American Concrete Institute

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Conservation of Historic Concrete

ACI Fall 2013 Convention
October 20 - 24, Phoenix, AZ

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WEB SESSIONS

Matthew Sherman received his B.S. in Civil Engineering from Cornell University in 1991 and his M.S. in Civil Engineering (Structural) from The University of Texas at Austin in 1993. Matthew has 20 years of experience in consulting and heavy-construction and has inspected, constructed, evaluated, and repaired concrete structures throughout the United States. His specialties include concrete materials evaluation, non-destructive testing, corrosion mitigation, and concrete repair. Some of his notable projects include the investigation of railroad tie failures, rehabilitation of the Notre Dame football stadium, rehabilitation of Boston's Central Artery/Tunnel slurry wall panels, evaluation of alkali-silica reaction in bridge and nuclear structures, and repair of overlay failures nationwide. Mr. Sherman is an active committee member of ACI and ICRI, and is also a member of ASCE, AWS, and The Concrete Society. He is an NRMCA Certified Concrete Technologist - Level 3 and 4.

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Renovation of Historic Stadium Structures

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Simpson Gumpertz & Heger

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Stadia aren't your typical job, they are…

- Heritage structures (and maybe historical),
- Connected to users on an emotional level,
- Utilitarian structures, but fundamentally architectural,
- Generally old structures,
- Very exposed to the elements,
- Not heavily used, but when they are used, it is severe use,
- Difficult and costly to maintain, and the dollars surrounding them can be a source of conflict.

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Repairing Stadium Structures Must Respect…

- Their visibility
- The heritage and emotional connection to their users
- Sound engineering
- Public safety
- Economics
- Stadium operations

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They pose particular challenges for rehabilitation…

- Seismic concerns

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- Unusual loadpaths

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They pose particular challenges for rehabilitation…

- Seismic concerns
- Building Code issues
- Unusual loadpaths
- Uncommon damage types

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Typical Damage At Stadia…

- Corrosion

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Typical Damage At Stadia…

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- Failed joints

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Typical Damage At Stadia…

- Corrosion
- Failed joints
- Organic growth

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Typical Damage At Stadia…

- Corrosion
- Failed joints
- Organic growth, and
- Freezing and thawing

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Most damage is caused by…

- Corrosion
  - Typically occurs due to carbonation
  - Is exacerbated by low cover
- Freezing and Thawing
  - Occurs when water gets into the concrete and freezes.
  - Modern concretes use air entrainment, but those only came into widespread use in the 50's, well after most stadia were built.
  - It is a progressive failure, starting at the surface and working its way into the concrete.

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Freeze/Thaw Repair Is Complicated By…

- Huge extents of damage
- Variability in damage
- Cracking that is not interconnected
- Fragility of concrete in direction parallel to exposed face
- Exposed nature of the concrete in use
- Requirement to prevent trapping moisture

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Repair Motivations and Goals

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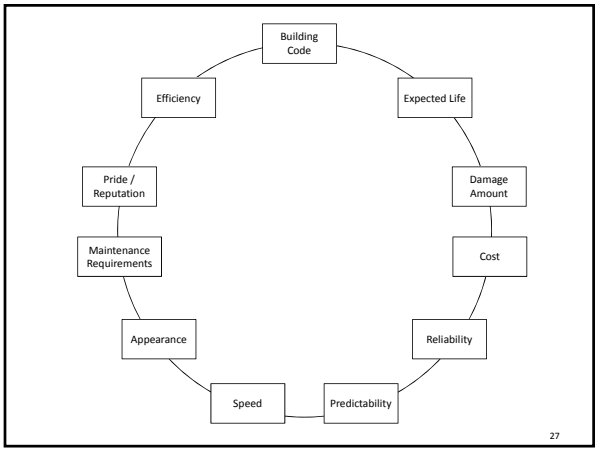

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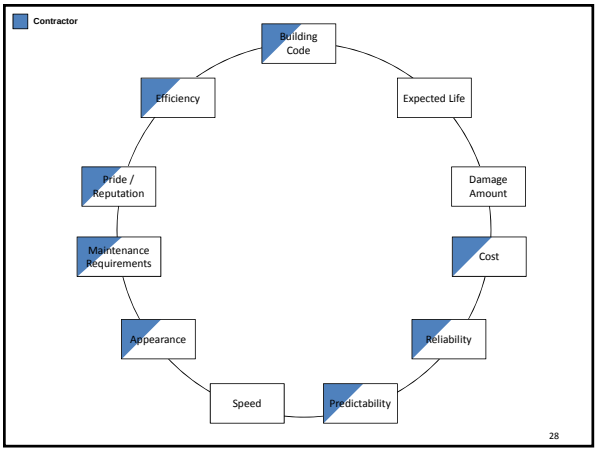

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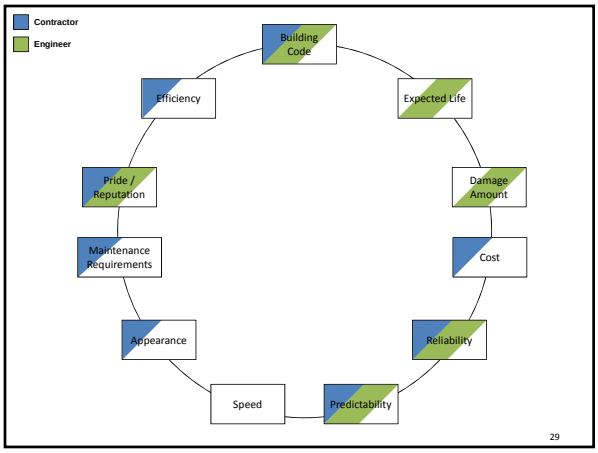

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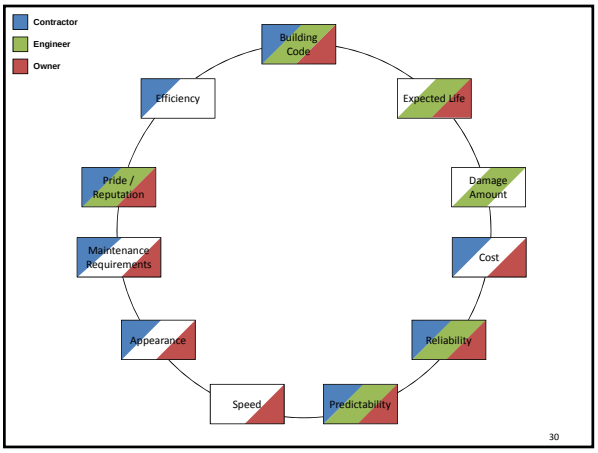

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So How Do We Deal With This Situation…

- Damage is complicated, with multiple damage types all occurring at the same time,
- Damage is widespread, and often concealed,
- Conventional techniques fall short of what is required,
- Making it "good as new" will essentially require complete demolition.

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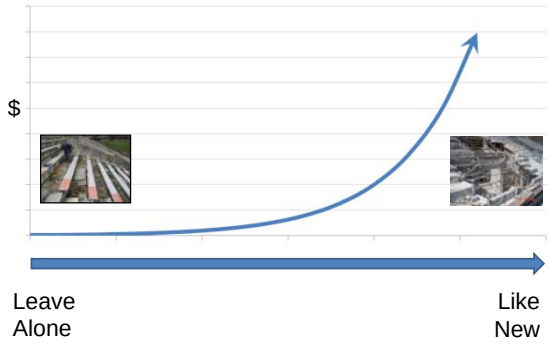
So How Do We Deal With This Situation…



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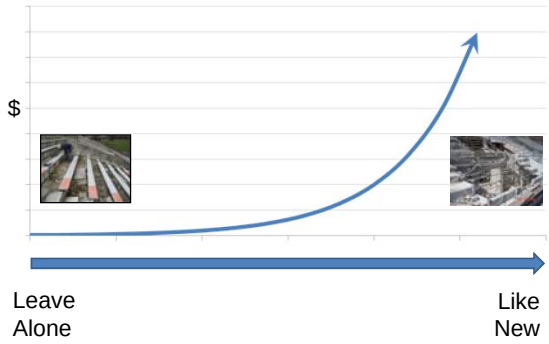

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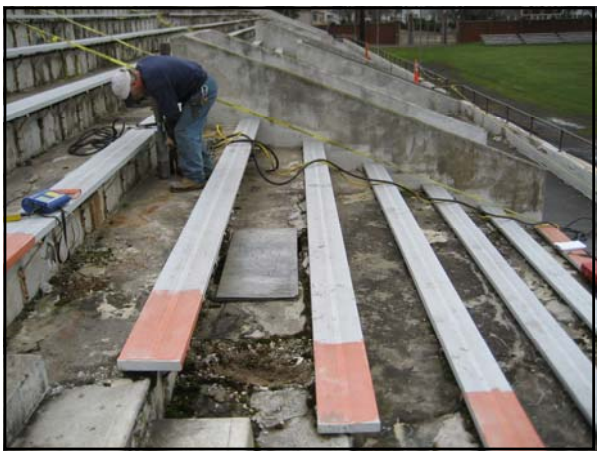

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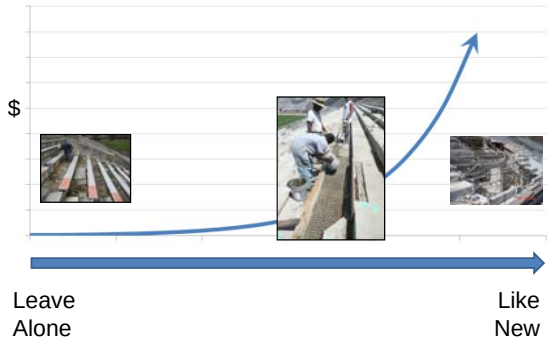

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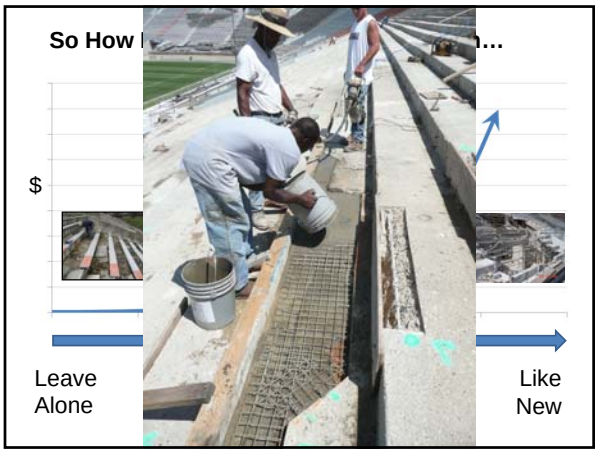

Solution Is Found In…

- Sharing common goals of:
  - Performing the (minimum) repairs necessary,
  - Still doing enough so that we get reliable repairs,
  - Avoiding building code issues,
  - Some level of predictability in planning and scheduling.
- Communicating motivations and expectations
  - It isn't going to be "like new",
  - The repairs may not be the prettiest thing ever.
- Staying flexible
  - Special procedures may be required,
  - "Old dogs" may need to learn "new tricks,"
  - Some on-the-fly detailing will be required because of particular conditions.

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To do this, we need to…

- Educate that we are doing enough, but not too much,
- Use on-site inspection to ensure we are doing enough,
- Provide some sort of predictability in bidding, and
- Think on our feet in the field – remembering that it won't be "like new."

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So How Does It Get Put Into Practice?

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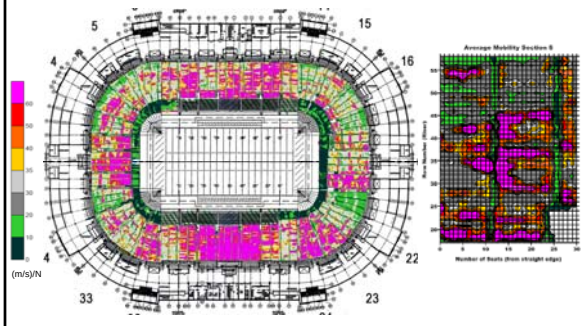
1 – Get a handle on the extents



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2 – Define approach and extent of work

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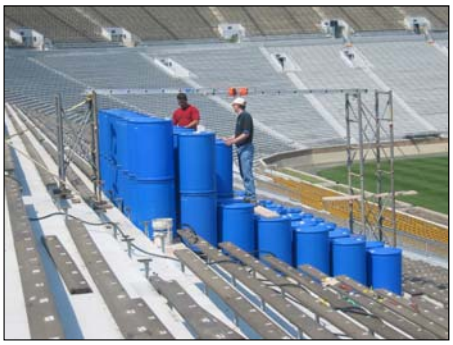
3 – Make sure it is safe



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4 – Prepare surfaces, remove shallow damage

- Hydrodemolition the superior method for removal of coatings and damaged concrete
  - "Mower" with rotating head for bulk removal
  - Lance for removing remainder

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5 – Removal of deeper damage

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6 - Inspection

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7 - Repair

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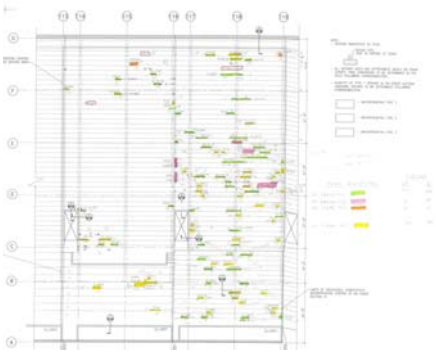
8 - Quantity & Inspection Tracking



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9 – Quality Control Testing

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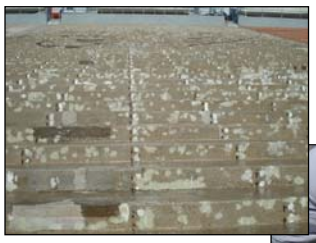
10 – Waterproofing preparation



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11 – Check that expectations are being met

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12 – Install coating

13 – Quality testing of coating

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Summary

- Stadium work incorporates different demands, motivations, and processes than typical repair,
- They present challenges to conventional thinking,
- Successful projects require careful alignment of goals and expectations of all parties,
- Careful and proper preparation is key, and
- Close cooperation and inspection is required.

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Questions?

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