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…

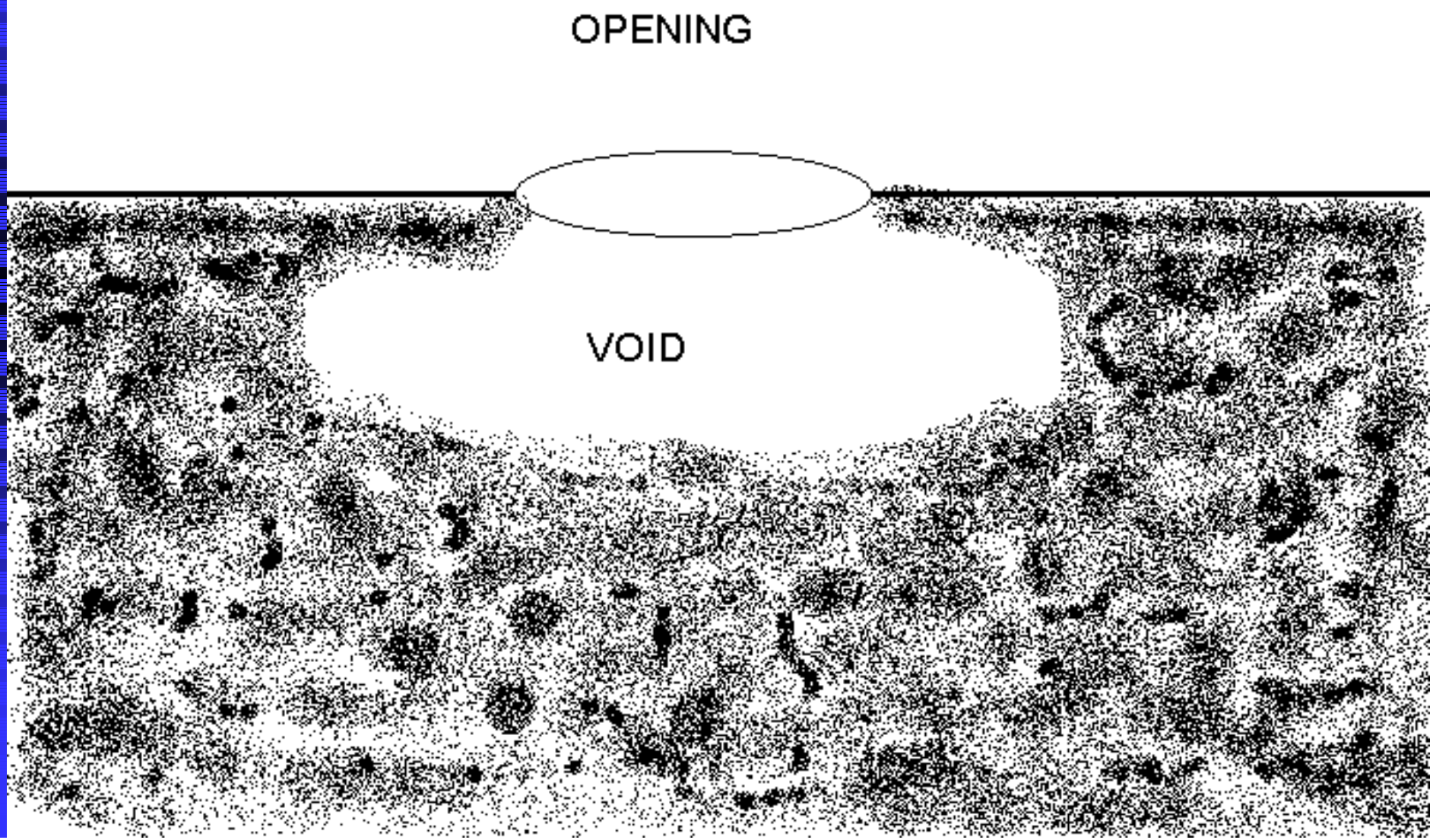
Keys to good projects.

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

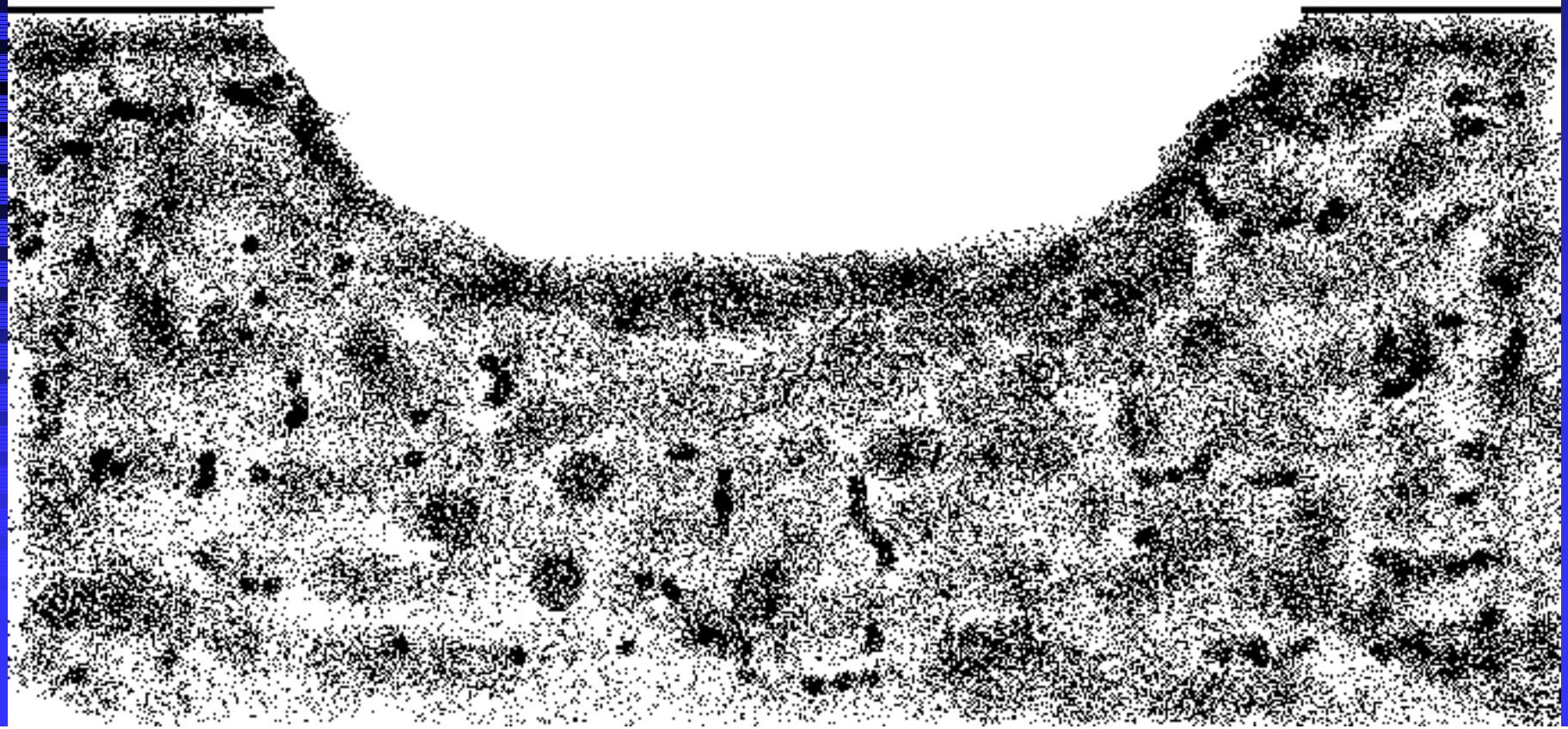
MBTA project emphasis points:

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

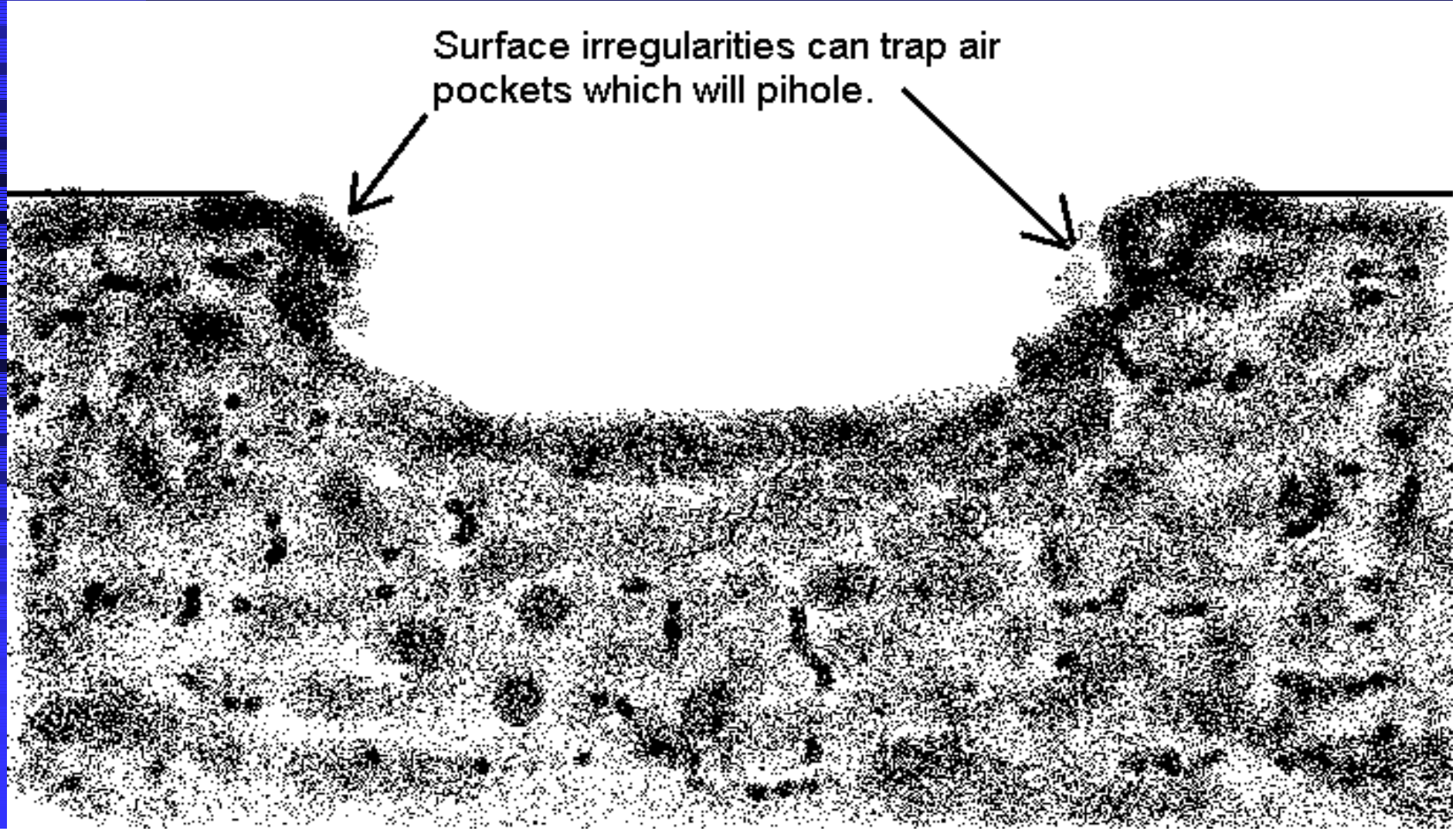
Bugholes and Voids.



After Water or Sand Blasting…



Not all voids will be as “open”.



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.