all greenhouse gas emissions



- Resource Consumption
  - -Raw Materials
  - -Energy
- Environmental Impact
  - -Chemical
  - -Biological
  - -Thermal
  - -Carbon cycle



- -One-time materials consumption
- -For Buildings, 10% of lifetime energy consumption
- Both can be partly reinvested through recycling



- Operation
  - -Continuing materials consumption
  - -For Buildings, 90% of lifetime energy consumption
  - -Difficult to replenish

### Recycling

- -Can the design re-use invested materials and resources?
- –Can the design reclaim invested energy?
- -Not part of today's typical analysis



- Regeneration
  - -Can the structure be <u>designed</u> to be repurposed?
  - -Can components be <u>designed</u> to be reused?
  - -Not part of today's typical analysis



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



- Specific Impacts: Energy
  - -Wood: Planting, harvesting, milling
  - -Steel: Ore grinding, furnace heat
  - -Concrete: Mining, grading & preparation, clinker production, grinding



- –Wood: Deforestation (if not managed), preservation, CO<sub>2</sub>
- -Steel: Toxins, particulates, slag, CO2
- -Concrete: Toxins, particulates, CO<sub>2</sub>



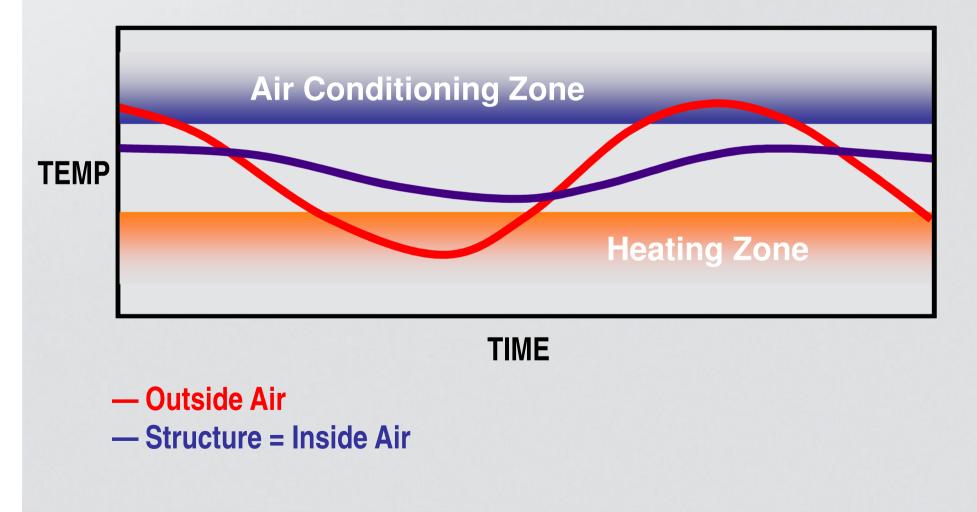
- Sustainable Concrete
  - -Abundant local materials
  - -Flexibility, adaptability
  - -Fire and natural-disaster resistance
  - -Thermal performance
  - -Durability



- Sustainable Concrete
  - -Low air infiltration
  - -Indoor environmental quality
  - -Minimum urban heat-island effect
  - -Noise resistance
  - -Bio-resistance



#### THERMAL MASS







- Sustainable Precast
  - -Enhanced thermal performance
    - Integrated insulation: R-Values 20-25
  - -Energy optimization
    - Thermal mass effectiveness
    - Lowest air infiltration



- Sustainable Precast
  - -Minimal site disruption
  - -Can be recycled at element level



AIR INFILTRATION (cfm/ft<sup>2</sup> @ 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)	0.005
Closed cell foam insulation	0.0002
6 mil (0.15 mm) polyethylene	0.0000
Precast concrete sandwich wall panel	0.0000



- US Concrete Industry
  - -Concrete Joint Sustainability Initiative
  - -MIT Concrete Sustainability Hub
    - <u>http://web.mit.edu/cshub</u>







- -fib Sustainability Initiative
  - 1988: Commission 3 (Safety and Performance Concepts) established
  - Sustainability proactively considered by all Commissions, in guidance documents
  - Collaboration sought with other organizations



- Precast Industry
  - -PCI Sustainability Council
    - Sustainable Plant Program Committee
    - Life Cycle Assessment Committee
    - Green Codes Committee
    - Information & Education Committee
    - Work with all PCI groups
    - Drive innovation within Industry

- Evolving the Design Process
  - -Classical "Divide, Solve, Re-integrate" methodology not adequate
    - Analogy: Masonry building
    - Need overarching organizational system: true Integrated Design





- –Implementing true Integrated Design requires:
  - Unprecedented interdisciplinary collaboration
  - Coordinated construction
  - Monitoring and validation
  - Advanced tools (e.g. BIM)





# Beyond Sustainable, structures can also be <u>Protective</u> and <u>Beautiful</u>



## **Beyond Sustainability: Protective**

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



#### **Beyond Sustainability: Beautiful**

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



# QUALITY PROCESS



- Complete Quality Process:
  - -Quality Assurance Program
  - -Quality Control Activities
  - -Certification Program

- Quality Assurance Program
   Preparation Guidelines
  - -Integrated, ongoing system<sup>for a</sup>
  - -Includes people, programs, knowledge Guality System MANUAL
  - Includes inspections, tests
     documentation, assessment
  - -Provides high probability that intended design requirements are met

# Quality Control

PCI

- -Operational activities to verify quality requirements
- -Testing, inspection documentation
- -Part of QA Program



# Certification

PCI

- -Ensures QA Program components are present and functioning properly
- Provides highest probability of a successful project
- -Vital component of QA, but is not QA in itself





- PCI Certification Programs
  - -Personnel Certification
  - -Plant Certification
  - -Erector Certification



- -QC personnel training since 1974
- -3 distinct certification levels (I, II, III)
- -ACI certification prerequisite
- -Requires written exam
- -Every PCI-Certified plant must employ at least one PCI-certified QC person





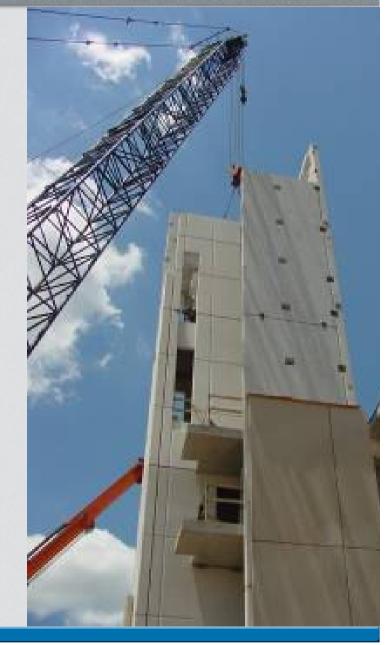


PCI

Active 5 years;
 over 120 firms

-3 Categories (S1, S2, A)

Includes"Qualified" Level



- Evolving the Quality Process
  - -Essential Goal: Fidelity to the Design
    - Design irrelevant if not accurately followed in fabrication and construction
    - More important now that we recognize greater impact of design



- -Evolution began with most critical attributes and moved outward
  - Life safety
  - Basic durability
- -Future evolution must embrace expanded Perspective Range



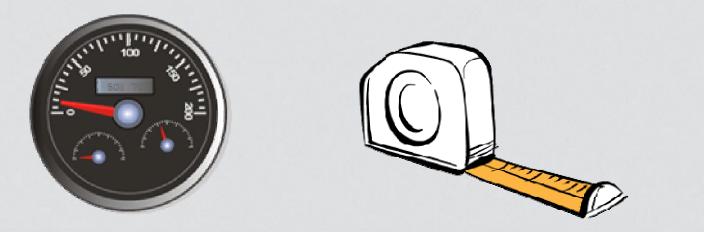
# PCI SUSTAINABLE PLANT PROGRAM



Purpose

 Introduce performance measurements and benchmarks for Sustainability in production

-Address increasing specifier demand





- Concept
  - -Voluntary program
  - Plants measure energy & environmental performance
  - -Data initially forms baseline
  - -Sets stage for future guidelines



- Benefits
  - -Provides education and guidance
  - Improves plant energy & environmental performance
  - -Lowers operating costs
  - -Identifies key measurable indices and benchmark data



- Benefits
  - –Instills culture of sustainability
  - -Provides a new level of transparency
  - -Supports competitive positioning in marketplace



- Structure
  - -Stage I: October 2011
  - -Stage II: 2013
  - -Stage III: 2014



- Structure
  - -Stage I (plant only):
    - Energy Consumption
    - Waste Management
    - Recycling
    - Water Management
    - Cement & SCM Utilization





- Structure
  - -Stage II:
    - Stage I items applied to Field Operations
    - Safety
    - Transportation
    - Materials Acquisition
    - Mix Design Optimization
    - Identification of Best Practices

-Stage III:

• Structure

- Enhancements to Stages I and II
- Social Responsibility
- Enhanced Monitoring and Reporting
- Additional Supply Chain Management

- Stage I Implementation
  - -Plant reports calendarie
    - Information often on inverse
    - Establishes baseline data
    - Enables 'Before and After' comparisons

- Stage I Implementation
  - -Plant conducts Energy
    - Often low or no cost
    - Provides roadmap for improvement
    - Documented starting point for energy use



PCT

#### **Sustainable Plant Program**

# Stage I Implementation

# –PCI develops standard Tracking Tool

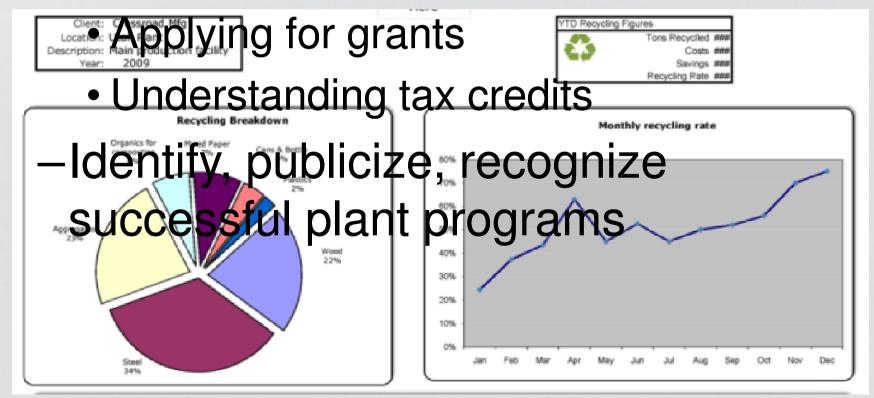
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- Support to Participants
  - -Listing of incentive programs to offset capital upgrade expense
    - Federal
    - State
    - County
    - Local power authorities



- Support to Participants
  - -Web links and guidance for:





# SUMMARY

#### Summary



# The Technical Institute

- -Develops and Advances Engineering Methods and Technology
- -Sets and Validates Quality Standards
- Sustainable Design
  - -The Next Step in Evolution of Design
  - -Needs New Tools and Methods
  - -Needs New Approach to Engineering



#### **Beyond Sustainability: Quality**

# Role of Quality

Design Without Quality is Useless
In Other Words:

As the impact of design becomes greater and more far-reaching, it is of greater importance that the finished structure adhere to the design.





• Therefore:

It Is the Duty of the Engineering Profession and the Technical Institute to Advance Sustainable Design



# THANK YOU !

