



Furnace Life Extension Techniques
GlassPex
Mumbai, India

Furnace Life Extension

Proactive/Reactive

- Proactive maintenance plan and culture
 - Periodic scheduled inspections
 - Campaign goal review
 - Maintenance Planning
 - Hot Repairs
 - Contingency Planning

Smaller scope repairs more often

Allows maximum operating life on depreciated asset

Furnace remains in operation until no longer cost effective

Capital spend avoidance

Maximizes profitability

Furnace Life Extension

Proactive/Reactive

- Reactive maintenance plan and culture
 - Random inspections – internal/external
 - Limited campaign goal review
 - Maintenance is justified based on production needs
 - Hot Repair spend is limited
 - Contingency planning is based on need

Larger scope repairs that require funding

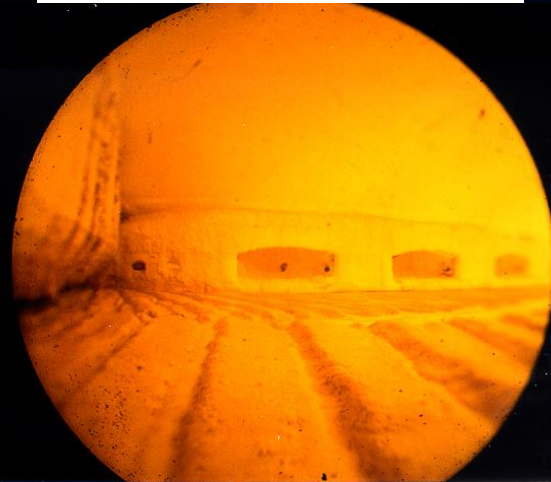
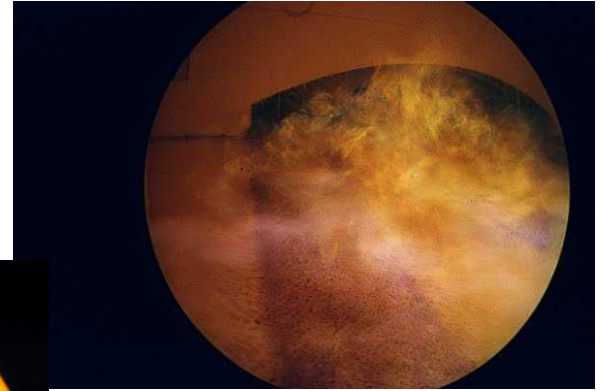
Campaign goals are fixed, or moving, as finances dictate

Mitigates possibility of capital spend

Profitability Is not maximized

Inspections

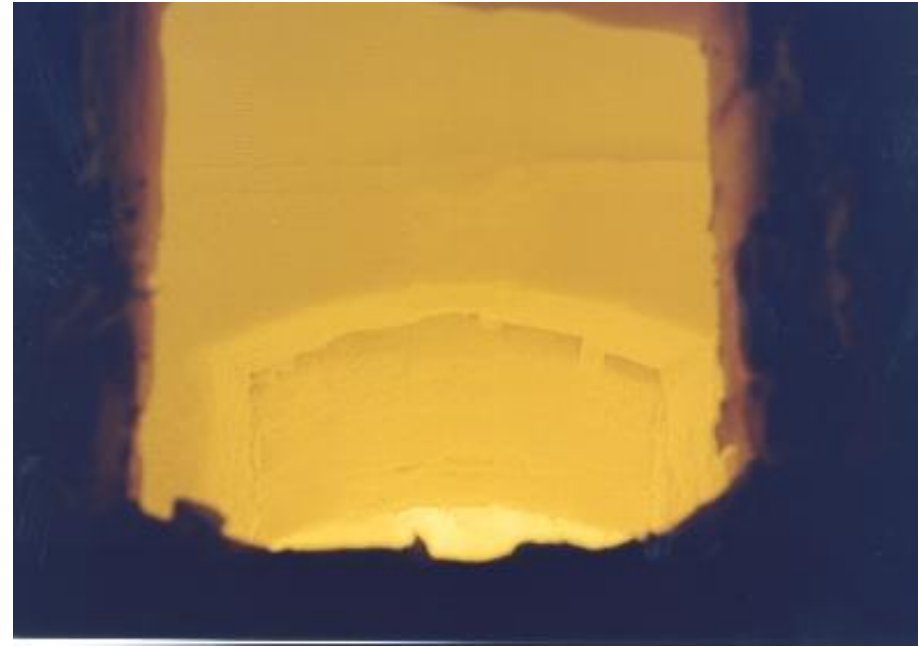
Proactive - Assessment of furnace condition



Proactive – Port Arch Sealing/Repair



Before



After

Proactive – Sealing Skews



Before



After

Proactive: Port floor and/or Port Sill Damage

Solution: Port Floor Restoration

View From Regenerator



Dam Complete – Before Casting



Casting Completed

Proactive: Holes in Melter or Regenerator Crowns

Solution: Crown Overcoating



Crown insulation package is removed and the crown is cleaned of debris.

A skew channel is installed to support material.



A fused silica shotcast material is applied to the entire surface of the crown structure to be addressed skew to skew till 6 to 9 inches of thickness.

Proactive: Checker Blockage

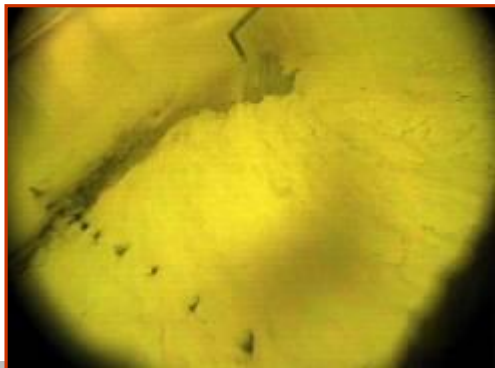
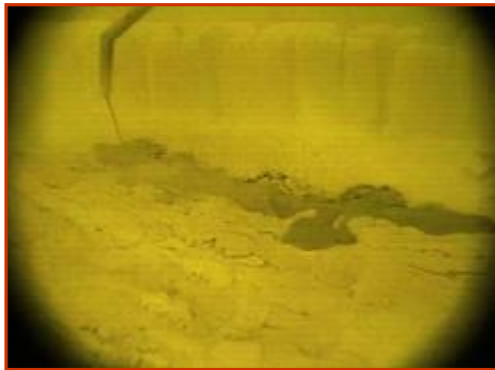
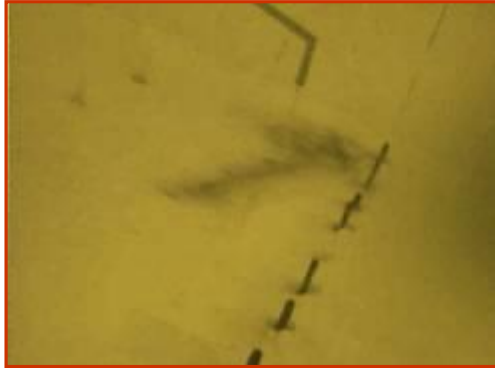


Checker Cleaning in Progress

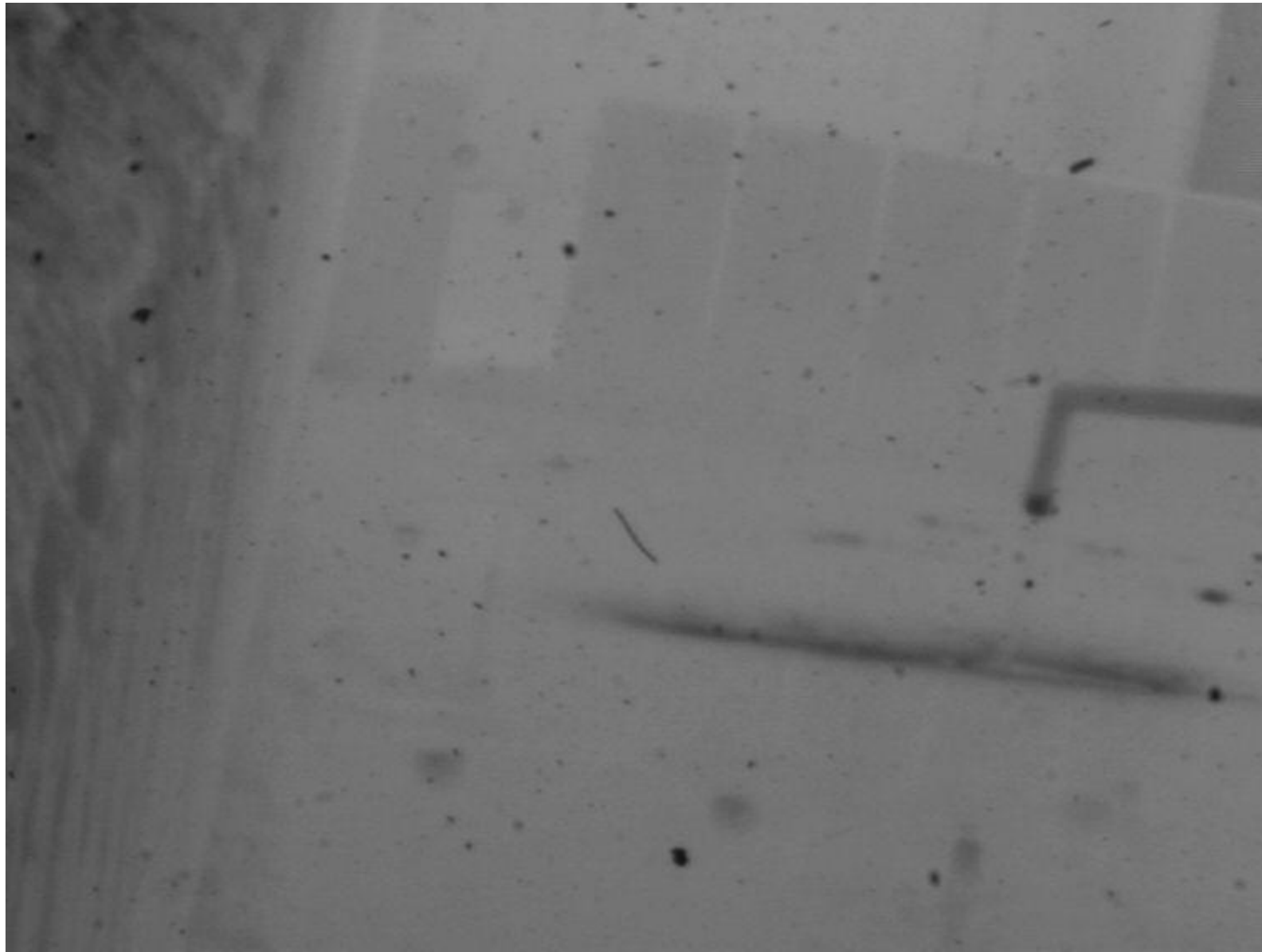
Solution: Checker Cleaning

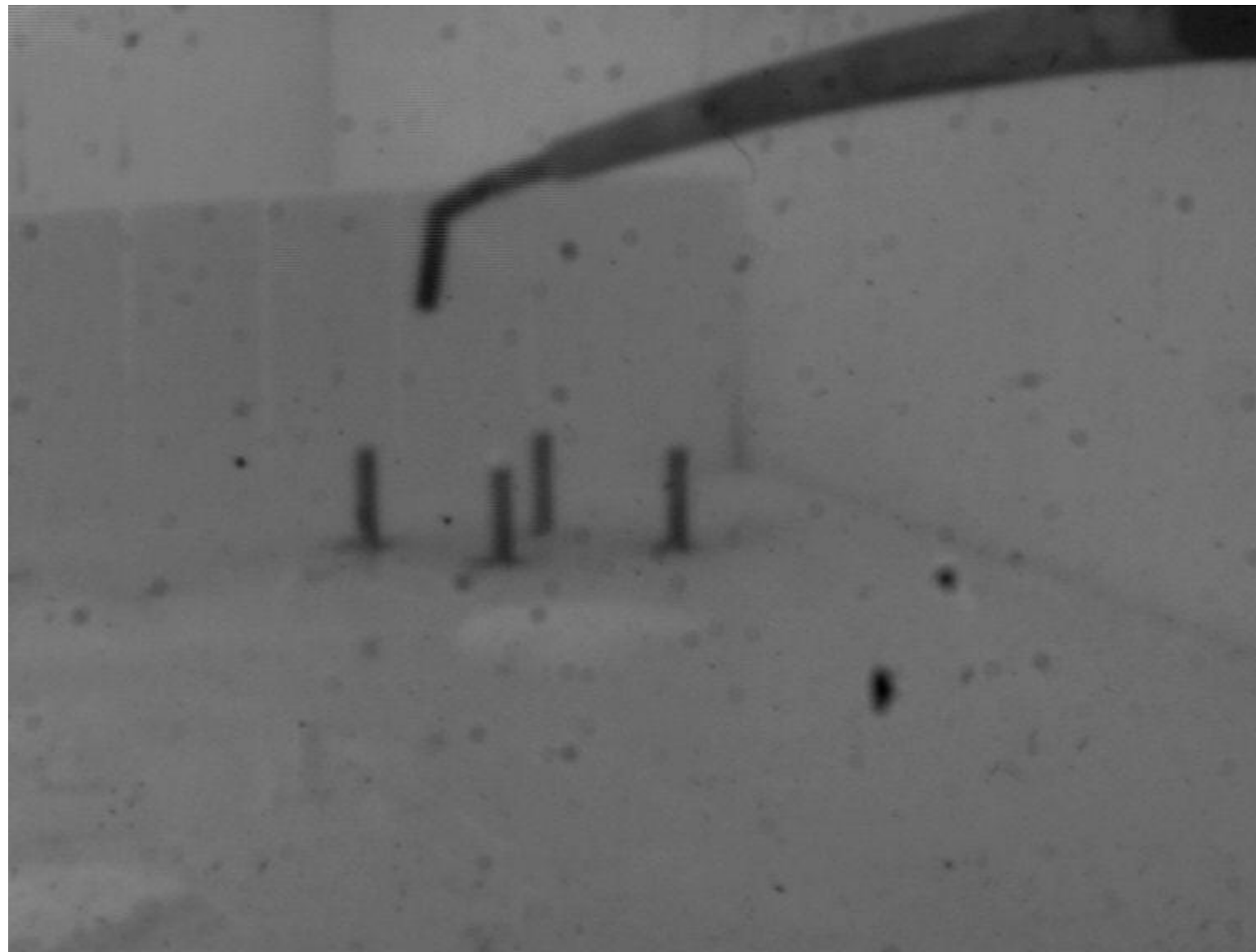
- Water-cooled lances are inserted to use either high pressure air, high pressure air with blast media, high pressure air with low quantities of water introduced to remove or shock and remove blockages on the top courses of checkers.
- This is only effective on the top courses (courses 1 through 3).
- It breaks up the blockage and blows it down the individual flues to provide a clean air flow.
- The Lancescope™ is critical for this process to ensure the flues are open down below the surface.

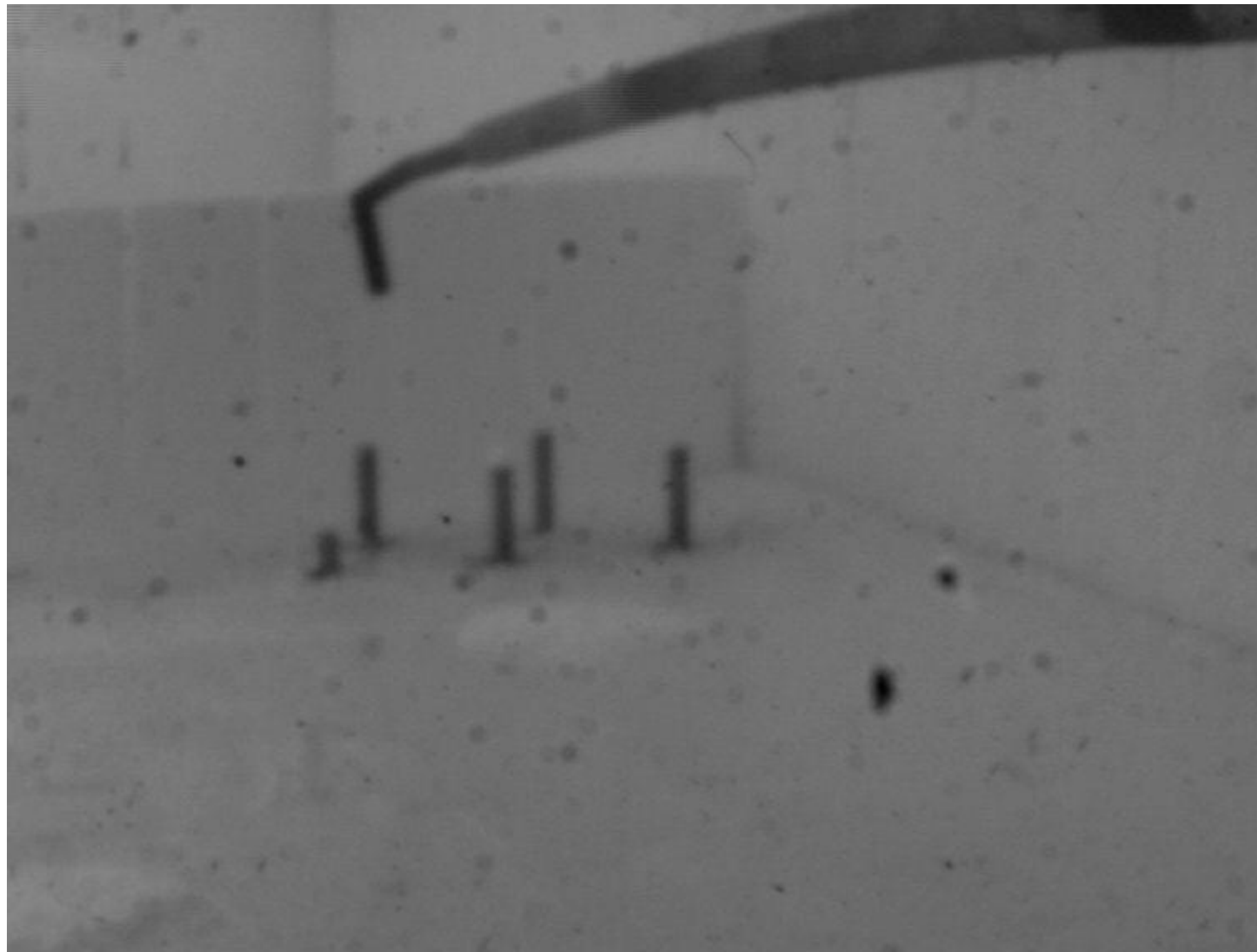
Proactive/Reactive: Hot Bottom Repair Process

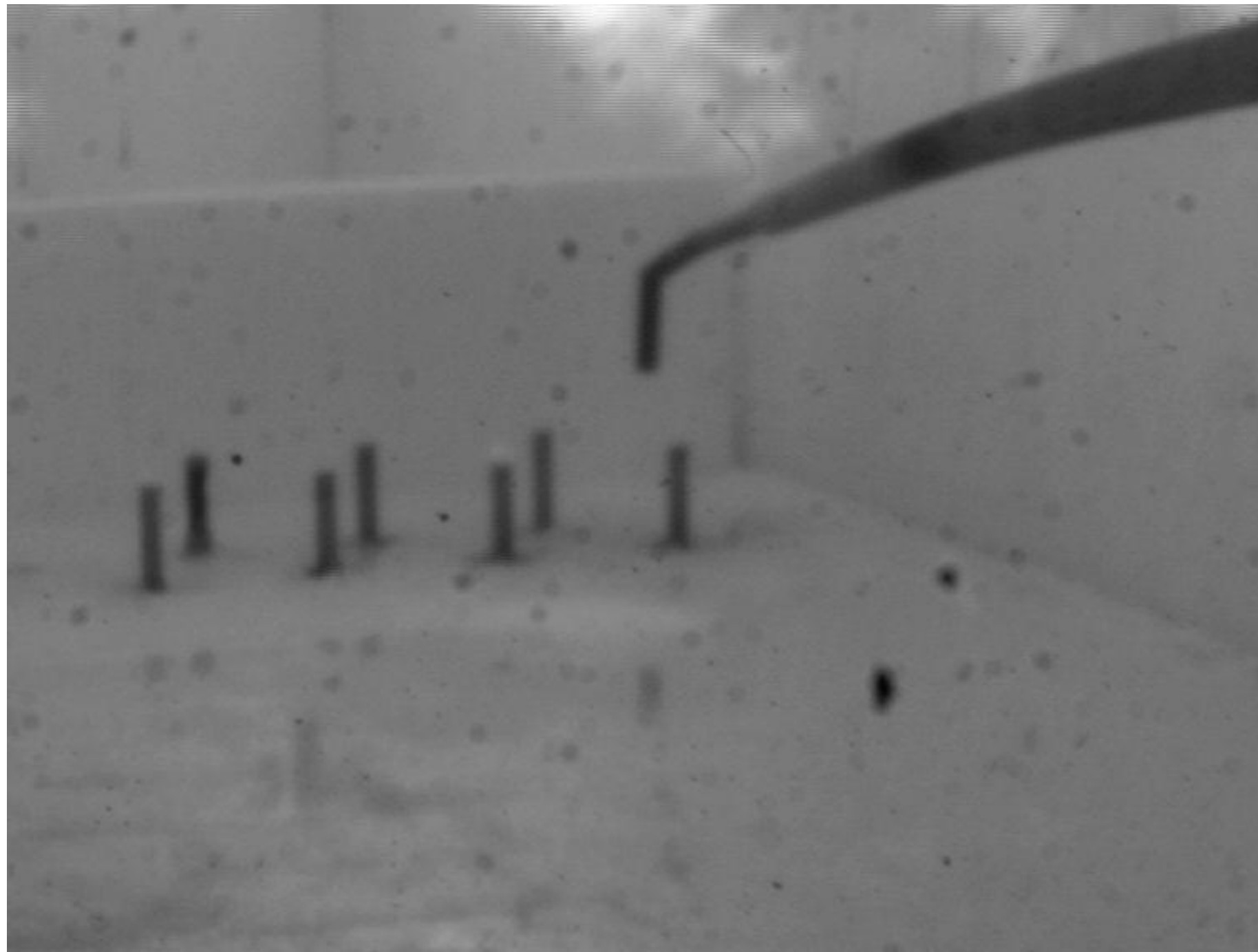


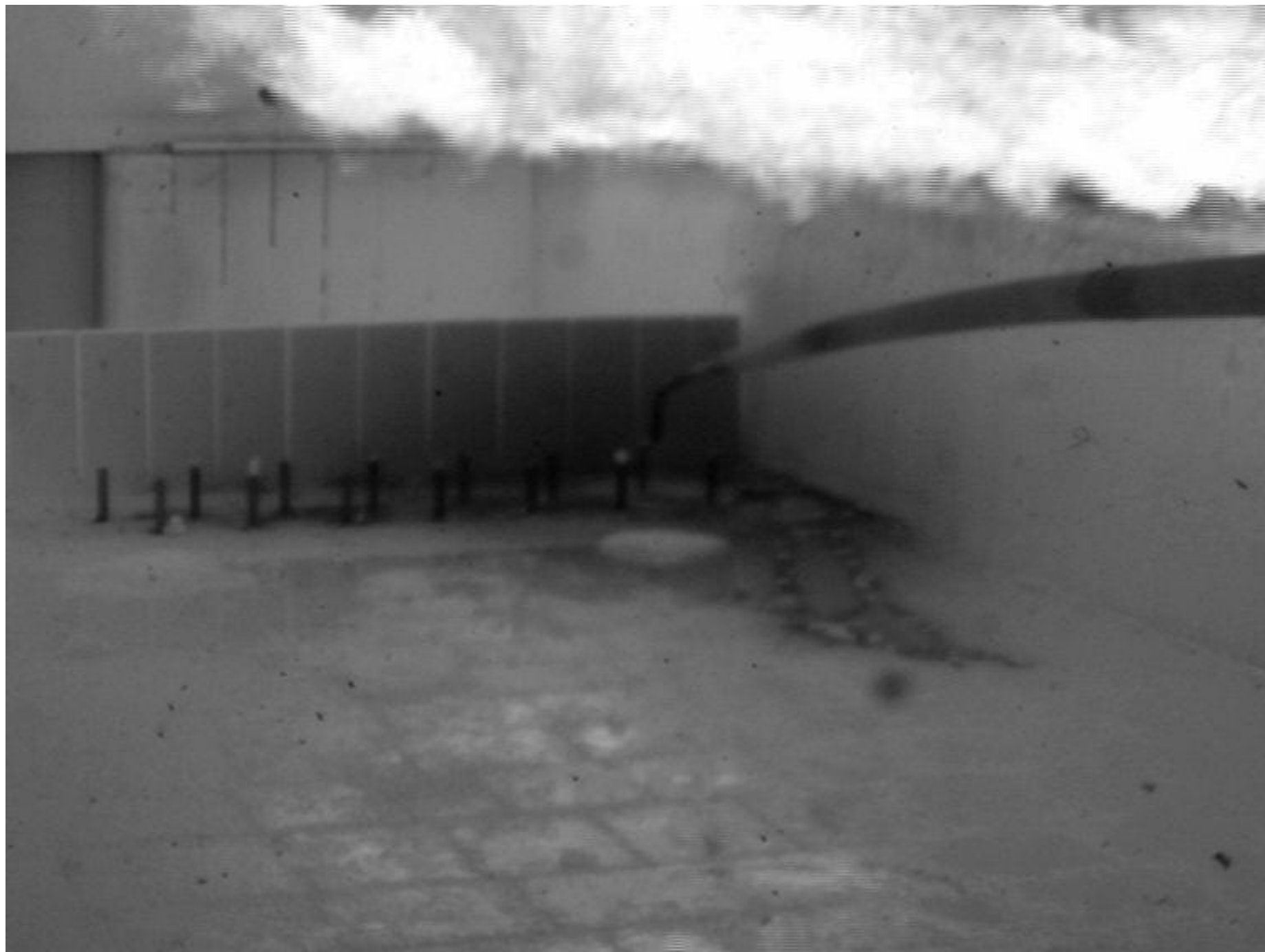
- Furnace is drained
- Damaged area is cleaned
- AZS refractory material injected using specialized lances, re-establishing furnace bottom stability
- Process undertaken with aid of endoscopes, lance cameras and TV monitors as needed
- Usually with minimal or no contamination

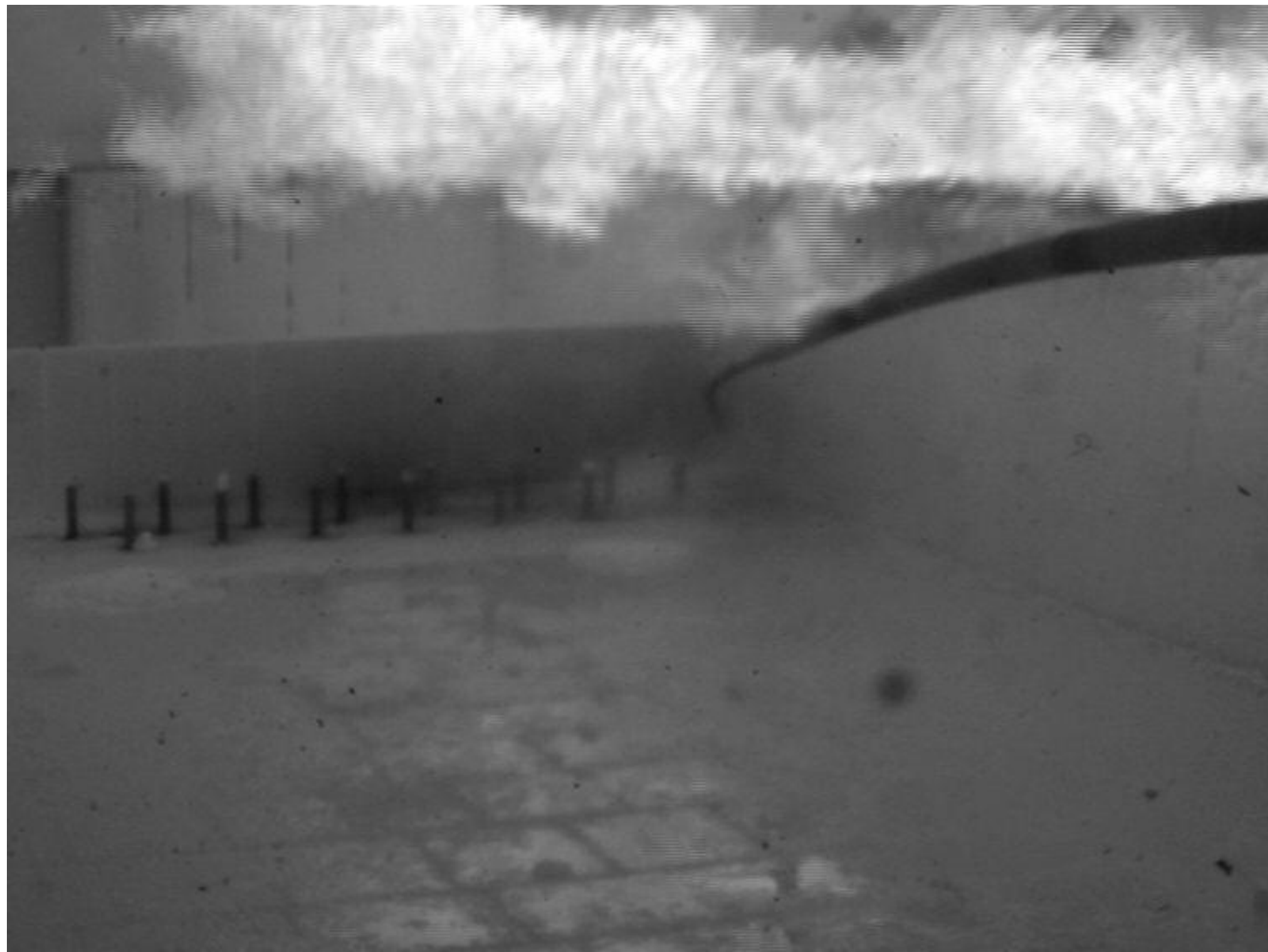


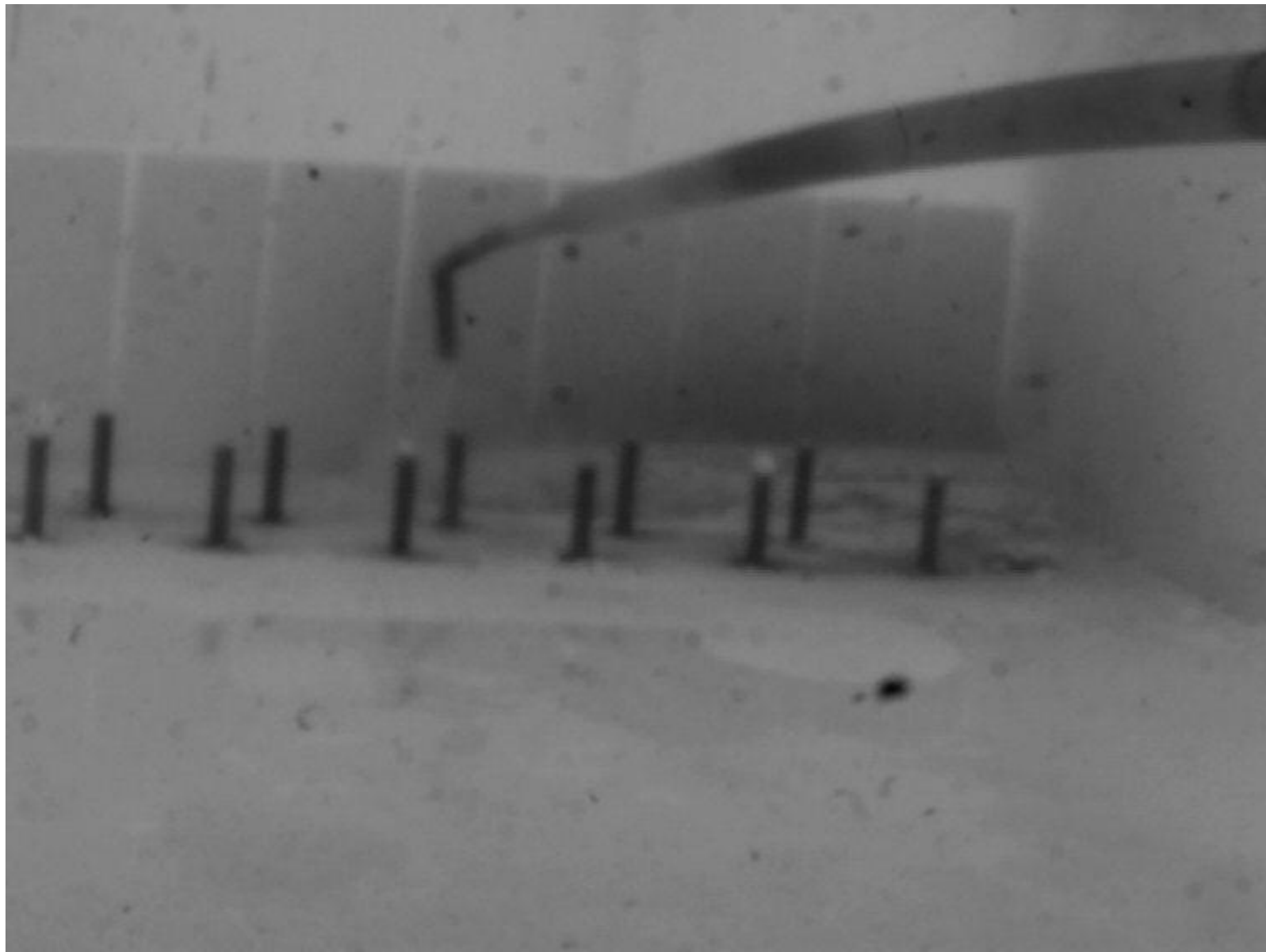


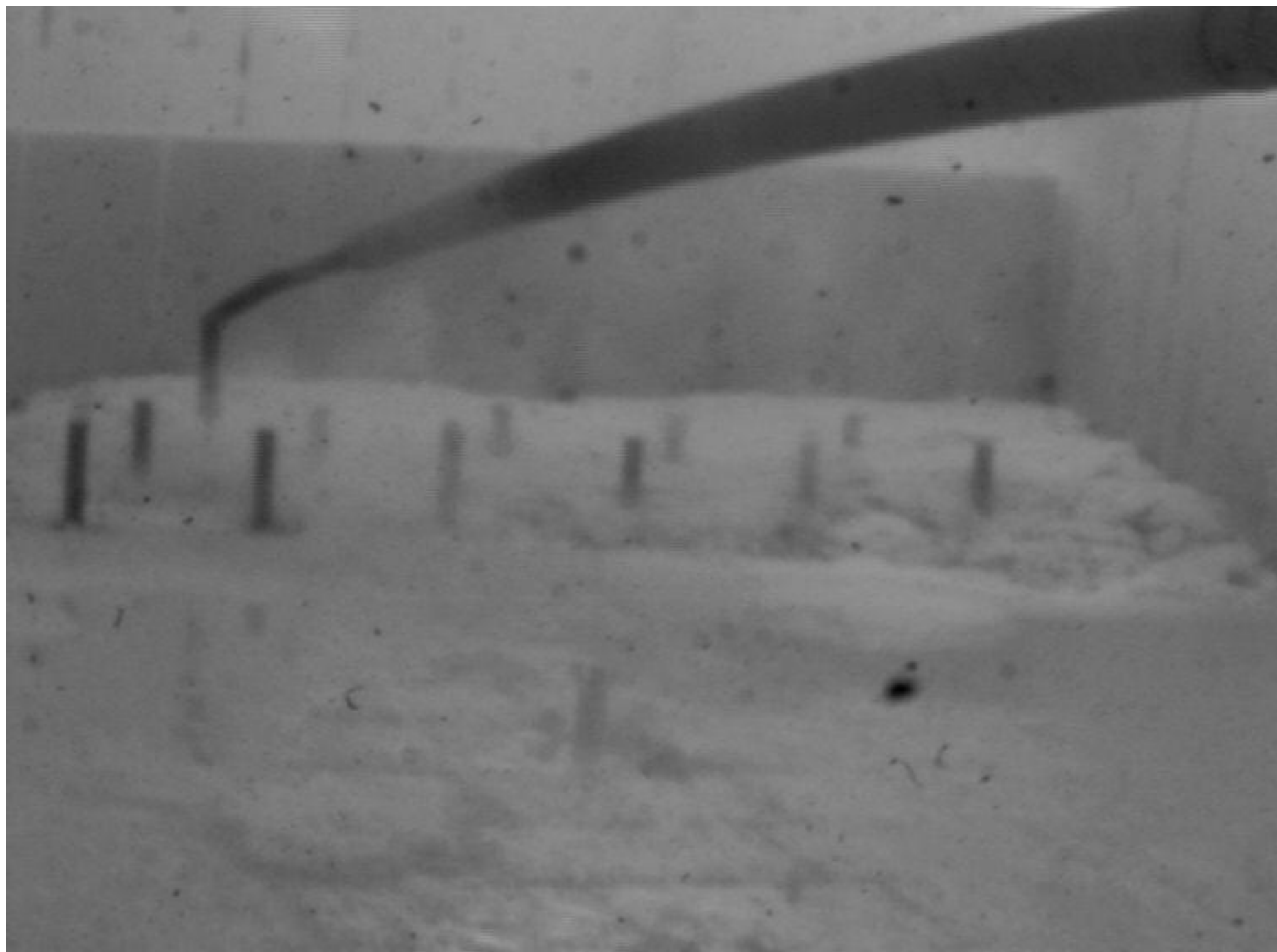


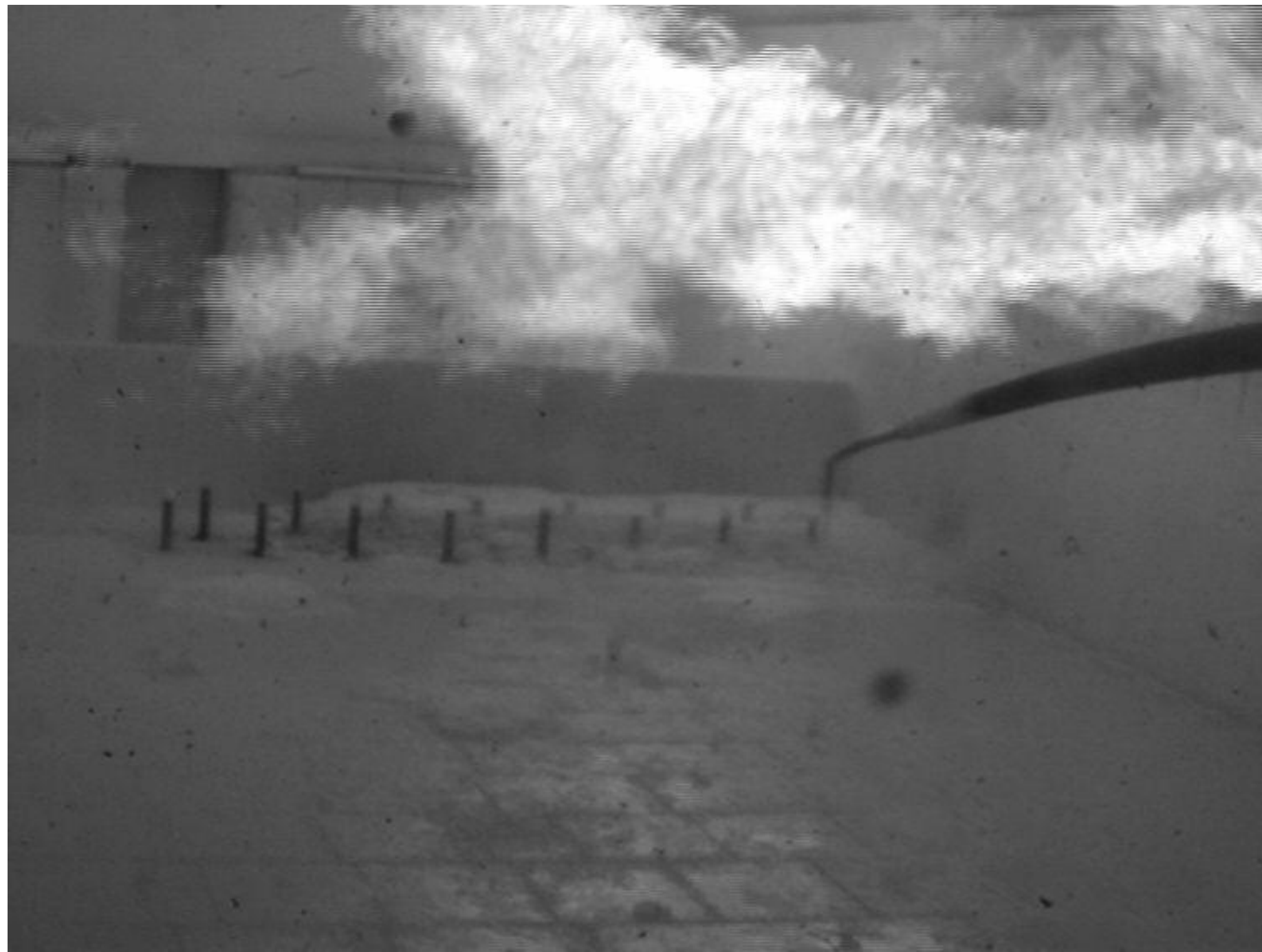


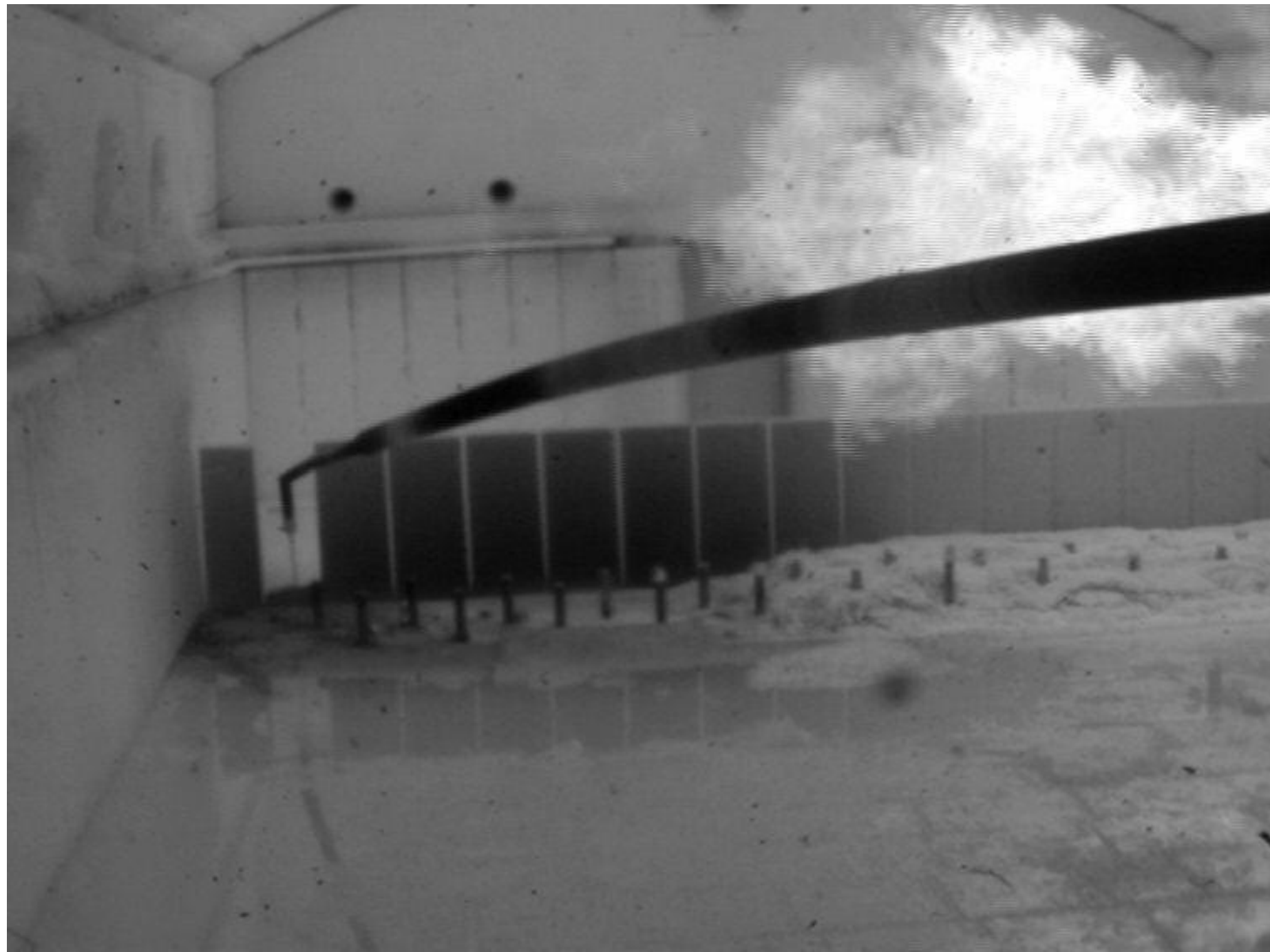


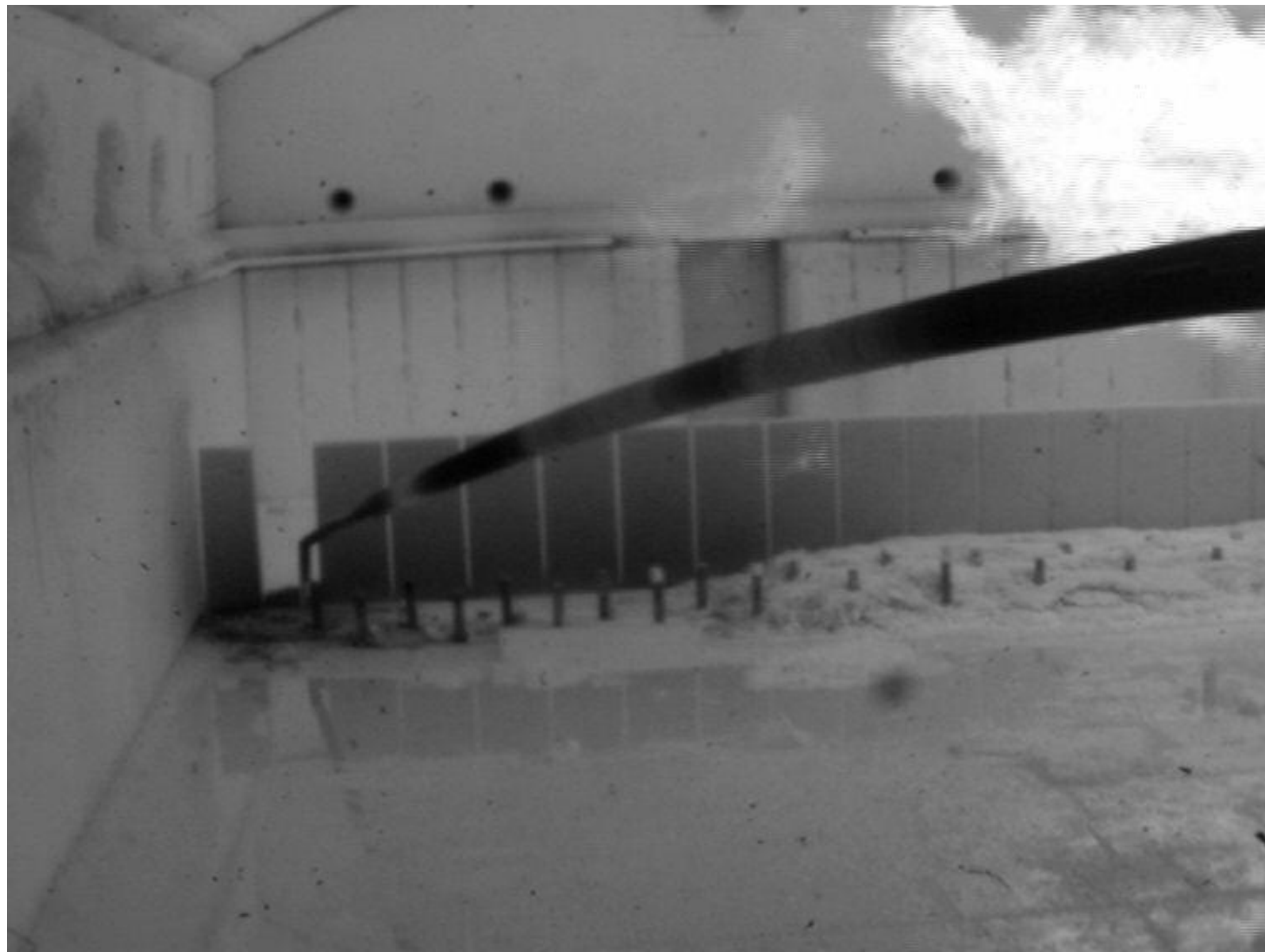


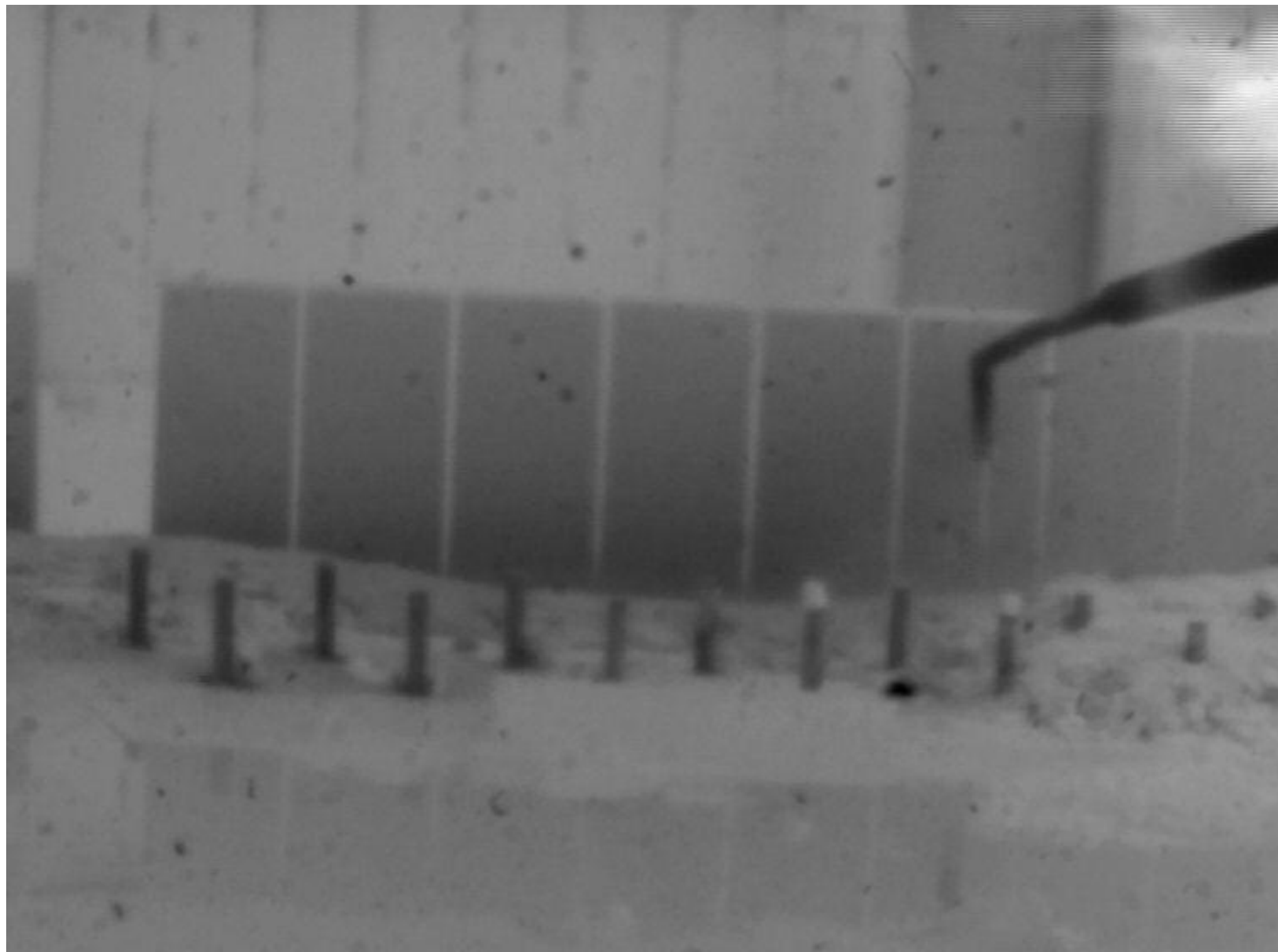


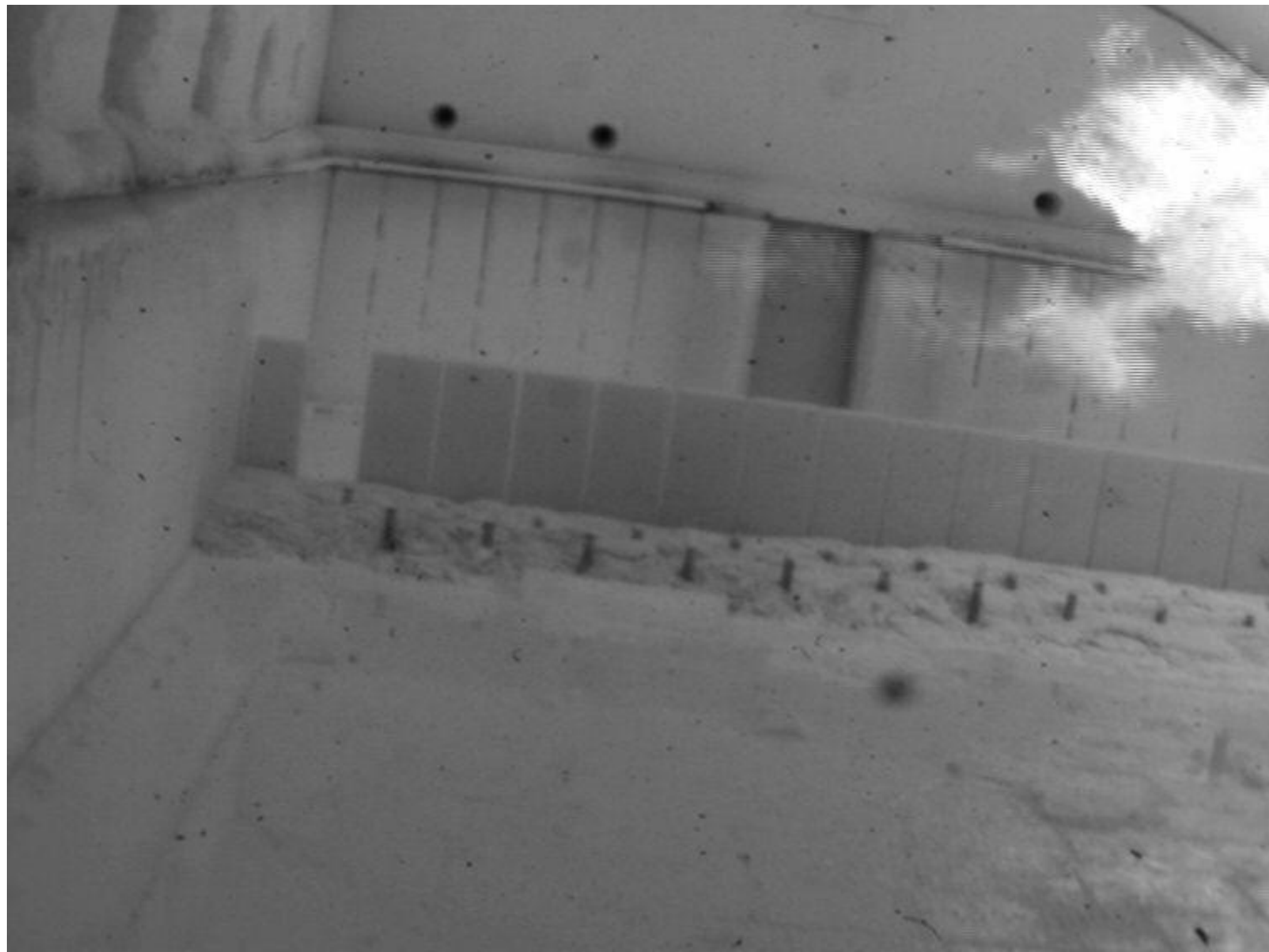


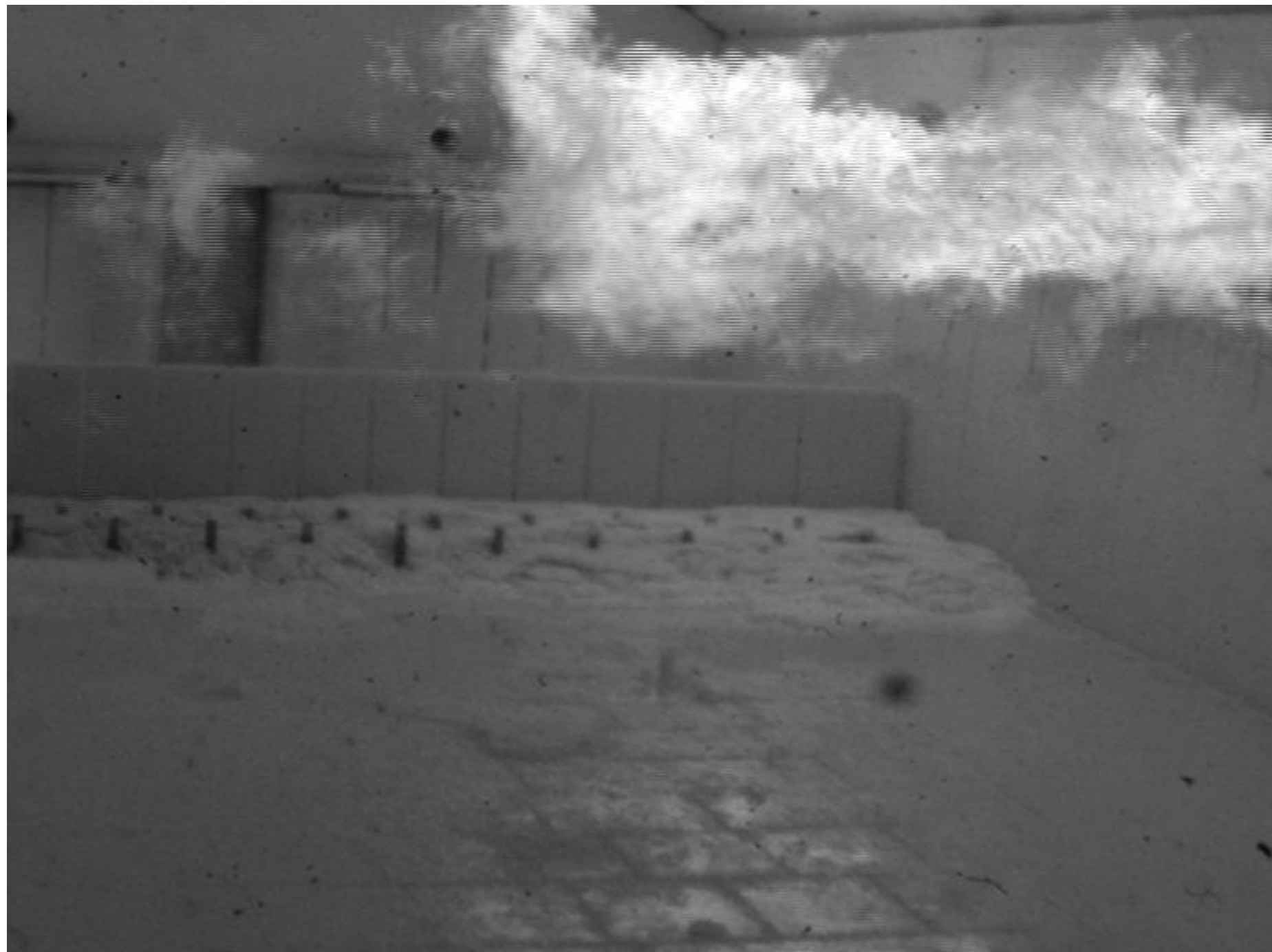


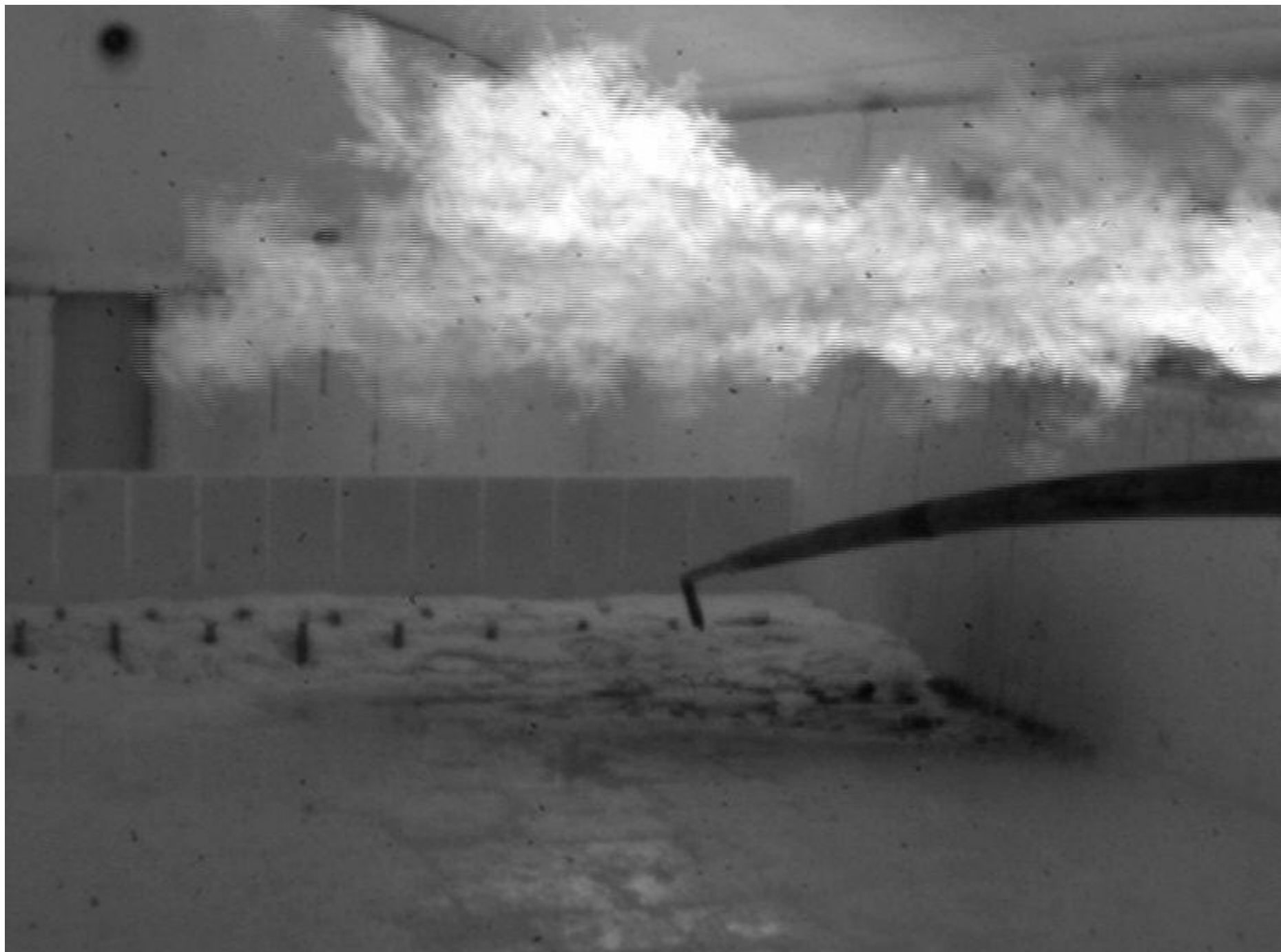


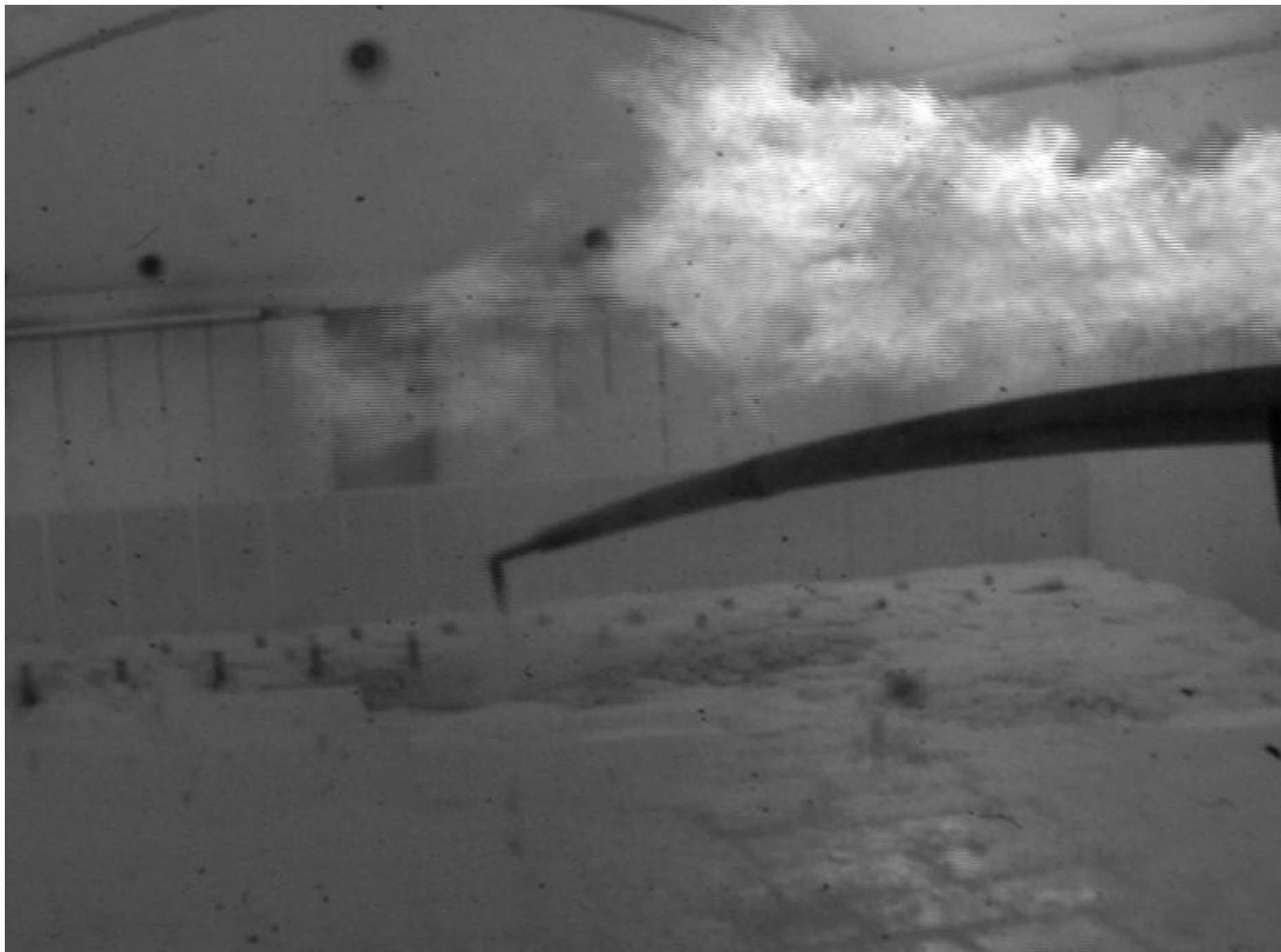


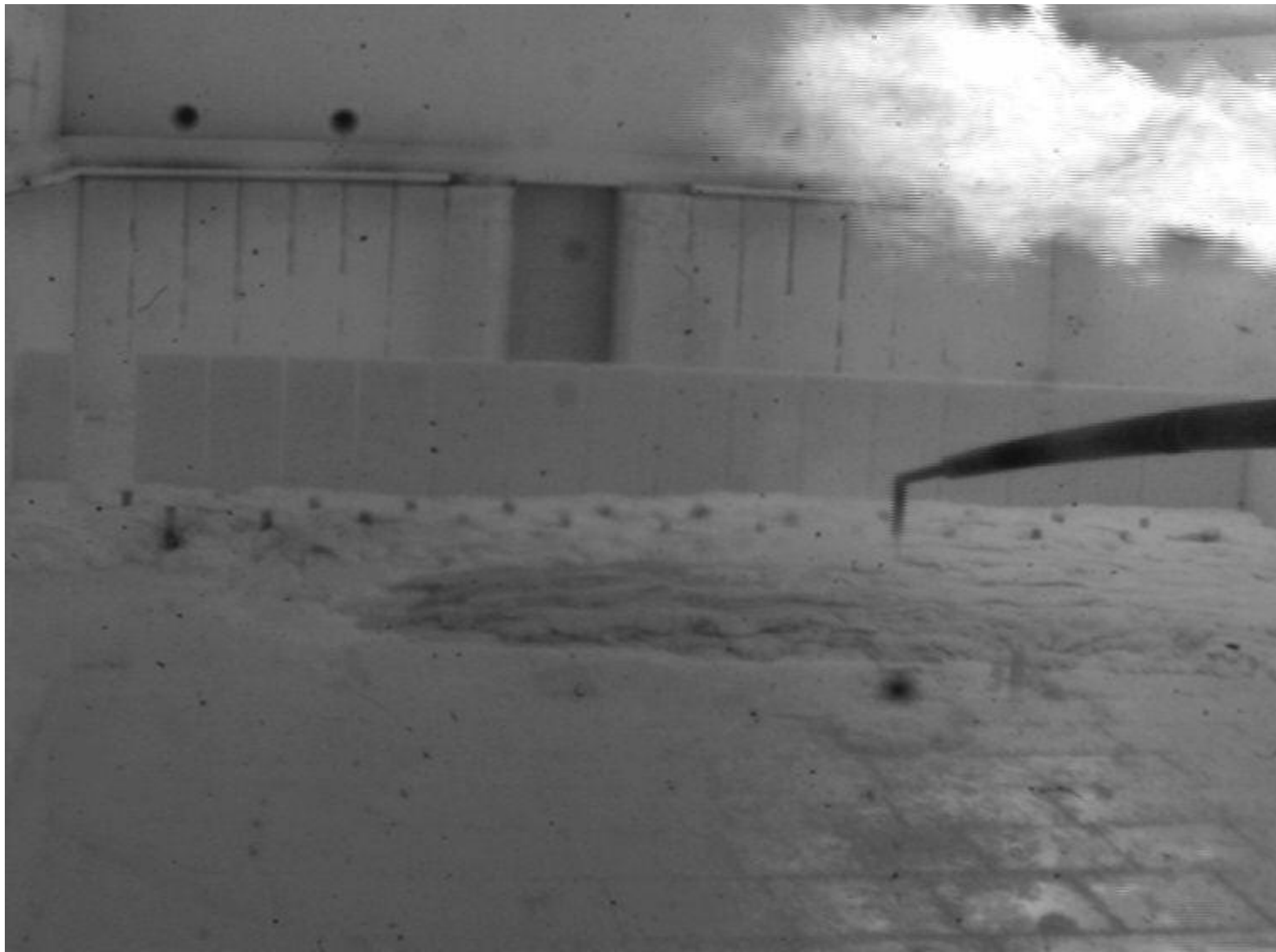


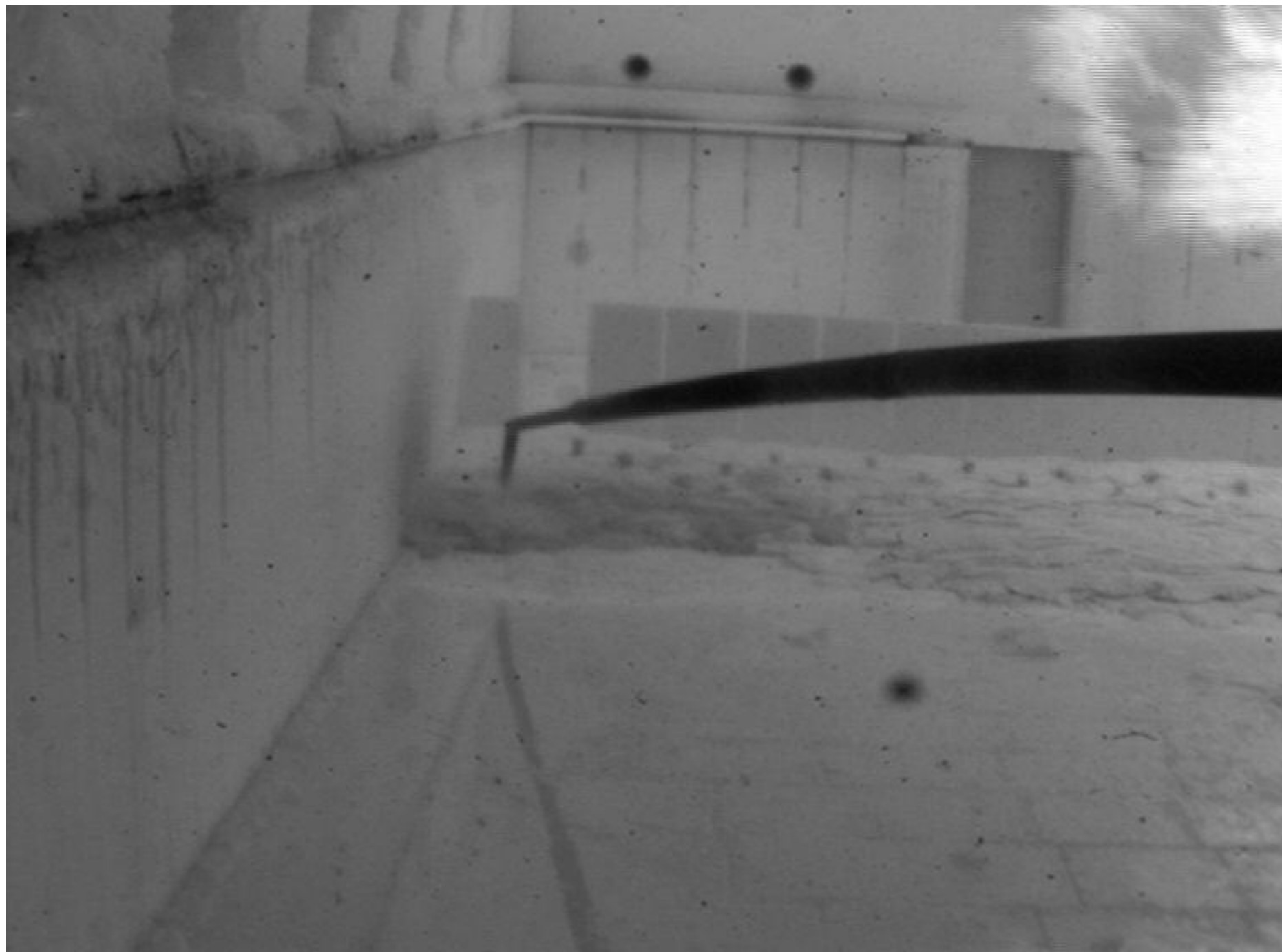




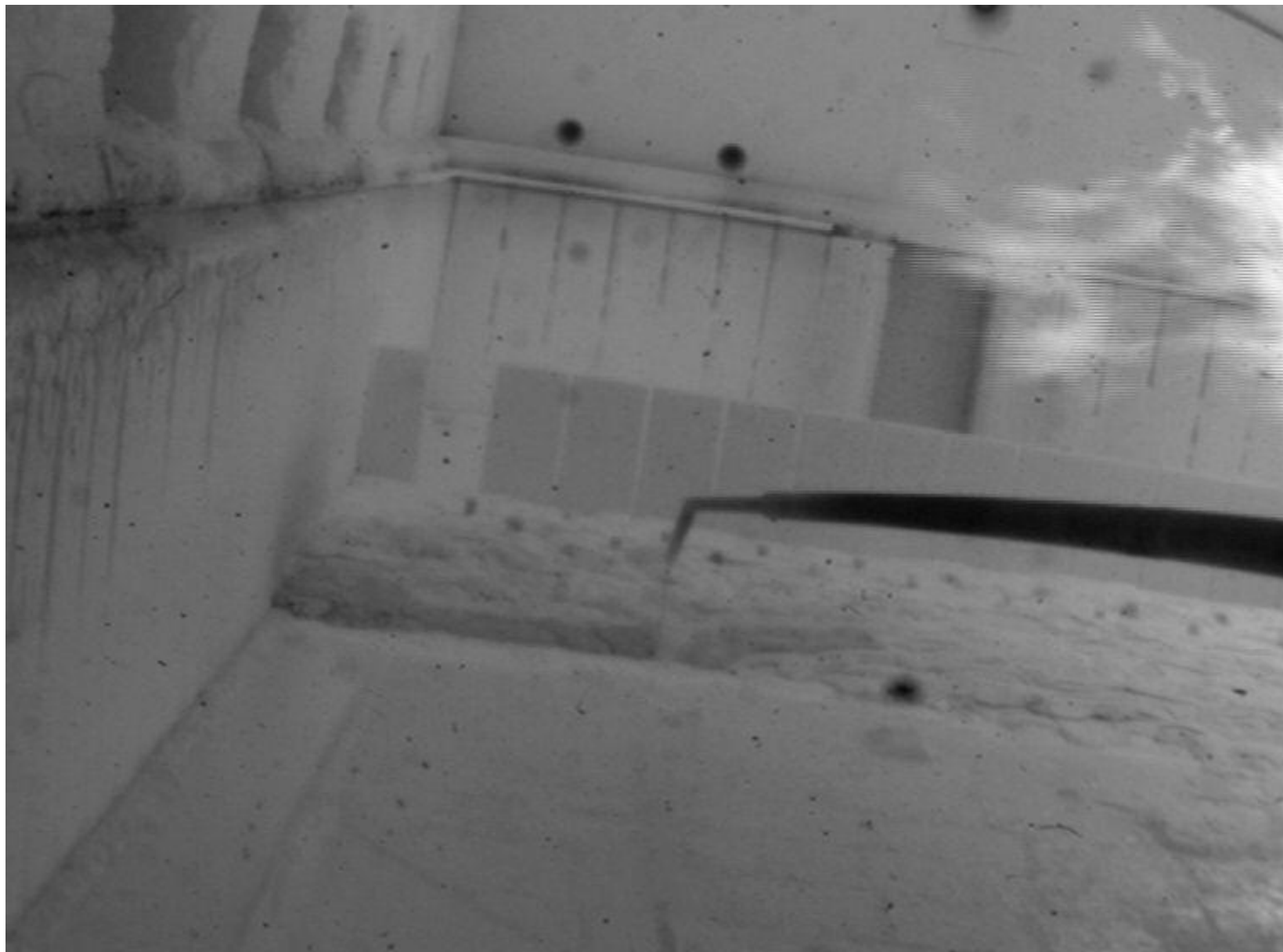


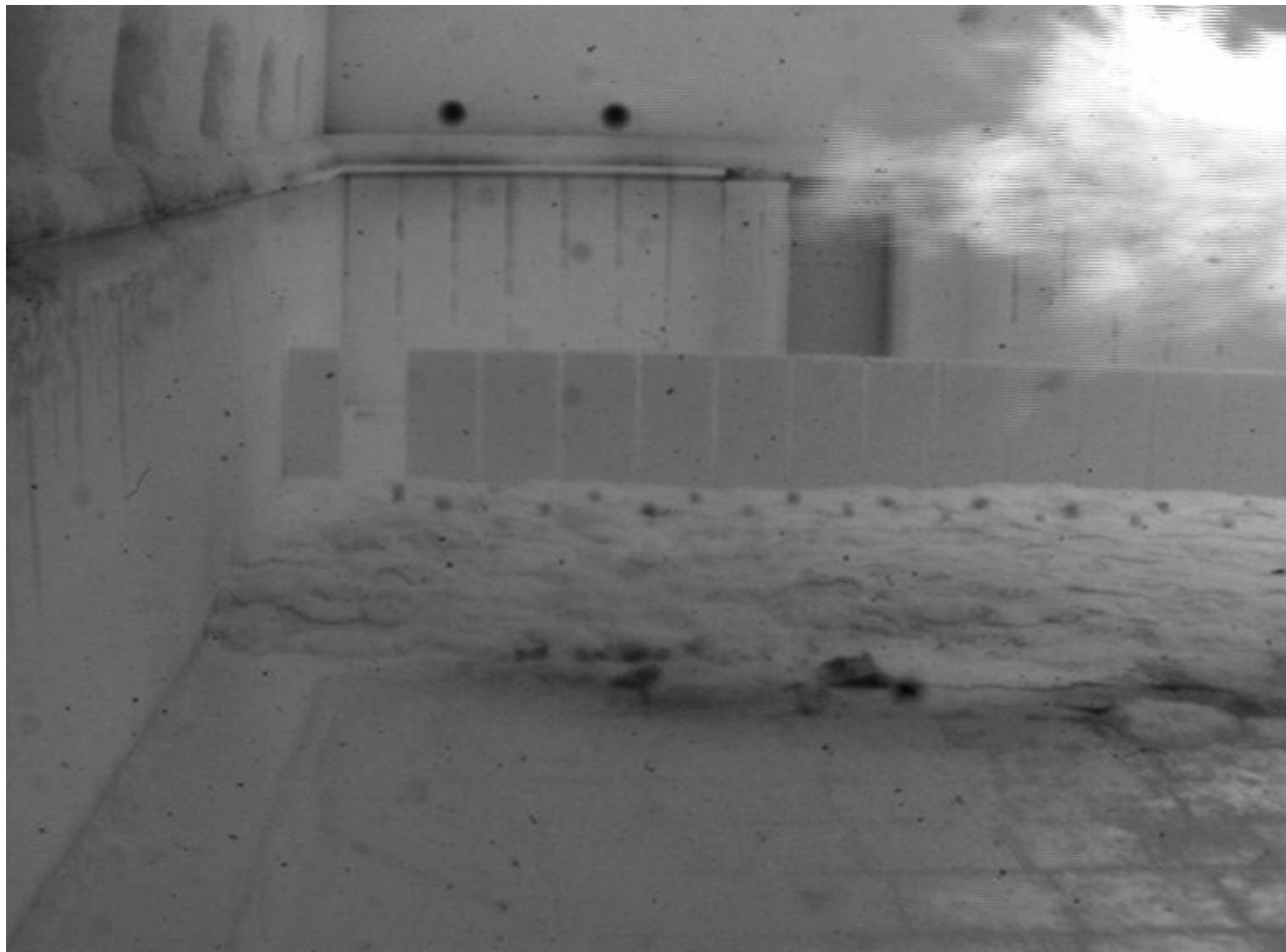


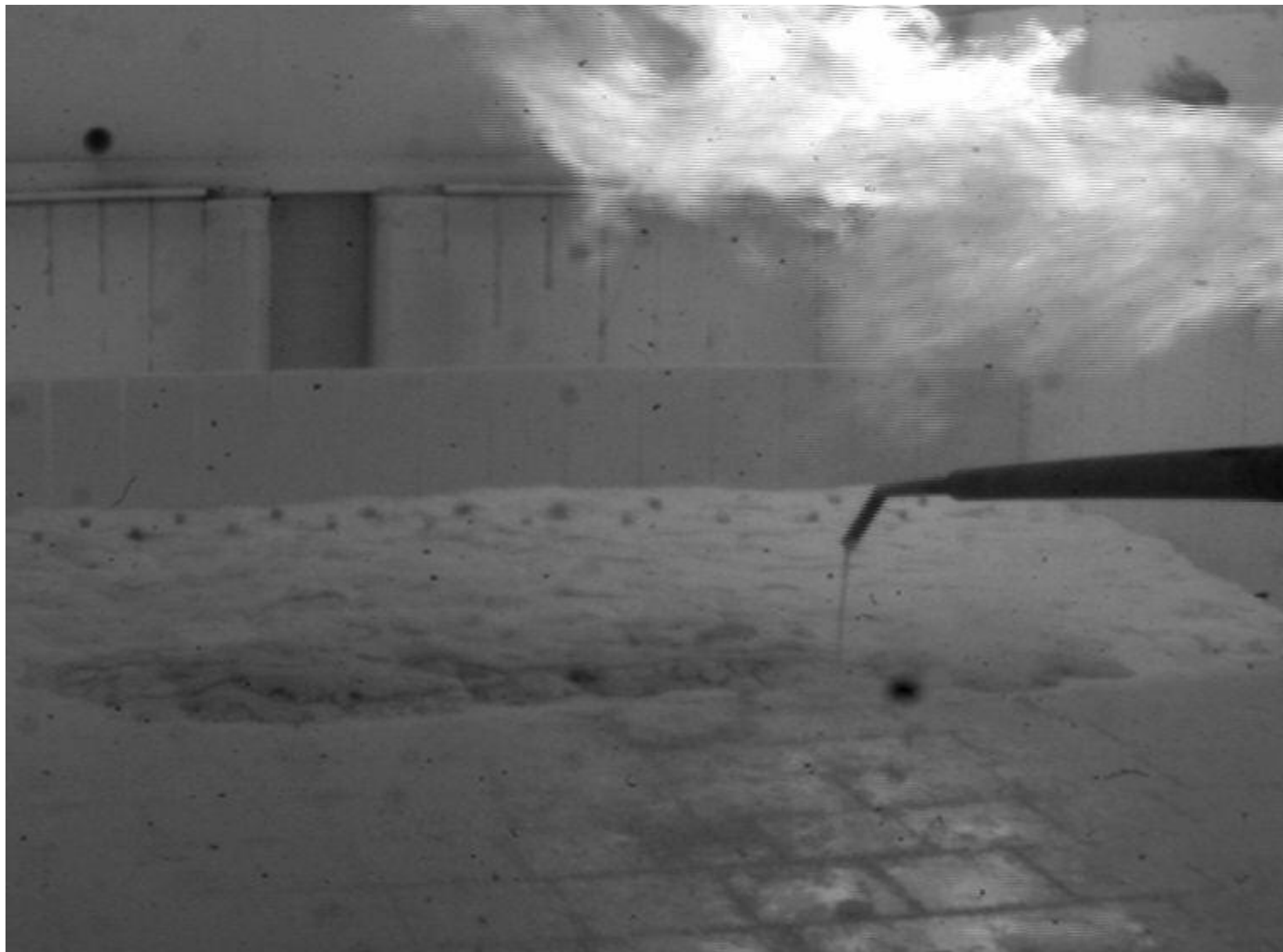


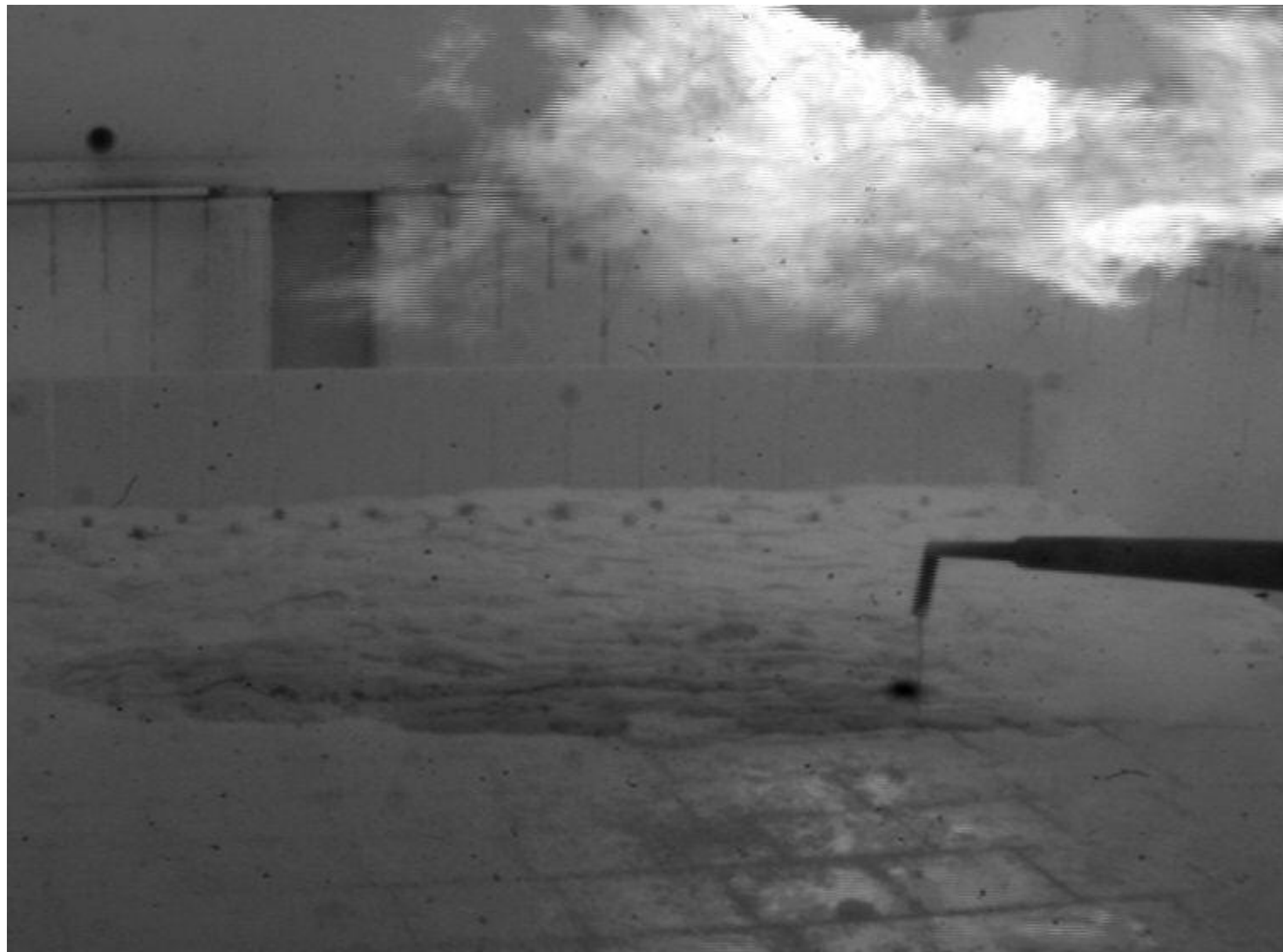






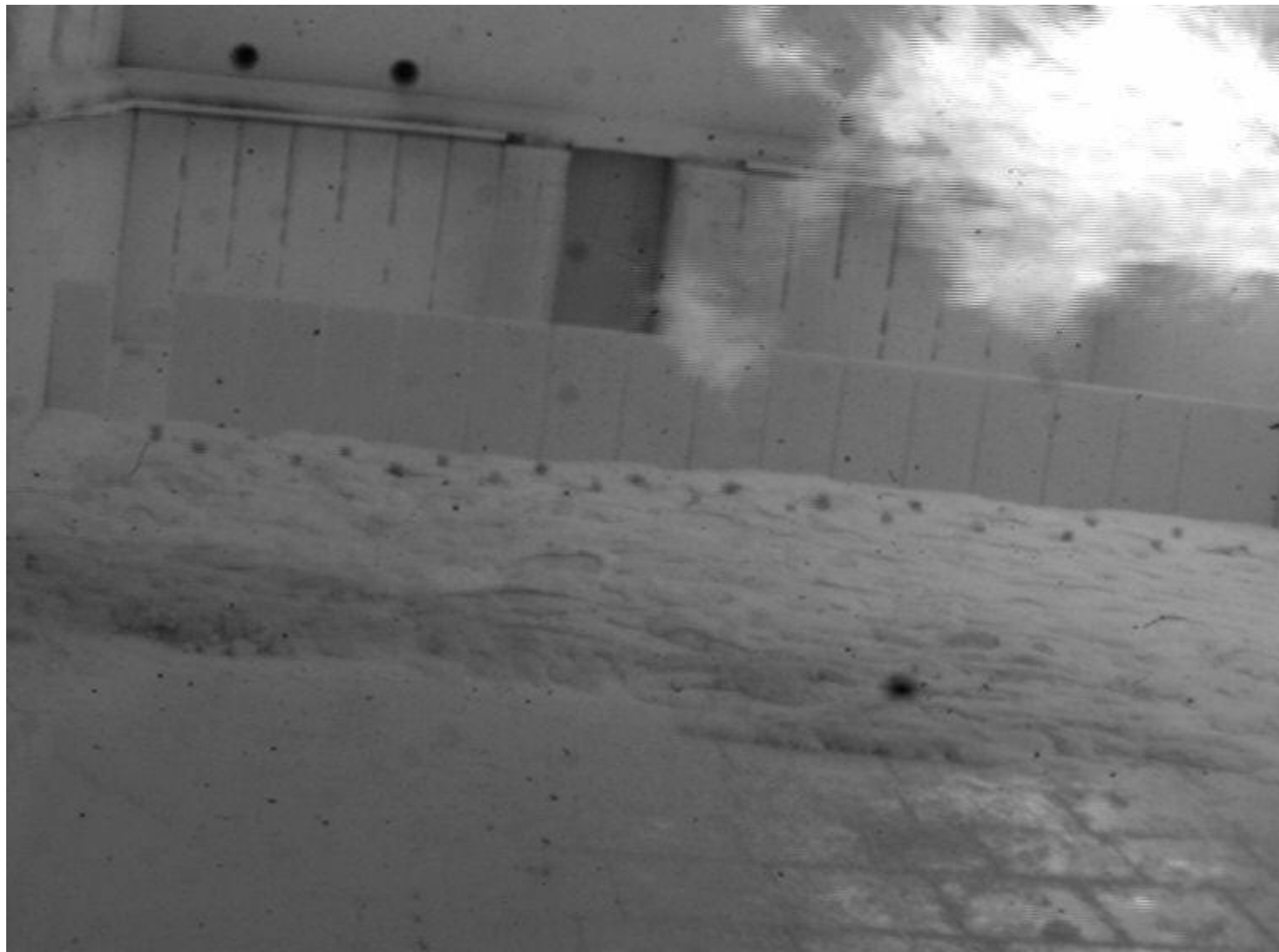


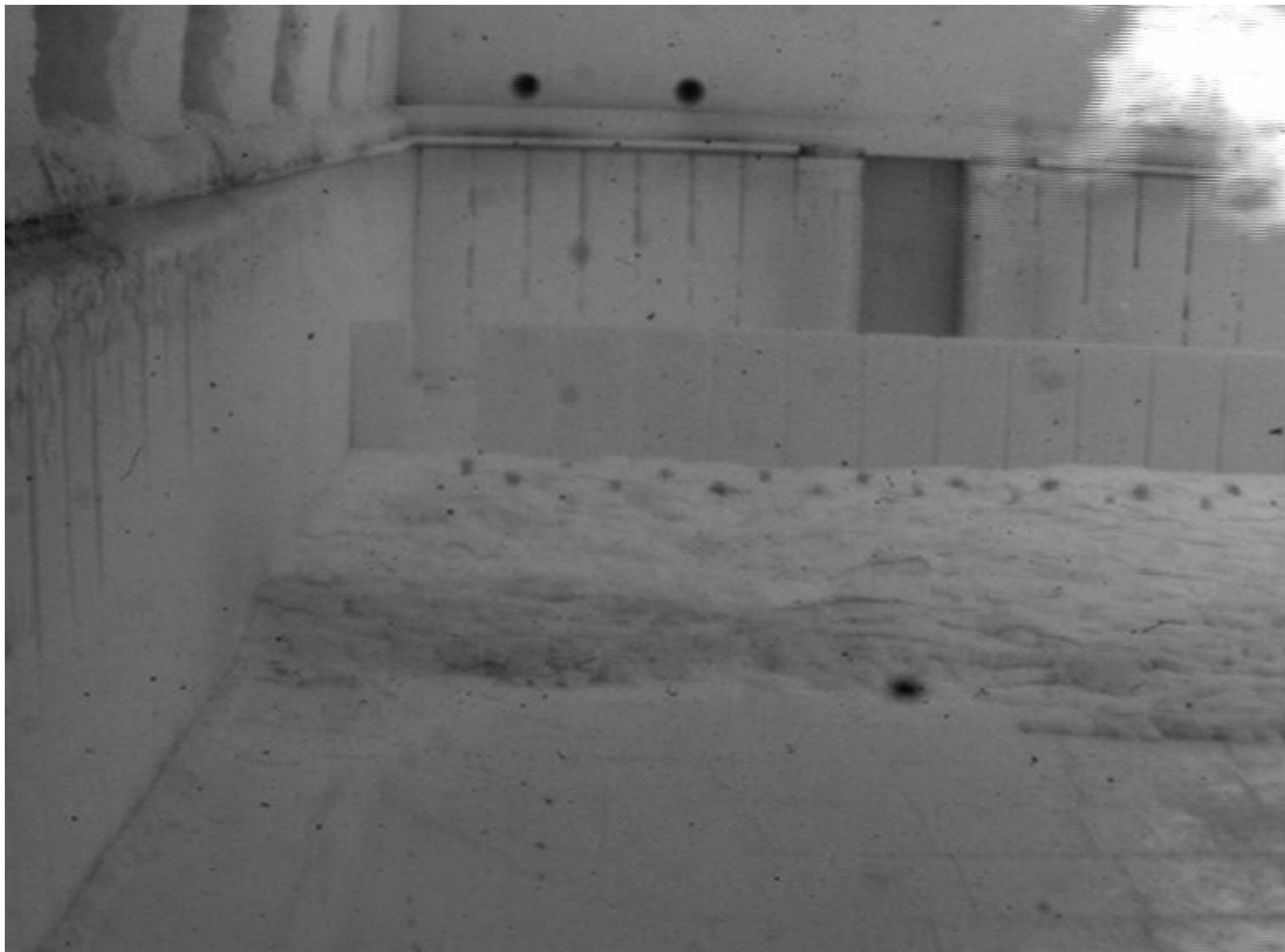


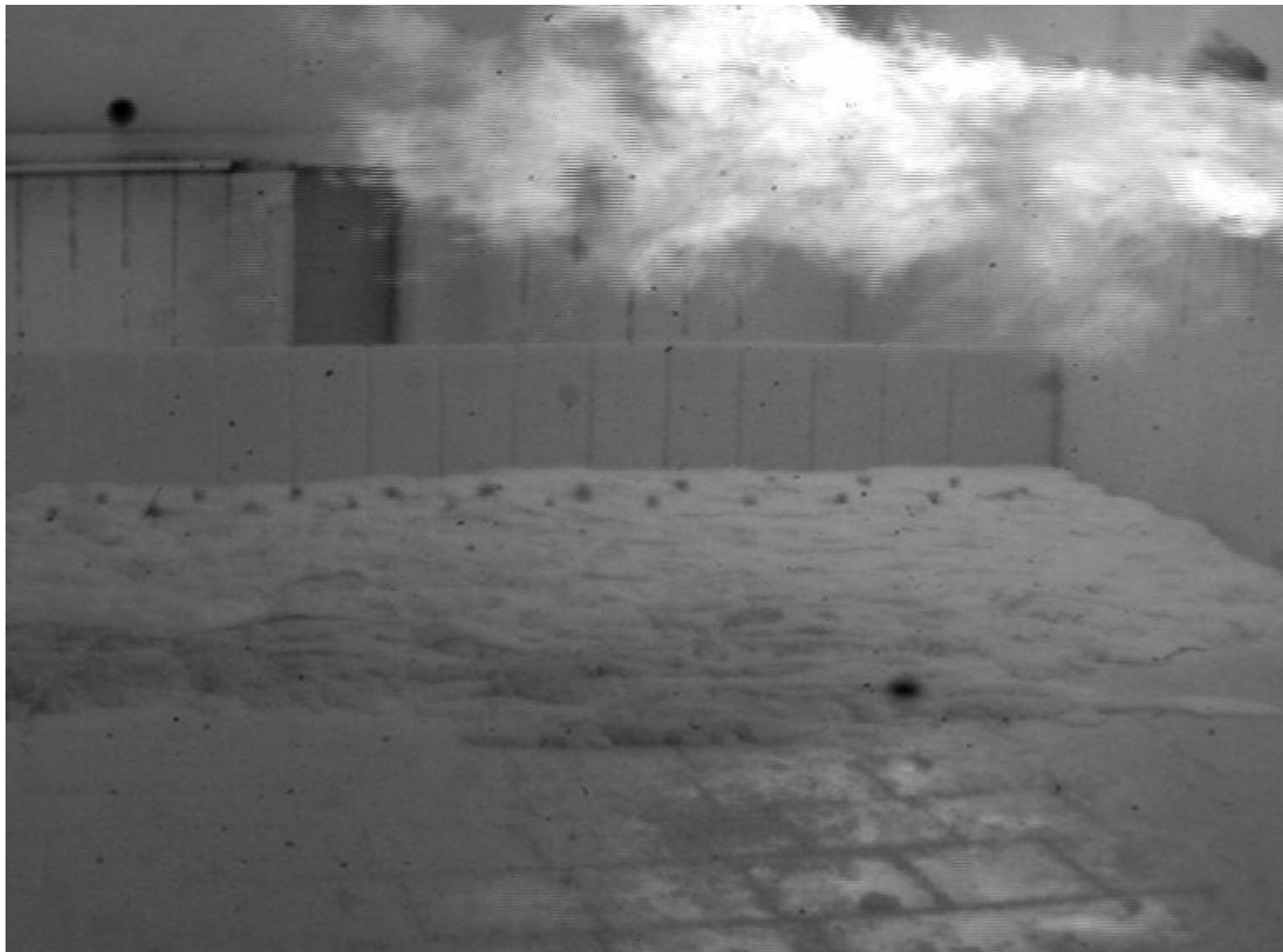


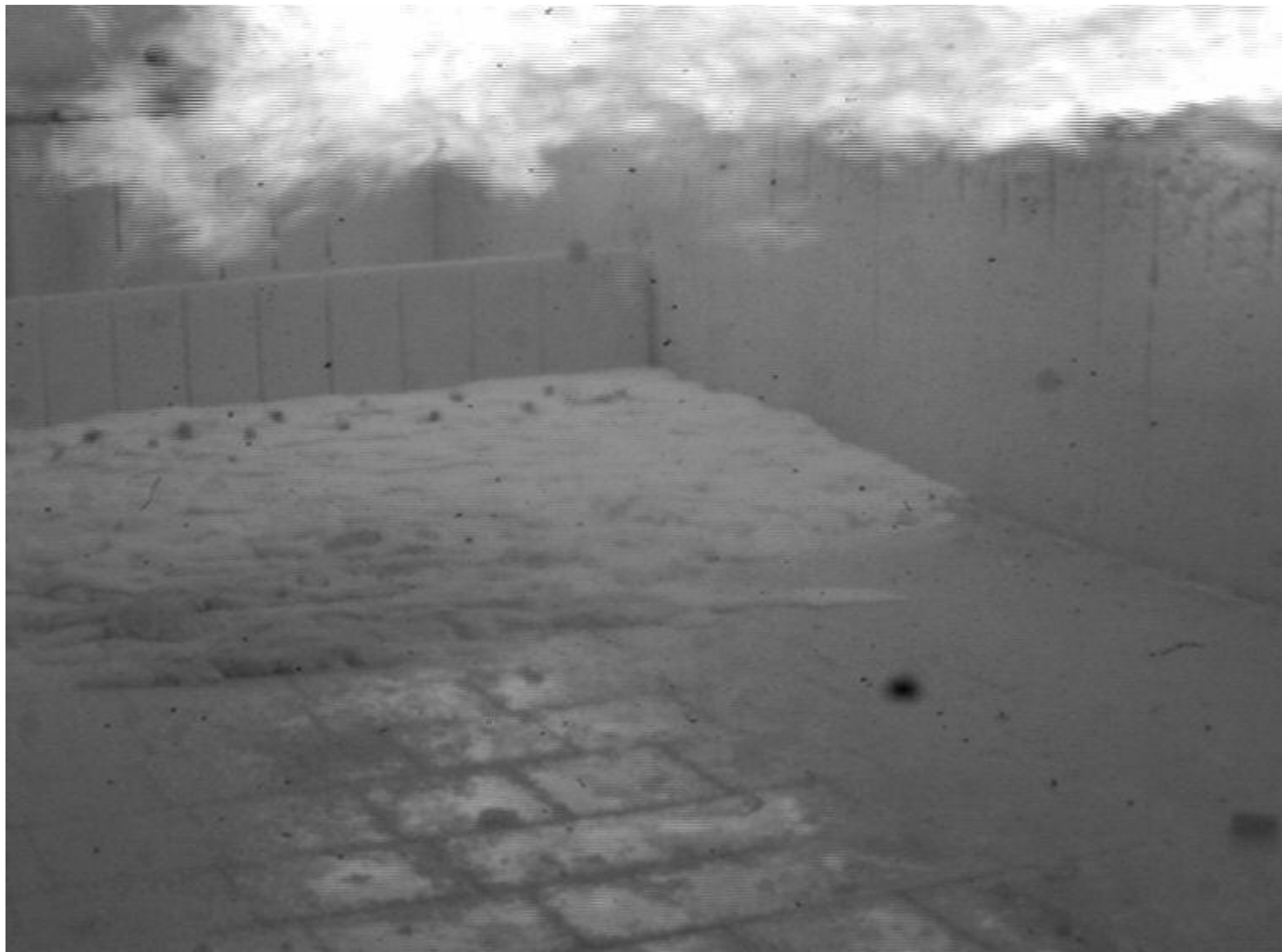












Reactive: Tuckstone Damage



Solution: Anchor Installation

- Drill holes
- Install anchors
- Ceramic weld from outside



Reactive: Breast Wall Movement or Partial Collapse



Removing by section

Solution: Remove breast wall in sections and rebuild with new brick until finished



Rebuilding wall



Finished wall

Reactive: Checker Collapse or Blockage

Solution: Melter Crown Burners Installed

- Best option is to clean checkers or other options listed later in presentation.
- If not possible, then melter crown burner installation can be performed. Other engineering changes to ports may be required based on furnace design.

◀ **Drill hole**



← **Insert burner sleeve**

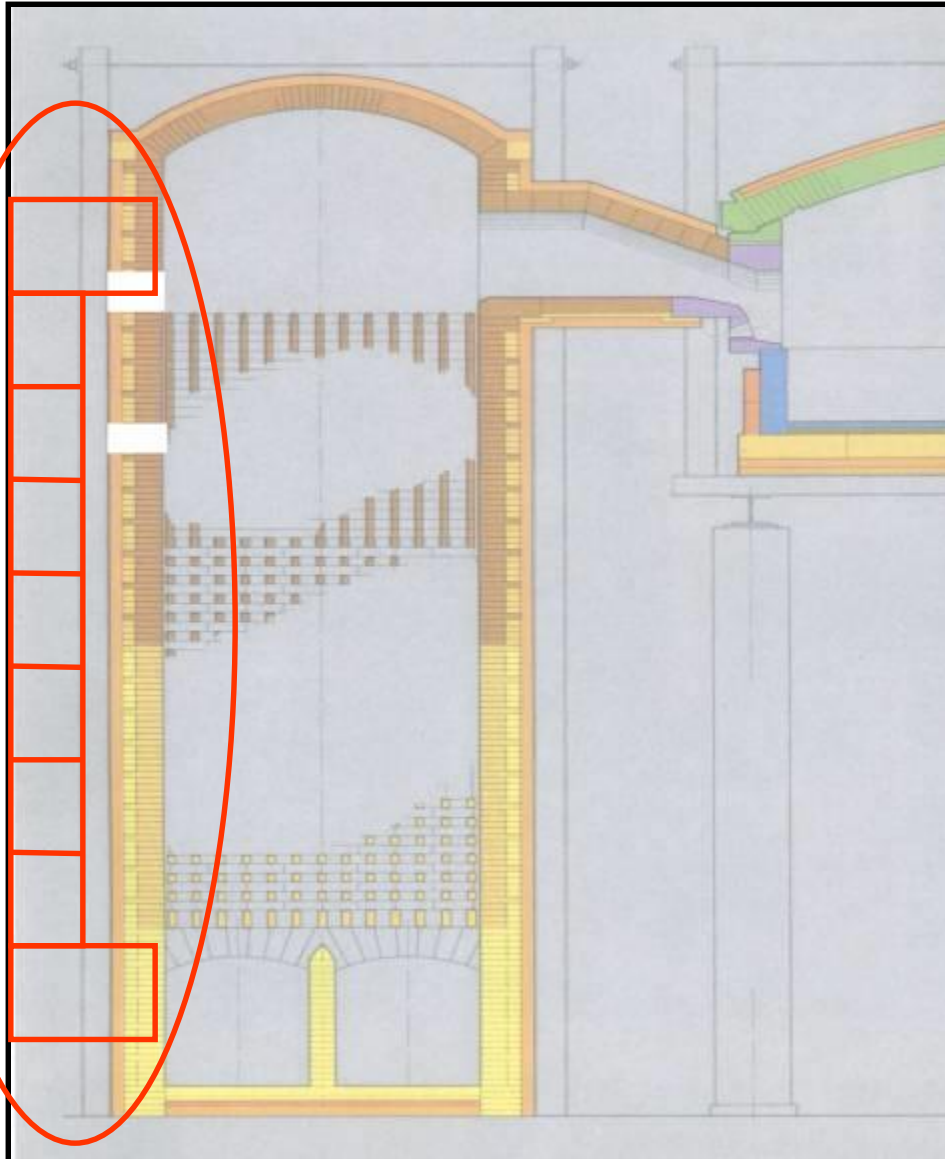


Install burner mount and burner



Reactive: Checker Collapse or Blockage

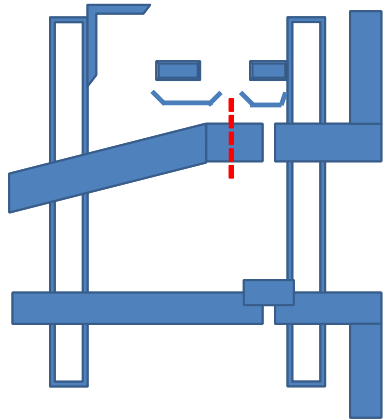
**Exterior
Flue**



Solution: Checker bypass

A flue is engineered and constructed which extends from the area above the checkers down to an area below the blockage to allow the air a short circuit around the blocked area. This is an expensive project and would be for furnaces that have several years of operation left.

Reactive: Checker Collapse or Blockage



**Cross
section
showing
layout**

Solution: Hot Checker Change

- Construct Temporary Flues
- Provide Temporary Heat
- Block Off Ports
- Open Access Points
- Remove Old Checkers
- Inspect and Repair Rider Arches
- Install New Checkers
- Close and Seal Access Points
- Heat up New Checker Pack



After cutting



**Dampers
in
position**

Contingency: Doghouse Mantle Block Damage



Existing mantle block being removed



New mantle block

Solution: Doghouse mantle block replacement

- Remove existing arch.
- Install new one piece block.



New mantle block being installed

Asset Life Extension

Furnace condition and campaign goals

- Assessment of furnace conditions
 - Alignment with campaign goals
 - Review of disconnects with furnace campaign goals
 - Melters
 - Hot Repairs
 - Ceramic Welding
 - Hot Repairs – Hot Bottom Repair/Bricks/Castables
 - Regenerators
 - Ceramic welding
 - Hot repairs
 - Checker Pack maintenance and repair
 - Ryder arch challenges



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