

Polyurea Waterproofing on Boston's Subway Tunnels.

- Owner is Massachusetts Bay Transit Authority.
- Project consists of three binocular tube tunnels.
- Highly reinforced, mass cast concrete.



Mass cast concrete presents opportunities to the contractor.



AND Problems...



Keys to good projects.

- Training.
- Equipment.
- Planning.
- Execution.

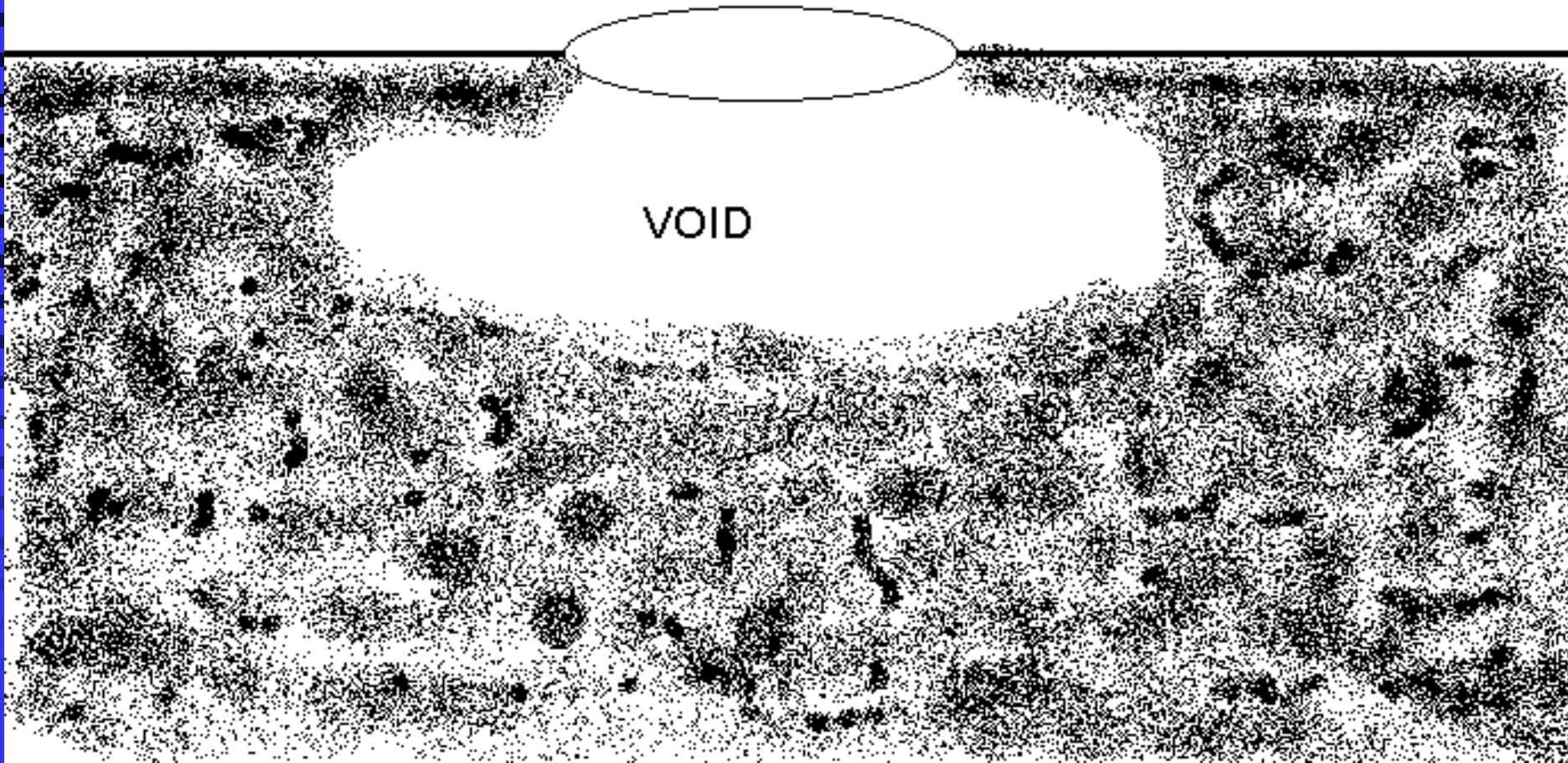
MBTA project emphasis points:

- Filling “voids” and “Bugholes”.
- Anti-corrosion Steel primer.
- Penetrating 100% solids concrete primer.
- Enhancing adhesion of polyurea to primers.

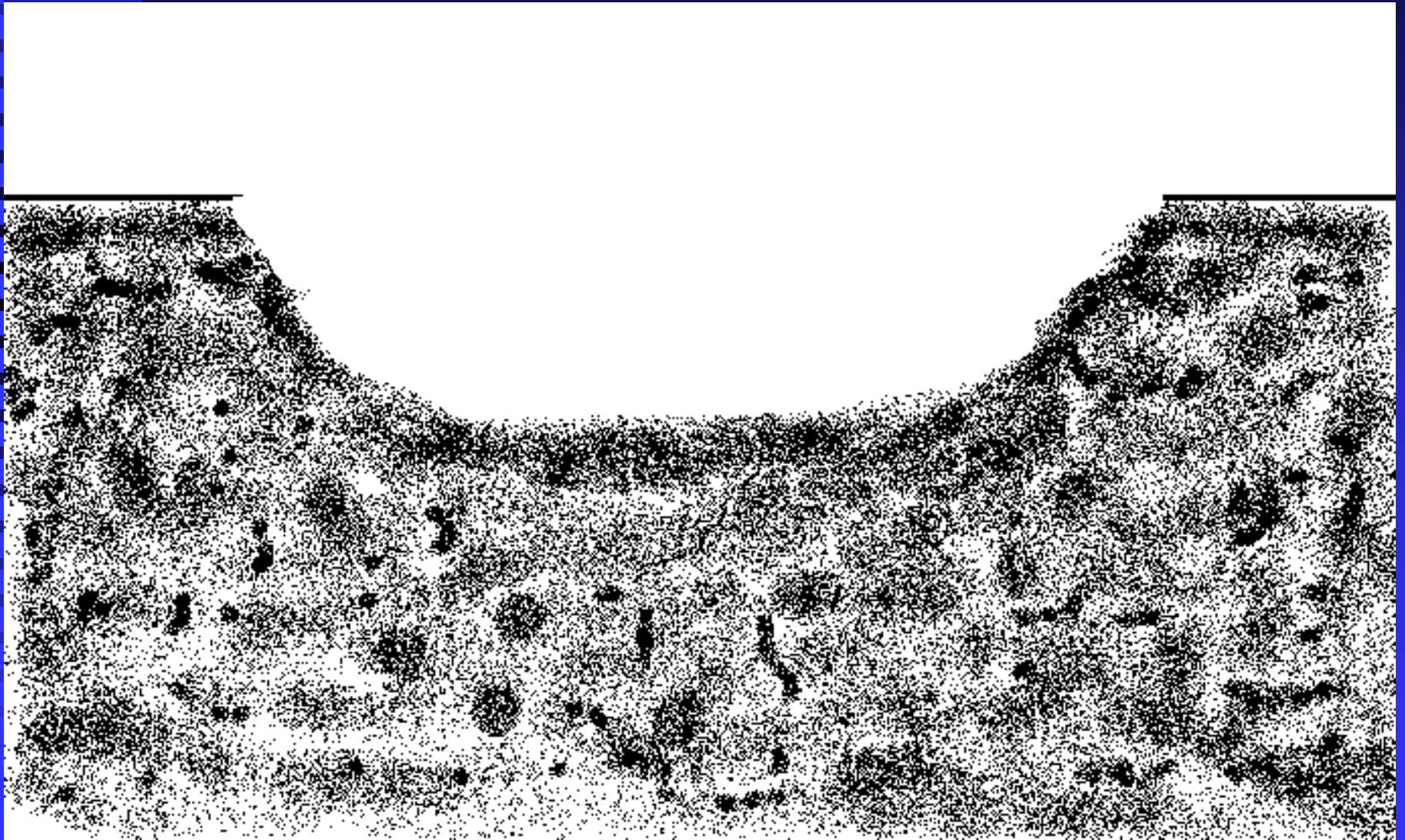
Bugholes and Voids.

OPENING

VOID

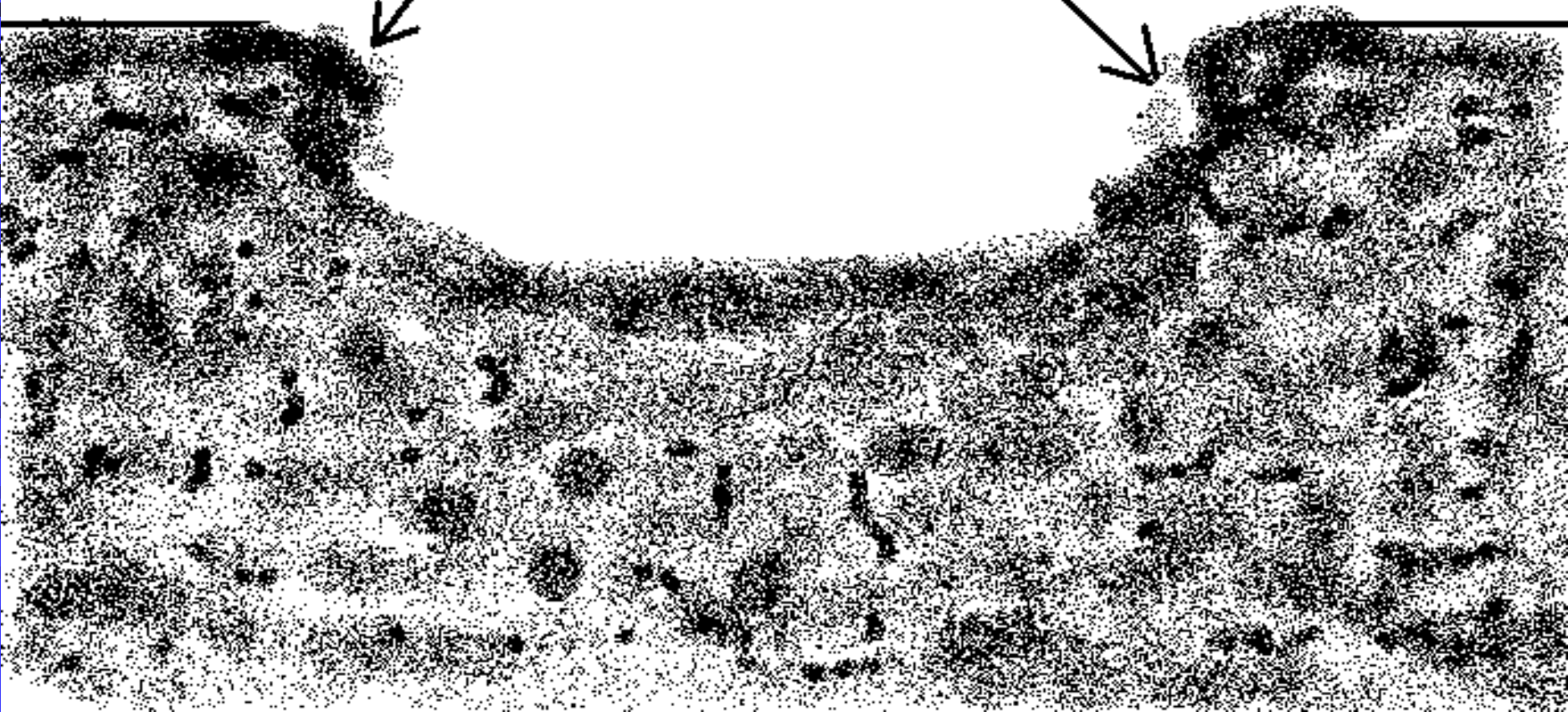


After Water or Sand Blasting...



Not all voids will be as “open”.

Surface irregularities can trap air pockets which will pihole.



How to fill bugholes?

- Thickened primers.
- Use Polyurea.
- “Parge” or fill with a Portland/Sand mixture.

Thickened primers

■ Advantages.

- Fills void.
- Some Adhesion.

■ Disadvantages.

- Labor intensive to apply.
- Removes surface geometry.
- Costly.

Using Polyurea to fill void.

- Advantages.

- Works sometimes.

- Disadvantages.

- Costly.

- Usually will Pinhole.

Parge coating with Portland/Sand Mixture.

■ Advantages.

- Cost effective.
- Retains surface profile.
- Fills voids well.

■ Disadvantages.

- Should be done by trained personnel.
- Labor intensive.

Parge formula:

- 1 part Portland Cement.
- 2 –3 parts Fine “sugar” sand.
- Mix with “Mixing Liquid”.
- Mixing liquid:
 - 1 part SB Bonding Agent.
 - 5 parts potable water

Parging or “Bagging” tunnel wall.



Priming concrete after parging.

- Primer should be 100% solids.
- Low-Viscosity to penetrate.
- Adequate Pot-Life.
- Wide temperature of Application.

Application.



Steel Coating.

- Near White Metal Sandblast.
- 2-3 mil profile.
- Corrosion resistant primer.
- Polyurea coating.

Sandblast to provide a good profile.



Prime the Steel.





Application.











Adhesion Testing.

- ASTM D-4541
- Torque meter that pulls off aluminum buttons glued to coating.

Elcometer adhesion button.



Elcometer Adhesion tester.



Elcometer Adhesion Results. Tube 1.

Test #1	600 psi	Adhesive Failure
Test #2	300 psi	Adhesive Failure
Test #3	600 psi	Adhesive Failure
Test #4	300 psi	Adhesive Failure

Elcometer Results: West Wall. Tube 1.

Test # 1	400 psi	Concrete Failure
Test # 2 Steel Base-plate	950 psi	Adhesive failure
Test # 3	550 psi	Concrete Failure
Test # 4	600 psi	Concrete Failure
Test # 5	600 psi	Adhesive Failure

Elcometer results: Roof Deck. Tube 1.

Test # 1	650 psi	Adhesive Failure
Test # 2	800 psi	Adhesive Failure
Test # 3	850 psi	Adhesive Failure
Test # 4 Steel-Plate	850 psi	Adhesive Failure

Elcometer Results. East Wall Tube 2.

Test # 1	800 psi	Concrete Fail
Test # 2	700 psi	Adhesive Fail
Test # 3	900 psi	Adhesive Fail

Elcometer Results. West Wall Tube 2.

Test # 1	600 psi	Adhesive Fail
Test # 2	400 psi	Adhesive Fail
Test # 3	200 psi	Adhesive Fail

Tube 2. West Wall. (con't).

Test # 1	675 psi	Concrete Fail
Test # 2	475 psi	Concrete Fail
Test # 3 Steel base-plate	1000 psi	Adhesive Fail
Test # 4	550 psi	Concrete Fail

Tube 2. Roof Deck.

Test # 1	600 psi	Concrete Fail
Test # 2	625 psi	Concrete Fail
Test # 3	700 psi	Adhesive Fail
Test # 4	450 psi	Adhesive Fail
Test # 5	650 psi	Concrete Fail

Tube 3. East Wall.

Test # 1	200 psi	Concrete Fail
Test # 2	450 psi	Adhesive Fail
Test # 3	750 psi	Concrete Fail
Test # 4	400 psi	Concrete Fail
Test # 5	600 psi	Concrete Fail
Test # 6. Steel Base-plate.	>1000 psi	Adhesive Fail

Tube 3. West Wall.

Test # 1	675 psi	Concrete Fail
Test # 2	475 psi	Concrete Fail
Test # 3, Steel Base-plate	>1000 psi	Cohesive Fail
Test # 4	550 psi	Concrete Fail

Tube 3. Roof Deck.

Test # 1	600 psi	Concrete Fail
Test # 2	625 psi	Concrete Fail
Test # 3	700 psi	Adhesive Fail
Test # 4	450 psi	Adhesive Fail
Test # 5	650 psi	Concrete Fail

Watertight doors cap ends of tunnels.



To Summarize...

- Concrete coating presents problems.
- Main problem is voids that cause “pinholes”.
- Most economical way to fill voids is using a parge coating of sand and portland cement.
- Follow using a low viscosity penetrating primer.
- Steel coating should be a white metal blast and then a corrosion resistant primer.



Thank You.

