

Sustainability as a Criterion for Construction Materials Selection

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Sustainable Materials Selection

- Traditional Criteria:

- Economics
- Performance
- Aesthetics

- New Considerations:

- Ecology
- Social Impacts
- Human Health
- Resource Supplies



Sustainable Materials Selection

- Objectives:
 - Subjective & Unquantifiable =>
Rational & Sustainable
 - Increasing Sustainability of Built Environment
by Choosing Sustainable Materials
 - Paradigm Shift in Design and Construction



Overview

- What is Sustainability?
- Why Should We Care about Sustainability?
- How Can We Implement Sustainability?
- Sustainability and Construction Materials
- Contributions, Benefits, and Conclusions



What is Sustainability?

- Sustainable Development:
 - “...development which meets the needs of present generations without compromising the ability of future generations to meet their own needs.” (World Commission on Environment & Development 1987)
- Continued Development using Finite Resources
- Inter- and Intra-generational Equity



What is Sustainability?

- Sustainability:
 - “...a system state marked by stability, where changes to the system remain constrained so as to maintain the stability of the system into the foreseeable future.” (Pearce 1995)
- System Context
- Stable, not Necessarily Static
- Indefinite Time Frame



Why Should We Care About Sustainability?

- Environmental Consciousness is Being Mandated
- Sustainability can be Economically Advantageous
- Sustainability will Facilitate Human Survival and Satisfaction



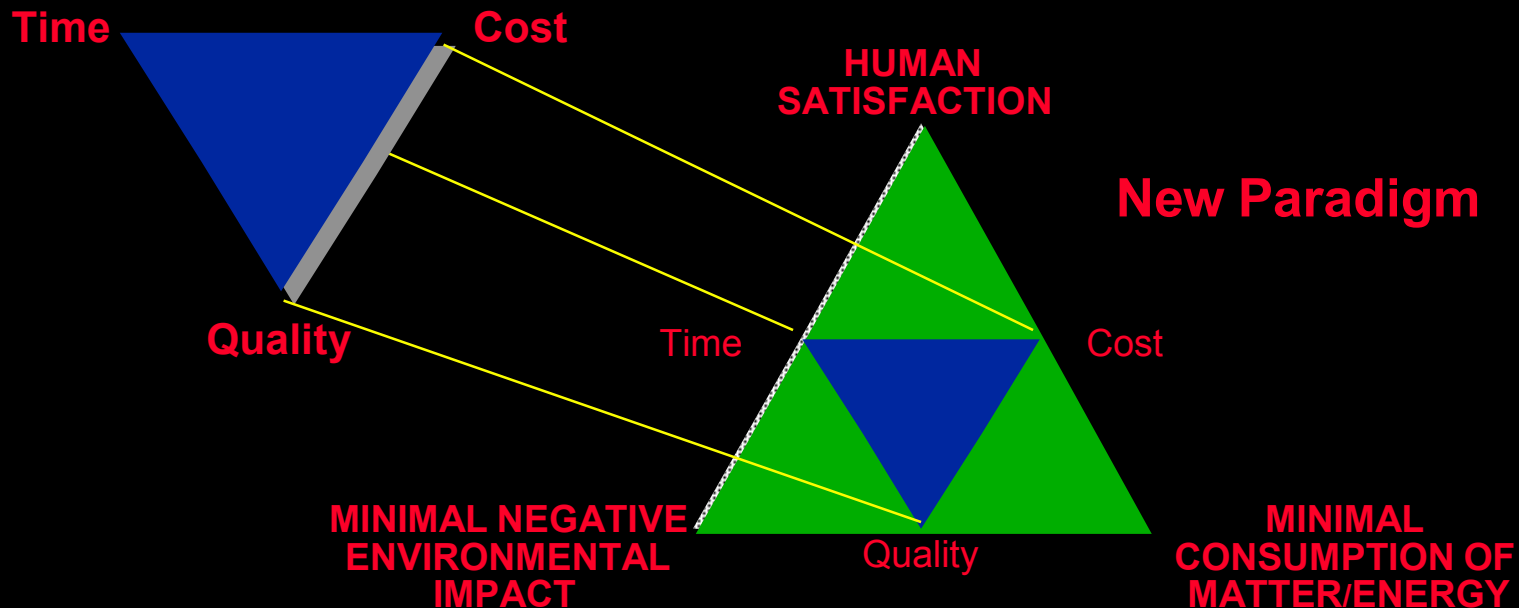
Why Should We Care About Sustainability?

- **Built Facilities have Significant Impacts:**
 - Consumption of Natural Resources
 - Displacement of Ecosystems
 - Meeting Human Needs
- **We (Designers, Engineers, Constructors) Control the Built Environment**
- **We Have the Power to Make Sustainable Decisions**



How Can We Implement Sustainability?

- A Paradigm Shift is Needed:





How Can We Implement Sustainability?

- Hypothesis:
 - Using sustainable building materials enhances the sustainability of the built environment
- The Question:
 - How can we improve how materials are selected, and incorporate sustainability into the decision?
- An Answer...



Sustainability and Construction Materials

- Research Methodology
- A Taxonomy of Sustainability Attributes
- “Rational Actor” Selection Process
- Sustainability Decision Support System



Sustainability and Construction Materials

- Research Methodology:
 - Sustainability Indicators and Sensitivity Analysis
 - Selection Heuristics for Context Specificity
 - “Rational Actor” Evaluation of Feasible Alternatives
 - Prototype System Development



Sustainability and Construction Materials

- A Taxonomy of Sustainability Attributes:
 - Technology (Performance, Quality)
 - Ecology (Integrity of Ecosystems, Consumption Minimization)
 - Economics (Life Cycle Competitiveness)
 - Ethics (Equity and Consumption Minimization)



Sustainability and Construction Materials

- “Rational Actor” Selection Process:
 - Select criteria and weightings
 - Generate alternatives
 - Analyze and evaluate alternatives
 - Recommend best alternative



Sustainability and Construction Materials

- Sustainability Decision Support System:
 - Inputs:
 - Design Elements
 - Decision Parameters
 - User Weights
 - Outputs:
 - List of Materials for Each Design Element
 - Whole Design Sustainability Index



Sustainability and Construction Materials

- Sustainability Decision Support System:
 - System Elements:
 - Material Property Database
 - Knowledge Base of Selection Heuristics
 - Material Choice Generator
 - Value Extractor
 - Sustainability Index Calculator
 - Amalgamator



Contributions, Benefits, and Conclusions

- Contributions:
 - Metric for Assessing the Relative Sustainability of Construction Material Alternatives
 - Systematic Methodology for Selecting Materials
 - Framework for a Computer-Based Sustainability Decision Support System



Contributions, Benefits, and Conclusions

- Benefits:
 - Increased awareness of selection criteria and priorities
 - More materials alternatives can be considered
 - Greater acceptance of innovative materials
 - Design alternatives can be quickly generated
 - Enhanced sustainability of the built environment



Contributions, Benefits, and Conclusions

- **Future Research:**
 - Extend SDSS Framework to other project decisions:
 - Process Selection
 - Equipment Selection
 - Include material sustainability metric in model of overall project sustainability
 - Integrate SDSS Framework into automated design system
 - Add knowledge acquisition capabilities



Contributions, Benefits, and Conclusions

- **Conclusions:**
 - Using a “Rational Actor” approach to materials selection improves the effectiveness of the selection process
 - Wisely choosing sustainable materials leads to enhanced sustainability of the built environment
 - Sustainability should be an important consideration in design and construction decision making
 - Many opportunities exist for further research.