



Geopolymers as a Concrete Repair Material in Industrial Facilities

Glenn Schaefer
July 2023 – Geopolymer Camp

STRUCTURAL

structural group



ANNUAL
REVENUE
\$850M+



OFFERING
Products
Engineering
Construction



TOTAL
EMPLOYEES
3,000+

structural TECHNOLOGIES

PRODUCTS AND ENGINEERING



ANNUAL
REVENUE
\$125M



REGIONAL
TECHNOLOGY CENTER
LOCATIONS
Baltimore, MD Dallas, TX
Houston, TX Chicago, IL

structural | PULLMAN

CONSTRUCTION COMPANIES



ANNUAL
REVENUE
\$725M



AVERAGE
NUMBER OF
PROJECTS
3000

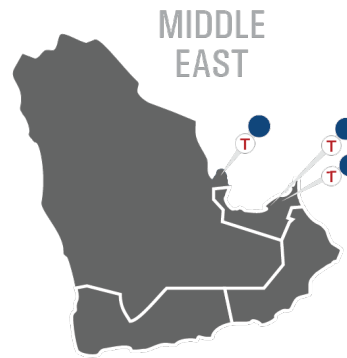
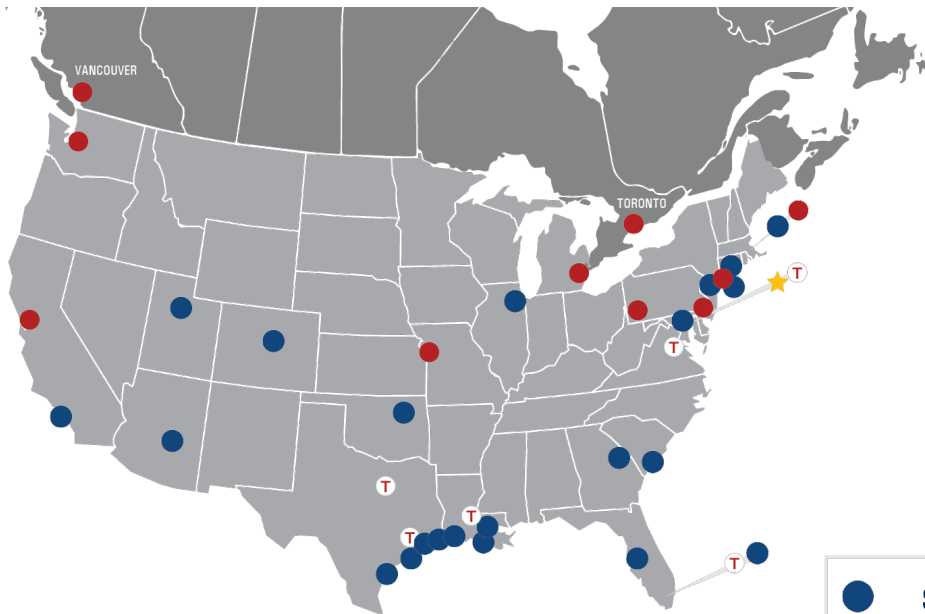





MARKETS
SERVED
NORTH AMERICA
& MIDDLE EAST



#3
CONCRETE
CONTRACTOR

Locations



	struc^rtural
	struc^rtural TECHNOLOGIES
	PULLMAN

Corporate HQ:

Columbia, MD

US Locations:

- | | |
|--------------------|--------------------|
| Phoenix, AZ | Baltimore, MD |
| Los Angeles, CA | Detroit, MI |
| San Francisco, CA | Kansas City, MO |
| Hartford, CT | Long Island, NY |
| Denver, CO | New York, NY |
| Washington, DC | Tulsa, OK |
| Jacksonville, FL | Philadelphia, PA |
| Pompano Beach, FL | Pittsburgh, PA (2) |
| St. Petersburg, FL | Charleston, SC |
| Augusta, GA | Corpus Christi, TX |
| Chicago, IL | Dallas, TX |
| Kansas City, KS | Freeport, TX |
| Baton Rouge, LA | Houston, TX |
| Lake Charles, LA | Nederland, TX |
| New Orleans, LA | Salt Lake City, UT |
| Boston, MA | Seattle, WA |

International Locations:

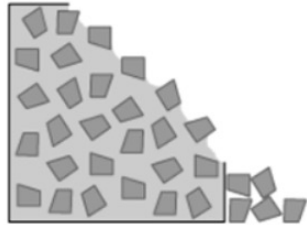
- Toronto, ON
- Vancouver, BC
- Abu Dhabi
- Dubai
- Qatar

Why Am I speaking

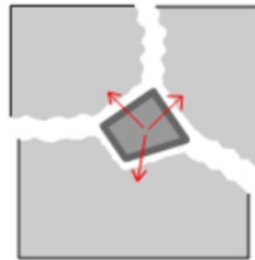
- May 8th email - *Each participant of the GP-Camp can make a small presentation (oral/Powerpoint) on a topic of his choice(10-15 minutes).*
 - Was in front computer at the time
 - Did not notice the word “can”
 - Did not do the math to think 105 people cannot all do a 15 minut presentation
 - I submitted topic
- The other presentations were nicely framed technical research papers.
- This is not.....

Geopolymers and concrete repair

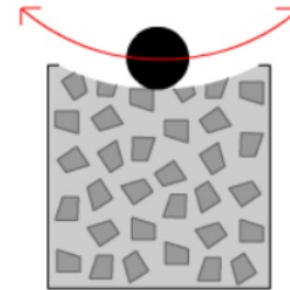
There are 3 basic mechanisms that can deteriorate concrete:



- A component of the concrete dissolves.



- Something inside the concrete expands and cracks the surrounding concrete.



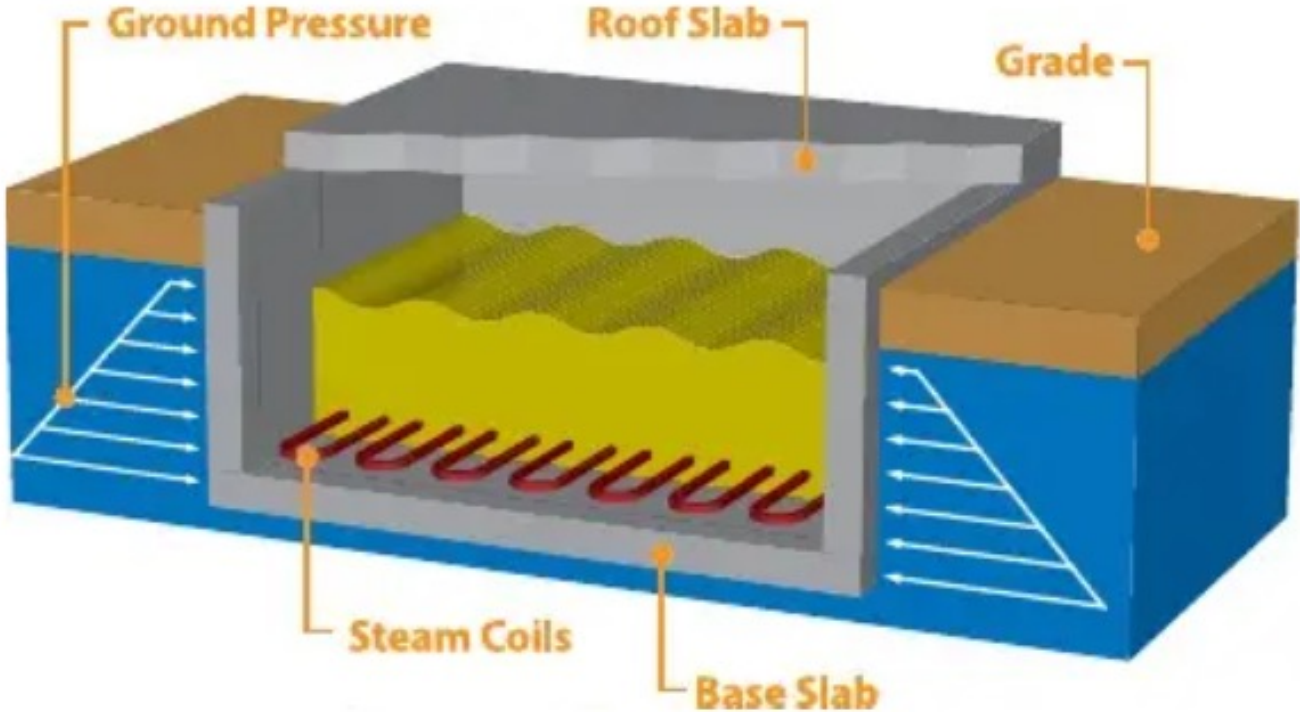
- An outside force wears away the concrete.

- Classic
- Significant work in Oil & Gas / Refineries and other Industrial Facilities
- Industrial facilities understand keeping an asset functional
- Process chemicals are often very aggressive to Portland Cement concrete (dissolving paste)

Chemical Attack



Sulfur Pit



Sulfur Pit



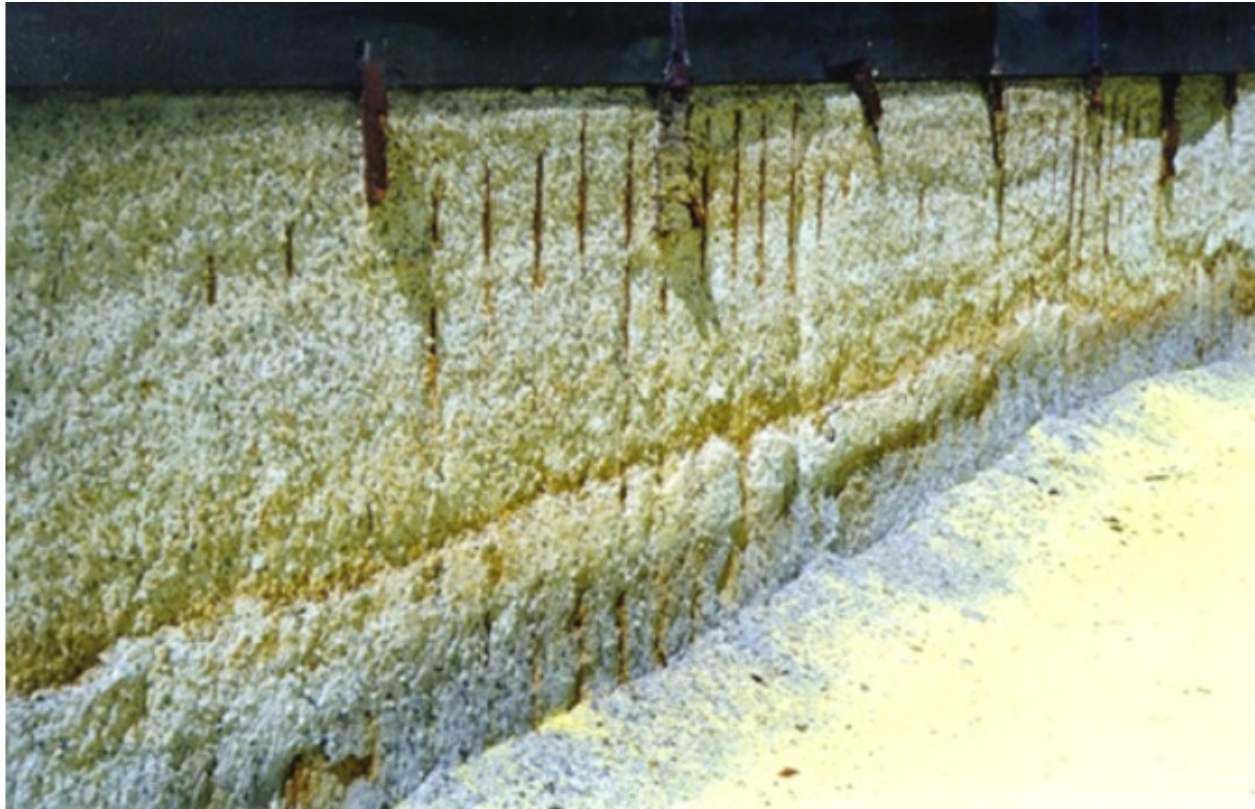
Chemical Attack – Sulfur Pit

- Elemental Sulfur does not cause sulfate attack
 - Pit is in ground so could be some exposure.
- Pits have cracks in walls
- Roof slabs have numerous penetrations
- Water + Elemental Sulphur = Sulphuric acid.
- Not a complex repair to execute but
 - Often requires plant outage
 - Must be done quickly
 - Days off-lines are millions of dollars

Chemical Attack – Sulfur Pit



Chemical Attack – Sulfur Trench



Industry Guidance - American Concrete Institute (ACI)

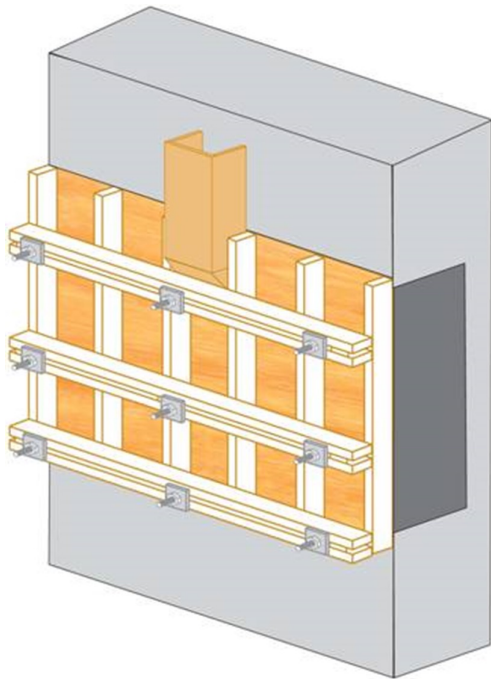
- ACI 201 – Guide to Durable Concrete
 - Low W/C ratios / Use of Pozzolans
- ACI 515 - Guide to Selecting Protective Treatments for Concrete
- Portland Cement Association (PCA) -“Effects of Substances on Concrete and Guide to Protective Treatments”
 - Good list of substances and relative severity
 - Low W/C ratios / Use of Pozzolans
 - Coatings
- Acknowledgment that Portland Cement concrete will be damaged
- Coatings are often ineffective and must be maintained

Geopolymers

- STRUCTURAL has experimented with Geopolymers in the past
 - Inconsistency in performance
 - Flash Set like issues
 - “Never Set” issues
- Assumption was suppliers with limited technical knowledge spot buying (different sources) without appropriate QA/QC specifications or understandings
- The potential for Geopolymers as a concrete repair material in industrial setting is large.
 - I can make Portland cement less permeable, use pozzolans, etc. to help it last longer but minor impacts
- Not having to perform (or delaying) future repairs saves costs

Contractor's perspective for success

- Specifications not too big of any issue
 - STRUCTURAL is also typically the EOR
- Placed like concrete by Form & Pour or Form & Pump techniques (not printed)



Contractor's perspective for success

- Reasonable Compressive Strengths (>40 MPa)
 - For form removal & back in service
- Moisture Retention
 - Will formwork and evaporation retardant be sufficient?
- Good Bond to substate
- Good dimensional stability (shrinkage/cracking)

Contractor's perspective for success

- Consistency in performance
 - If it does the same thing all the time, can get to work
 - Printing analogy
- Slower rather than quick set time/big workability window
- Combined with Rapid Strength Gain
 - Sulfur Pit is an anomaly – Large volume
 - Most application are smaller volumes distributed over many placements
- Production process: mixing binder for minutes, then filler, etc. makes technical sense
 - Harder to make work in field
 - Ability to extend with Coarse Aggregates

Questions
Thank You

gschaefer@structuraltec.com