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# National Priority

## *Improving Our Levee System*

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# Sustainability from Two Perspectives

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## PRODUCT

- Raw materials
- Composite materials
- Recycled content
- Design decisions

## PROCESS

- Materials storage
- Manufacturing
- Transportation
- Waste management

SUSTAINABILITY IN CONSTRUCTION

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## Sustainable Design Philosophy

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$$Sustainability = \frac{\text{Design Requirement} > \text{Design Function}}{\text{Time}}$$

- Design Requirement
    - Specified level of performance necessary
  - Design Function
    - Specified intent for use of the structure from the Owner
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# Sustainable Design Philosophy

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Design Requirement = PERFORMANCE

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# Sustainable Design Philosophy

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$$\textit{Sustainability} = \frac{\text{Performance} > \text{Function}}{\text{Time}}$$

- Performance
    - Expected result from the design as measured by a standard method
  - Function
    - Intended use of structure or structural element
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## Concrete Design Philosophy

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PRESCRIPTION  $\approx$  PERFORMANCE

- Generally accepted design approach
  - Supported by Codes and Standards
  - Don't have to exercise judgment
  - Perception that it minimizes liability
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# Conflicting Design Philosophies

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$$\textit{Sustainability} = \frac{\text{Prescription} > \text{Function}}{\text{Time}}$$

- Is it possible to "prescribe" sustainability?
  - Does a traditional approach create an inherent conflict with sustainability?
  - How do we resolve the conflict?
  - What to look for in specifications...
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## Traditional or Prescriptive Elements

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- By the Code, or generally accepted design methods:
    - Maximum w/cm
    - Minimum cement content
    - Limitations on pozzolanic replacement
    - Air content
    - Slump ranges not determined by Contractor
    - Time and drum revolution limits
  - None of these are “performance” based
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## Issues and Challenges: Engineers

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- Sustainability = Performance
- What performance is needed?
  - Verification of performance
  - Do your homework
- Be explicit, not implicit!
  - Set time
  - What strength at what day?
- Must see the mix design...why?



## Issues and Challenges: Architects

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- Often don't understand own specification
- Material experience is rarely first hand, based on last major problem...
- What is the metric for performance?
- Cost awareness is essential!



## Issues and Challenges: Contractors

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- “Any change is a bad change”
  - Changes in placing
  - Changes in finishing
- Someone else is the expert
- \$/ft<sup>2</sup> can be the deal breaker
- Performance is too good?



## Issues and Challenges: Testing Labs

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- Verify performance for owner
  - Based on job specs (explicit!)
  - **NOT** based on speculation or assumption
- New technology and old assumptions = problems
- Mix design?
- When to include in process



# Questions

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