Evaluation, Restoration and Protection of Sandstone Façade on a Historic Building – The Boston Building Denver, CO

Presenter: Leo Whiteley
Boston Loft Building History

• On Southeast corner of 17th and Champa in the middle of Denver's financial district

• Known as the 1st “Strictly Modern Office Building” to be erected in Denver
History

• Combination of Renaissance Revival and Richardson Romanesque architecture

• 9 story building faced with red sandstone quarried near Manitou Springs, Colorado
Timeline

• Constructed in approximately 1890
• 1959 the front entrance was modernized
• 1978 added to the National Registry of Historic Places
• 1997 was converted into apartment lofts
• 2011 added to Colorado Historic Society
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  - Red Sandstone Balcony with Balustrade over the top of the 3 entrance arches
  - Rusticated stones at base.
Structure

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- Solid sandstone lintels or sandstone block arches are spanning all exterior window/door openings.
Sandstone Lintels and Arches
OBSERVATIONS AND FINDINGS
Failed Existing Patches

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Mismatched Existing Patches

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Deteriorated Existing Patches
Structural Lintel Cracks

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Deteriorated Sandstone
Dirt & Water Staining

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Deteriorated Wood Frames

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In 2011 a complete Condition Appraisal was undertaken.

- Determined the cause of stone pieces falling on the sidewalk
- Established the current condition of the building façade
- Identified, located, and illustrated deterioration and/or failures on building elevations
- Performed material testing to determine deterioration causes
- Assessed findings in order to present and prioritize repair, maintenance, and upgrade recommendations
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- Construction Documents were developed and Construction Administration undertaken during the restoration.
Background Research

• Where did the sandstone come from?
• What are the properties of the sandstone?
• How has the sandstone behaved in this climate?
• Was this type of sandstone utilized anywhere else nearby?
Research Findings

- Greenlee Sandstone was quarried near Manitou Springs, Colorado
- Stone: Soft, medium grained red sandstone with iron oxide material properties
Research Findings

• Iron oxide is the prominent binding material in this type of sandstone which creates the warm red color.

• Oxidation (rusting) of the iron in the stone has caused disintegration, and a loss of the cohesive binder.

• Material testing revealed that this stone is very absorbent, making it susceptible to saturation and freeze thaw damage.
Cored Sandstone Samples

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Deterioration Mechanisms

- Freeze/Thaw action
- 6.3% absorption characteristic holds water
- Ledges and detailed pieces suffer most damage due to collection of water
Deterioration Mechanisms

- Bedding planes of sandstone are natural lines of weakness and are strongest when horizontal.
- Water is more likely to split the stone if the bedding planes are in a vertical orientation.

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Identified Repairs

- **Sandstone Repair**
  - No major deterioration of the sandstone blocks that required replacement
  - Removal of loose, flaking and deteriorated stone surfaces
  - Modify ledge conditions
  - Patch material
  - Structural crack repairs
  - Tuck-pointing

- **Waterproofing**
  - Sealants
  - Flashing

- **Cleaning**
  - Correct Method / Product

- **Sealing**
  - Consolidant vs Siloxane

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Modify Ledge Conditions

- Slope ledges in repairs to allow positive drainage
Patching Material

- Customized to match substrate
- 2-component
- Latex modified cementitious patching compound.
- Single custom color match was utilized
Patch Material/Appearance

• “Liquidirt”
  ✓ Colored stain was applied to match natural variations, atmospheric staining and aging in the sandstone
Structural Crack Repair

- Stainless steel dowels set in epoxy
- Pressure inject epoxy
Anchoring

- Stainless steel rods set in epoxy
Tuckpointing

- Mortar joints hand cut to minimize overcutting
- Install grout in “Lifts”
Masonry Cleaning

• Cleaning the stone is important for:
  ✓ Aesthetic Reasons
  ✓ Remove surface contaminants: Carbon, crust, salts, pigeon droppings, mildew and atmospheric stains
  ✓ To ensure proper saturation of the protective sealer

• Abrasive or Non-Abrasive
  ✓ Avoid a cleaning method that is too aggressive, do not want the stone to wash away

• Tested Mild Detergents
  ✓ Sandstone soaked up detergent and could not be rinsed out

• Hot Water & Nonacidic Liquid Cleaner
  ✓ Medium / Low pressure hot water
ICRI Concrete Repair Terminology

✓ “The process of maintaining a concrete structure in its present or restored condition by minimizing the potential for deterioration of damage in the future. (See also maintenance and preservation.)”
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National Park Service “Preservation Briefs #47 – Maintaining the Exterior of Small and Medium Size Historic Buildings”

✓ “Preservation is defined as “the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property.”
Choosing a Sealer

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  ✓ Sandstone properties vary greatly from region to region which may not allow a successful applications
  ✓ Testing is mandatory
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- Stone consolidants can be divided into 4 main groups: inorganic materials, alkoxysilanes, synthetic organic polymers, and waxes. (Waxes have been used for over 2000 years)

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Consolidant vs. Sealer

- ASTM E2167-01 (2008); Standard Guide for Selection and use of Stone Consolidants
  - Can be beneficial in stabilizing sandstone
  - Does keep water out
  - Does not breathe, may trap moisture in
  - May contribute to deterioration or create unanticipated problems
  - Consolidation of porous stone is an irreversible process.
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• Siloxane Sealer coats pores but does not clog them
  ✓ Does keep water out
  ✓ Allows sandstone to breathe
MAINTENANCE

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  ✓ “Over time, the cost of maintenance is substantially less than the replacement of deteriorated historic features.”

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• Foundations and Perimeter Grades.
  ✓ The foundation walls, piers and the ground immediately around a foundation serve important structural functions.
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- Written procedures should outline step-by-step approaches that are custom-tailored for the building.
- Schedules and checklists for inspections.
- Forms for recording work.
- Written procedures for the appropriate care of specific materials.
- Record keeping.
Cost of Deferred Maintenance

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After Photos

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