Structure Sustainability in an Industrial Environment A Design/Build Approach

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Initial Site Visit and Research

- Initial site visit and observation report October 2009.
- Received and reviewed original construction drawings dated 1952.
- Literature search regarding soda ash
- Two potential deterioration mechanisms Soft water and salt scaling.
- Recommended Petrography testing


SAMPLE 1
TOP FMC SILO
2 NORTH

Petrography Report

- Samples extracted and sent to Petrography lab in April 2010
- Petrography report indicated a “weak zone of concrete at a depth of 0.15-inches. The weak zone is characterized by soft concrete paste and micro-cracks. An abundance of white deposits and micro-cracks in this weaker zone indicates that crystallization pressures related to the formation of salt deposits such as certain types of sodium salts may have exacerbated the deterioration.”

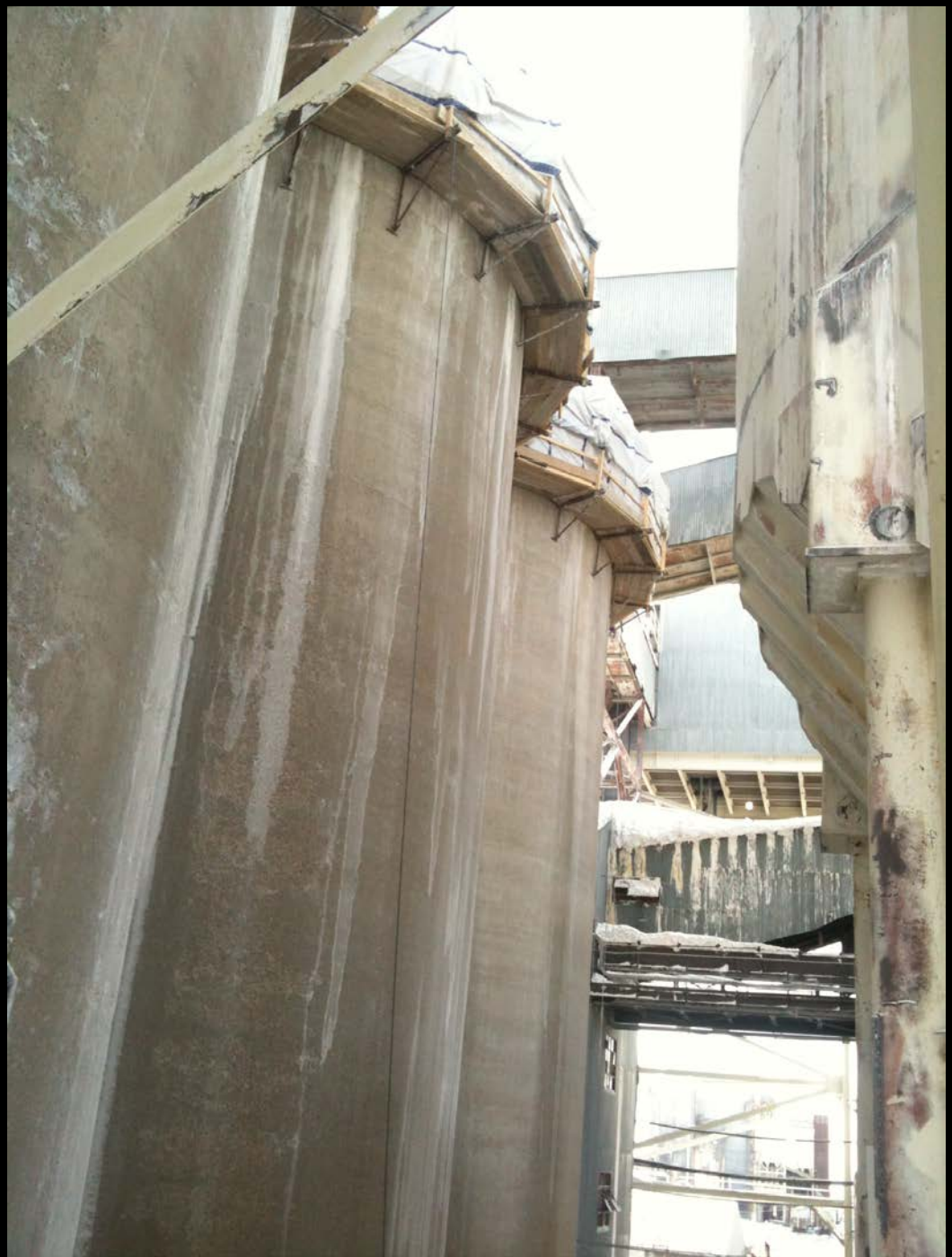
Developing Repair Scheme

- Investigate Roof Support Trusses
- Clean concrete and remove the .15-inches of soft/weakened concrete at surface
- Install HPC concrete overlay
- Apply silane sealer as additional salt protection.
- Truss Investigation approved April 2011, completed June 2011.

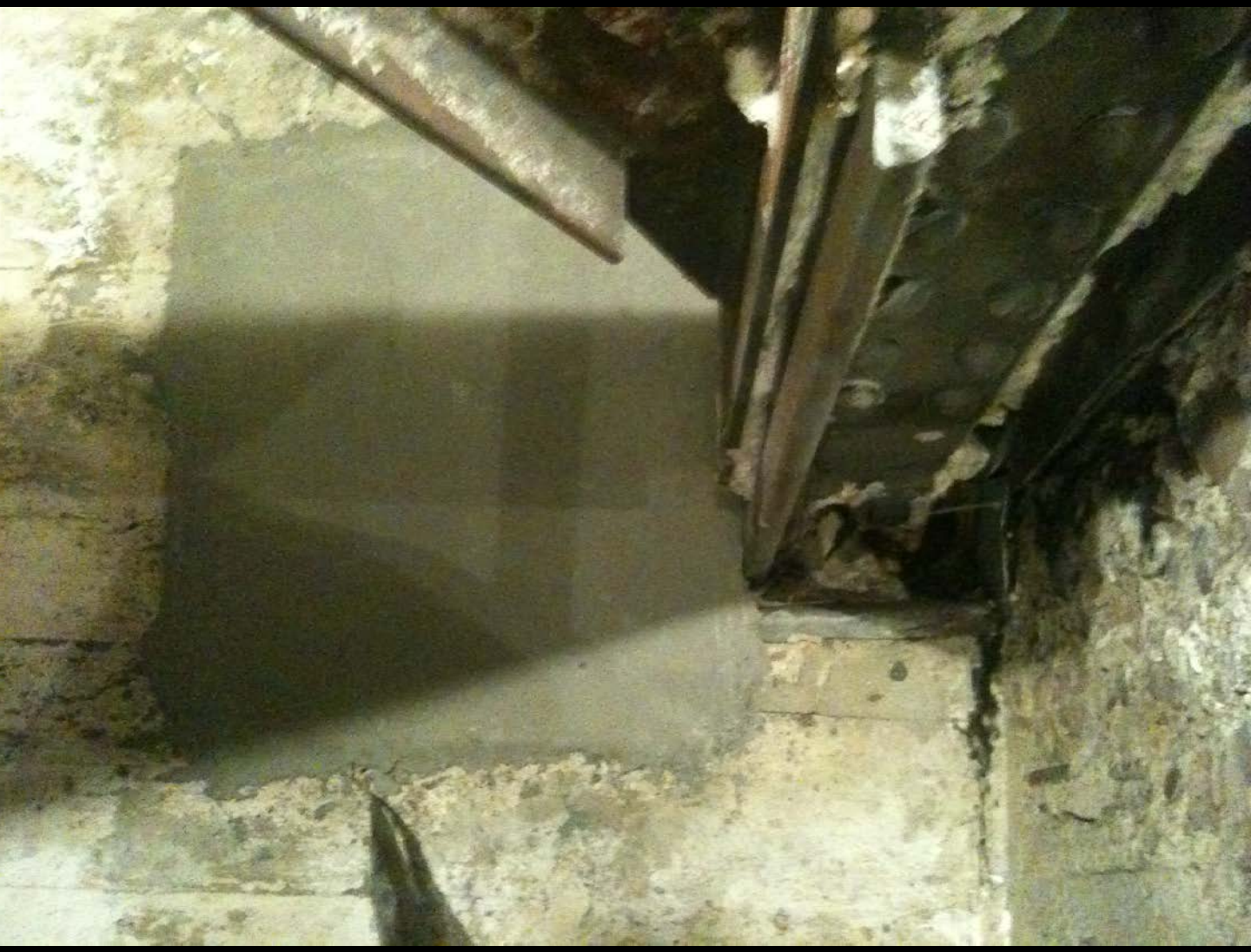
Truss Investigation

Repair Scheme After Truss Investigation

- Investigate Roof Support Trusses
- Clean concrete and remove the .15-inches of soft/weakened concrete at surface
- Install HPC concrete overlay
- Apply 100% solids silane sealer, known chloride screen.
- Repair Inside Wall Bearing Pocket
- Add new steel bearing seat
- Project Approval September 16, 2011
- Contracted as a Design/Build Project




Western
States Equipment
801-596-2300



Contract Modifications During Construction

- Outside Wall Truss Bearing Pocket Repair
- Inside/Outside Wall Repairs Middle Bin
- Overhead Slab Repairs at Building Line, middle bin
- Additional Slab Repair, middle bin

HPC Protection Slab Specs and Procedures

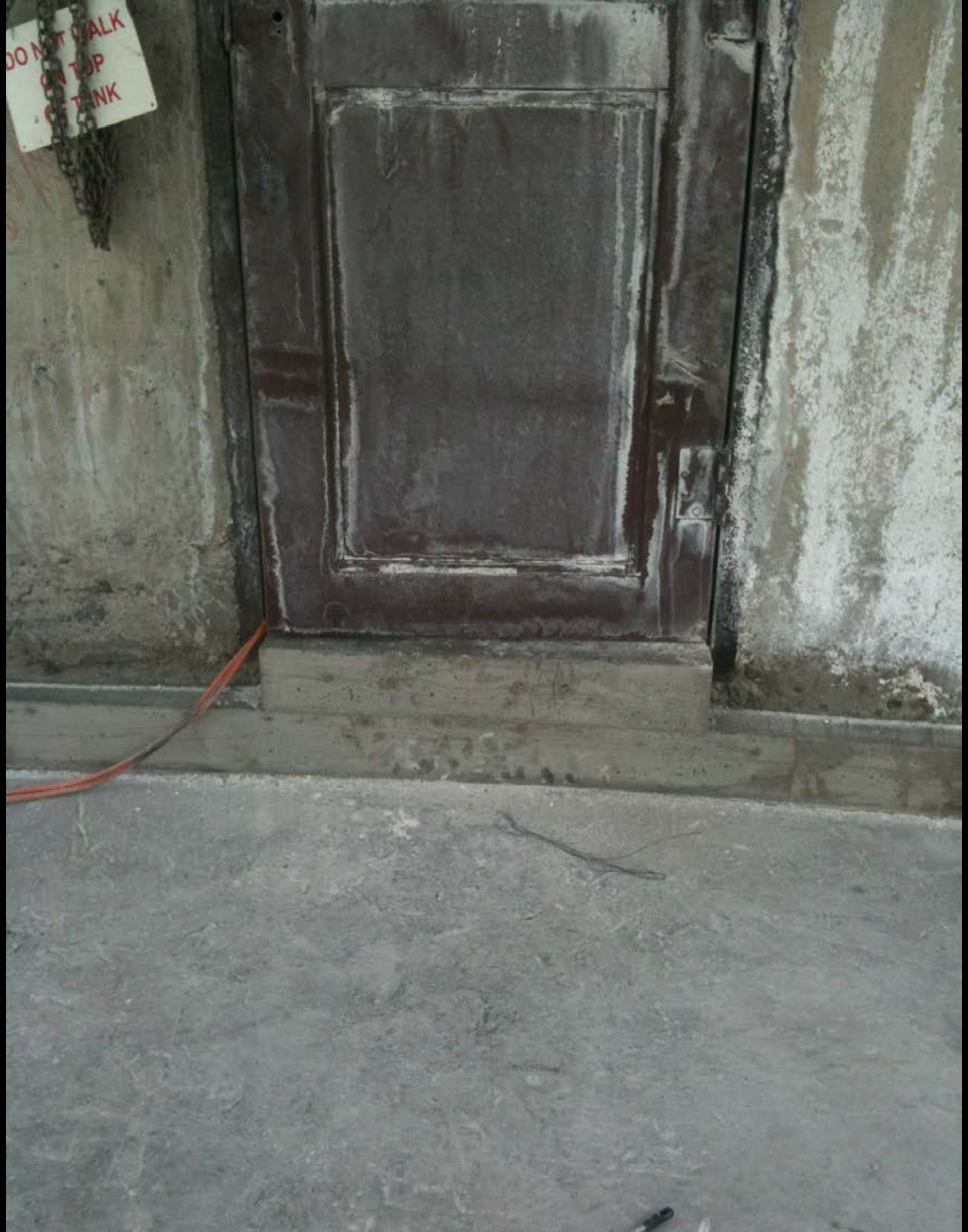
- #4 reinforcing bars at 16” on center each way
- 3.5” max thickness sloped to 2.5” min.
- Research WYDOT Specs regarding silica-fume bridge deck overlay.
- Research Grace Eclipse 4500 SRA
- Trial Batch Delivery on December 15, 2011
- ASTM C157 Shrinkage testing
- Compressive Strength Cylinders

Mix Design

- 680 Lbs cement per cubic yard
- 55 lbs micro-silica per cubic yard
- 30.5 gallons City Water (w/c ratio = 0.36)
- 1677 lbs pea gravel per cubic yard, 74% pass 3/8” screen 10% pass #4 screen
- 1172 lbs concrete sand per cubic yard
- 11 oz low range water reducer
- 99.2 oz super-plasticizer
- Total Air Content 6% plus/minus 1.5%
- 10.2 oz Grace Recover, Hydration Stabilizer per 6 yard load, 45 minute drive from batch plant to project site.
- Modeled Slump 3-5”
- Hot Water Usage

Placement Conditions

- Placement Day December 21, 2011
- Daily High Temperature 29 degrees F
- Overnight Low Temperature 10 degrees F
- Placement Time 11:00 am- 3:00 pm totaling 12.5 cubic yards
- Concrete ordered in 6 yard loads.
- Concrete testing results
  - Slump = 6.75” (total 120 oz of super-plasticizer added)
  - Air content = 6.8%
  - Concrete Temp = 59 degrees F
- Confilm evaporation retarder applied approximately 7:00 pm
- Applied curing blankets at 9:00 pm
- Placed steam line to outside form edge and top blankets.
- Temperatures of slab at 9:00 pm was 45-55 degrees F.
- 1.5 cubic feet concrete re-mixed with 6 oz Eclipse 4500 for comparative shrinkage test results


DO NOT WALK
ON TOP
OF TANK

Project Completion

- De-mobilize from project week ending January 20, 2012
- 28 Day trial batch compressive strength 9460-psi
- 28 Day overlay compressive strength 8810-psi
- ASTM C157 linear shrinkage trial batch = -.038%
- ASTM C157 linear shrinkage remixed 1.0 cubic foot sample of overlay batch with Grace Eclipse 4500 = -.035%