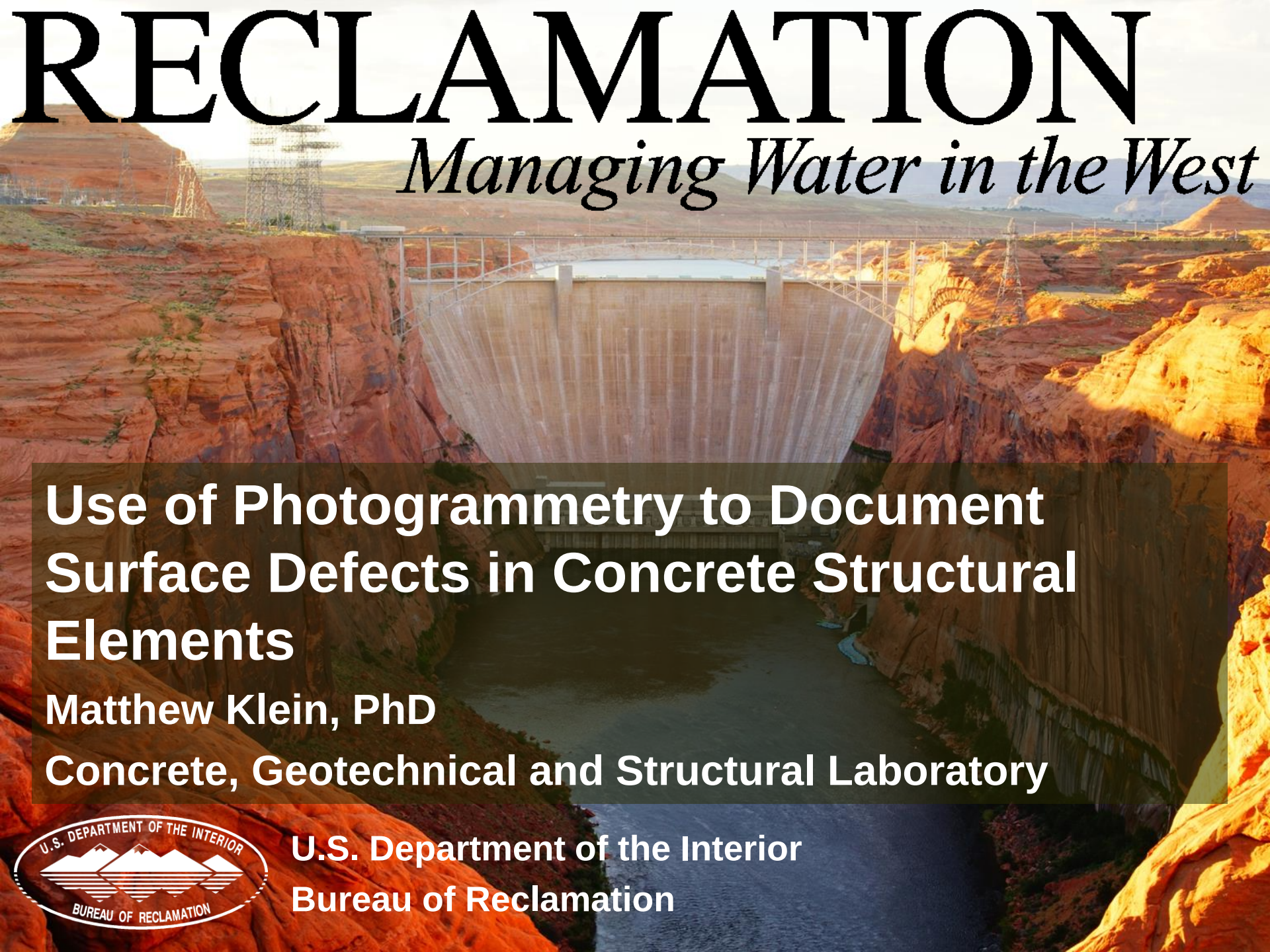

Use of Photogrammetry to Document Surface Defects in Concrete Structural Elements

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U.S. Department of the Interior

Bureau of Reclamation

US Department of the Interior
Bureau of Reclamation

- Structures: Dams, Powerplants and Canals
- Location: 17 Western States
- Largest Water Wholesaler in the US
- Second Largest Producer of Hydroelectric Power in the US

Facility Characteristics

- Built between 1930 and 1960
- Concrete Structural Elements:
  - Spillways
  - Dams
  - Buildings
  - Reservoirs
  - Tunnels
  - Canals
  - Bridges
- Harsh Exposures

Concrete Deterioration

- Detection is 99% Visual
- Geometrically Quantifiable
- Physically Characterizable
  - Spalls
  - Cracks
  - Delamination
  - Scaling
  - Erosion
  - Crumbling
  - Corrosion

What is Photogrammetry?

The art, science, and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring, and interpreting photographic images and patterns of EM radiant energy and other phenomena.

What is Photogrammetry, Really?

Photogrammetric Procedure

1. Data collection
   - Cameras and image format
   - Disable digital post-processing
   - Constrain focal length, focus, aperture, shutter speed, ISO and WB
   - Enable GPS (if installed and outdoors)
   - 60% overlap
   - Perpendicular positioning
   - Avoid movement and blur
   - Include scale and targets

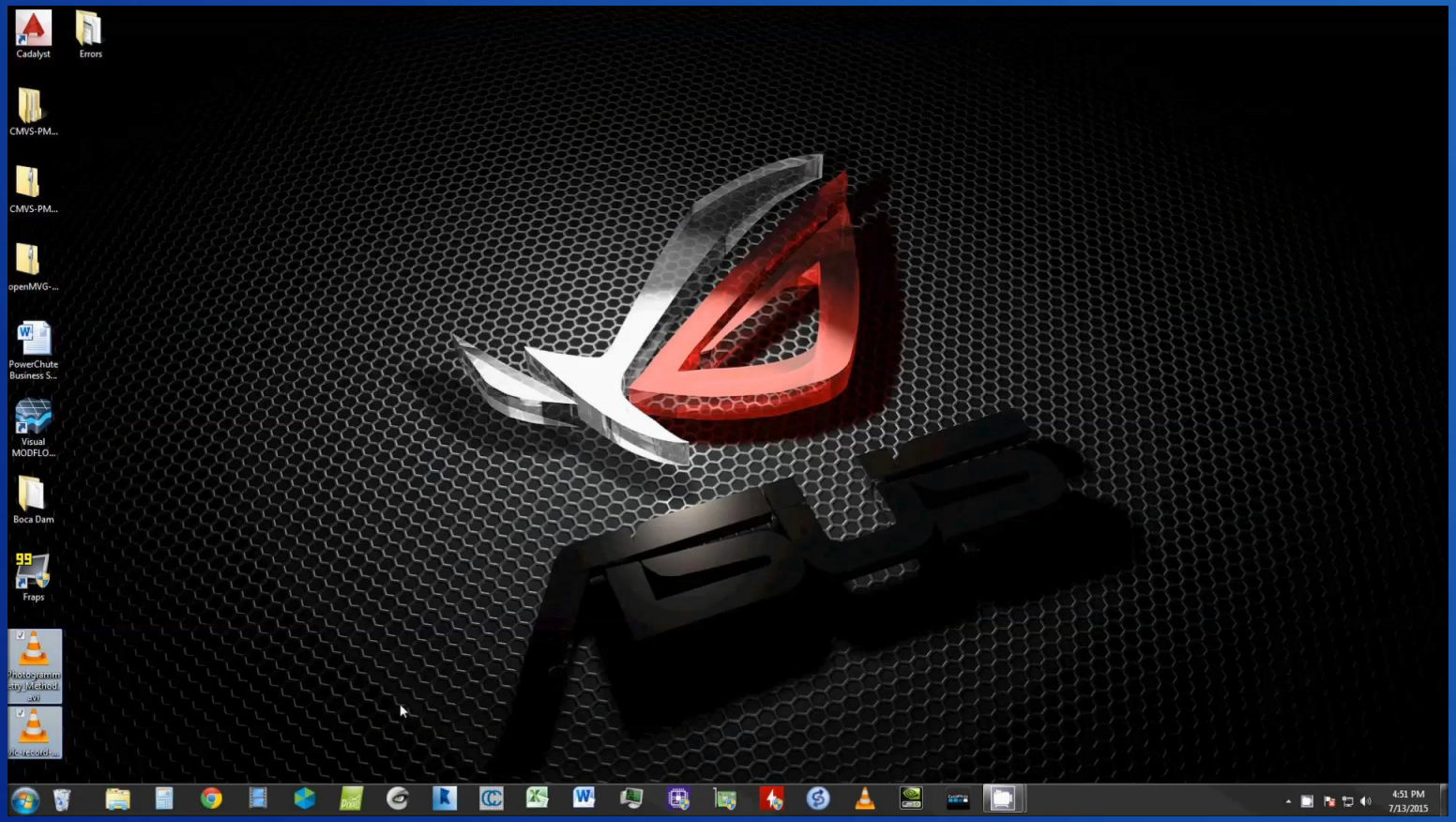
Photogrammetric Procedure

2. Software processing
   - Detect and match features/ Solve camera positions
   - Apply scale and coordinate system
   - Iteratively remove weak points and optimize parameters
   - Construct point cloud
   - Generate mesh
   - Apply photorealistic texture

Photogrammetric Procedure

3. Analysis
   - Fly-through animations
   - Volume and length calculations
   - Classify point cloud
   - Contours and grids
   - Measure differences in position
   - Animate 3D frames
   - Digital records

Photogrammetric Procedure



Deterioration and Photogrammetry

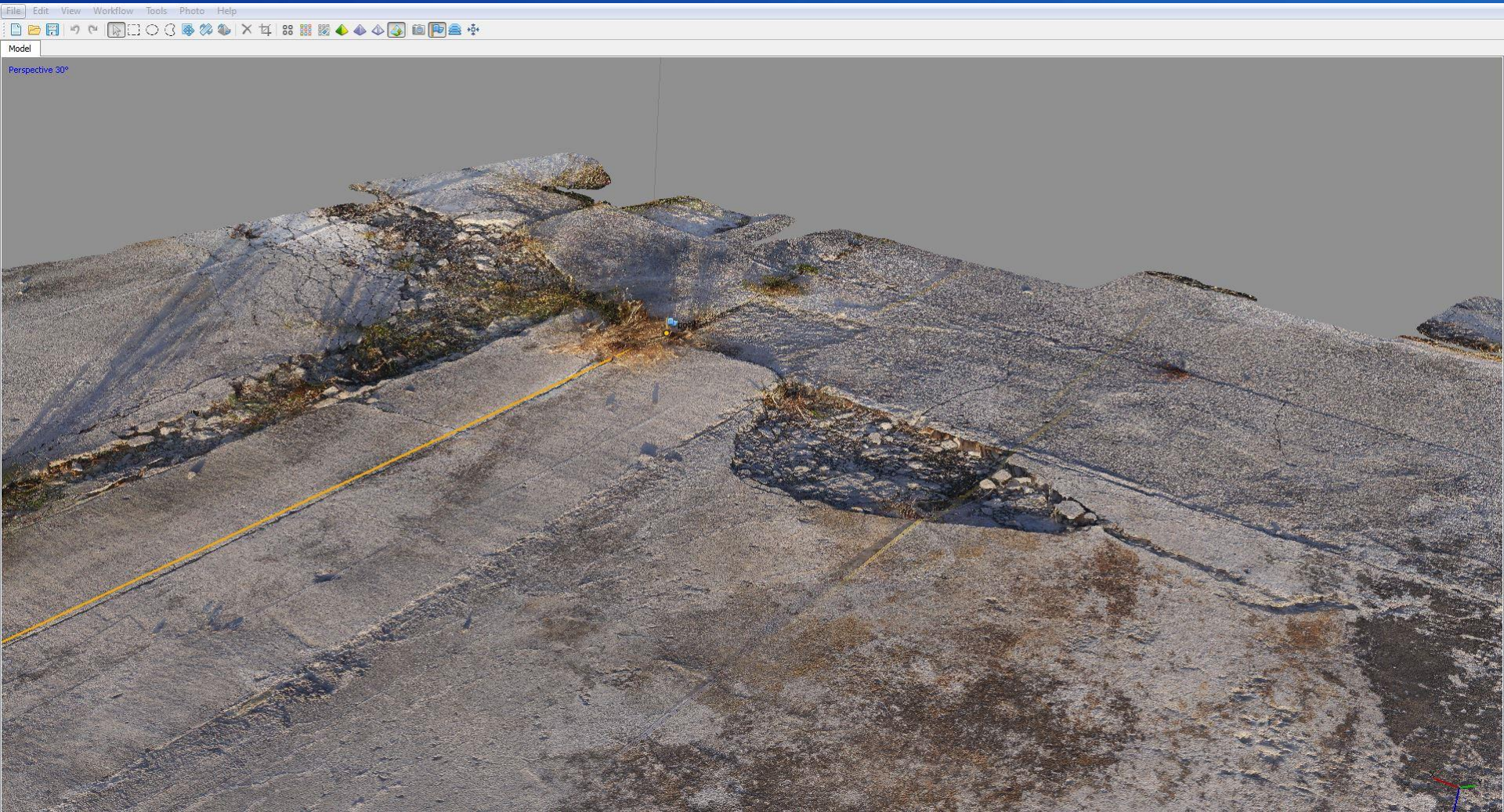
- Applications
  - "Arm-chair Inspections"
  - Measure extent of damage
  - Identify seepage or corrosion
  - Map locations
  - Determine movements
  - Compare time-based changes
  - Archival records

INSPECTIONS

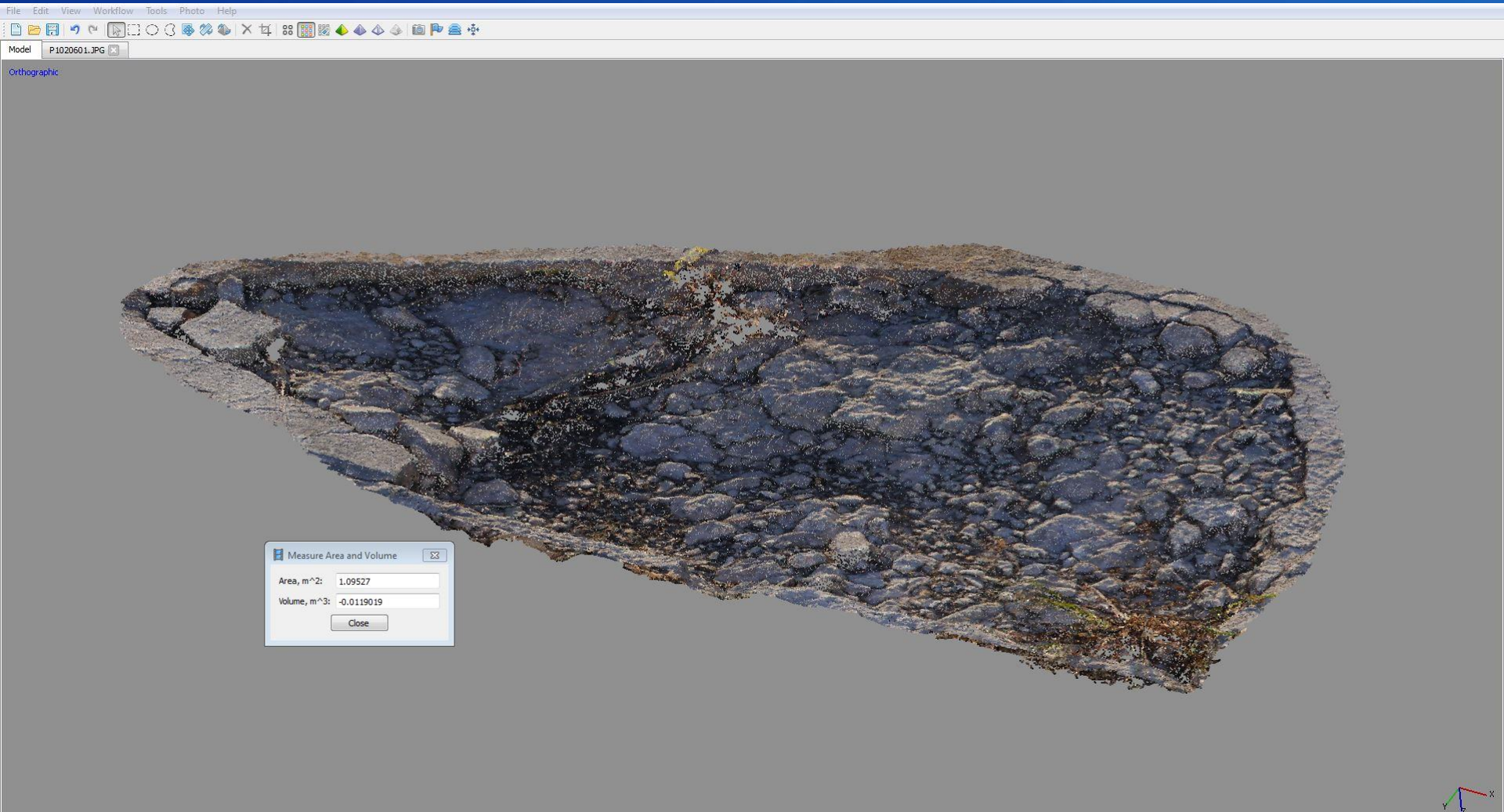
INSPECTIONS

Diversion Structure Crack

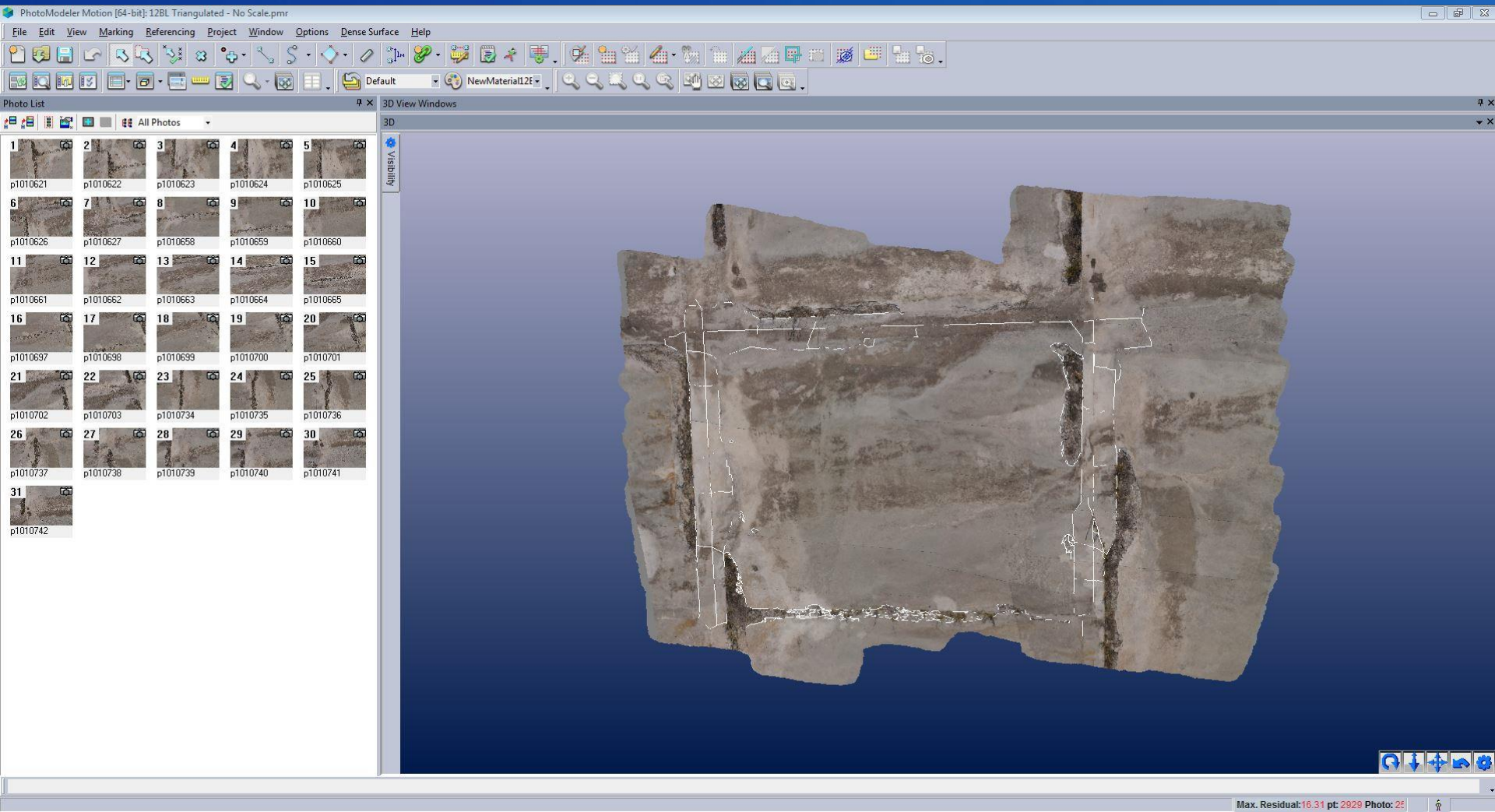
Spall Volume



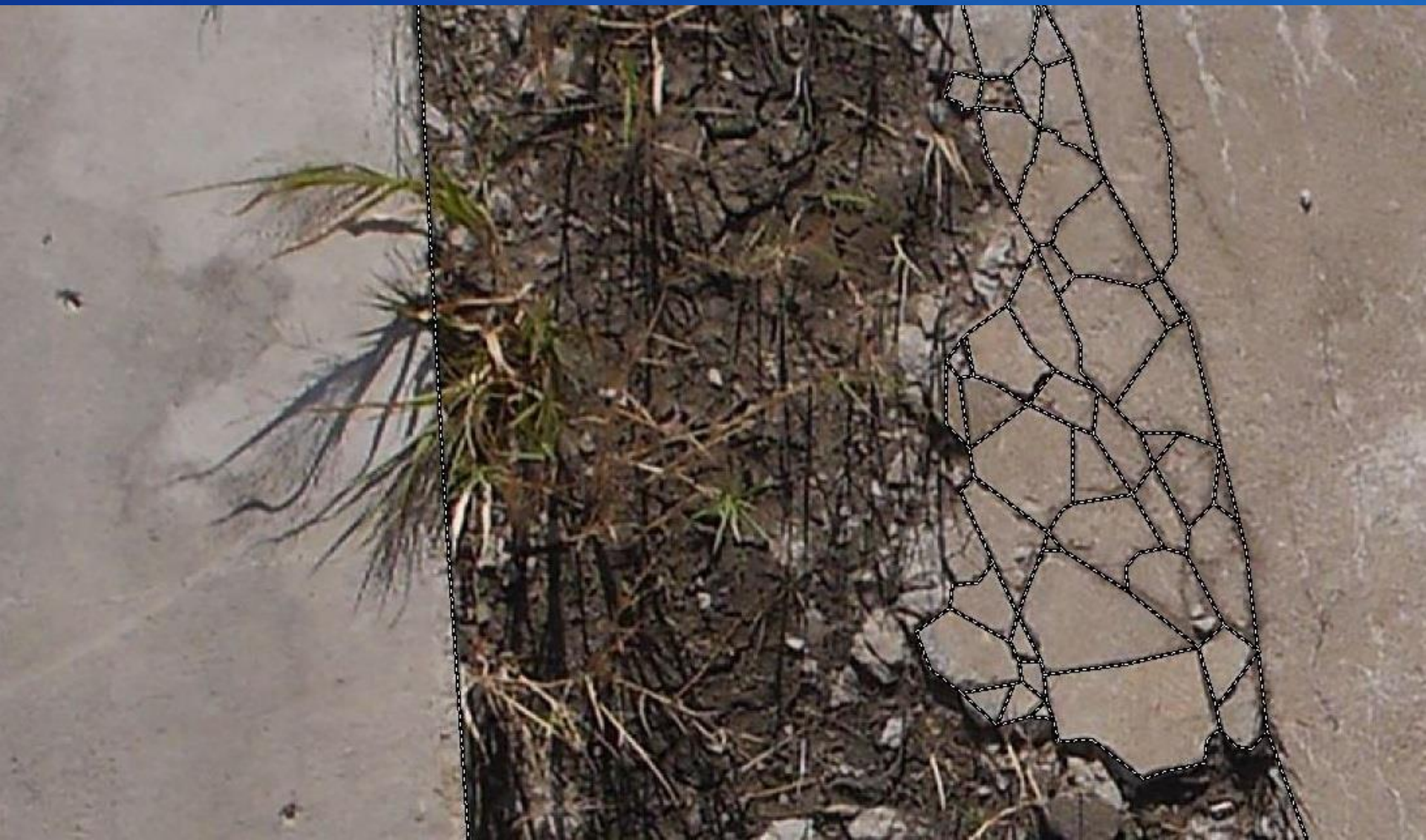
Spall Volume



CRACK MAPPING

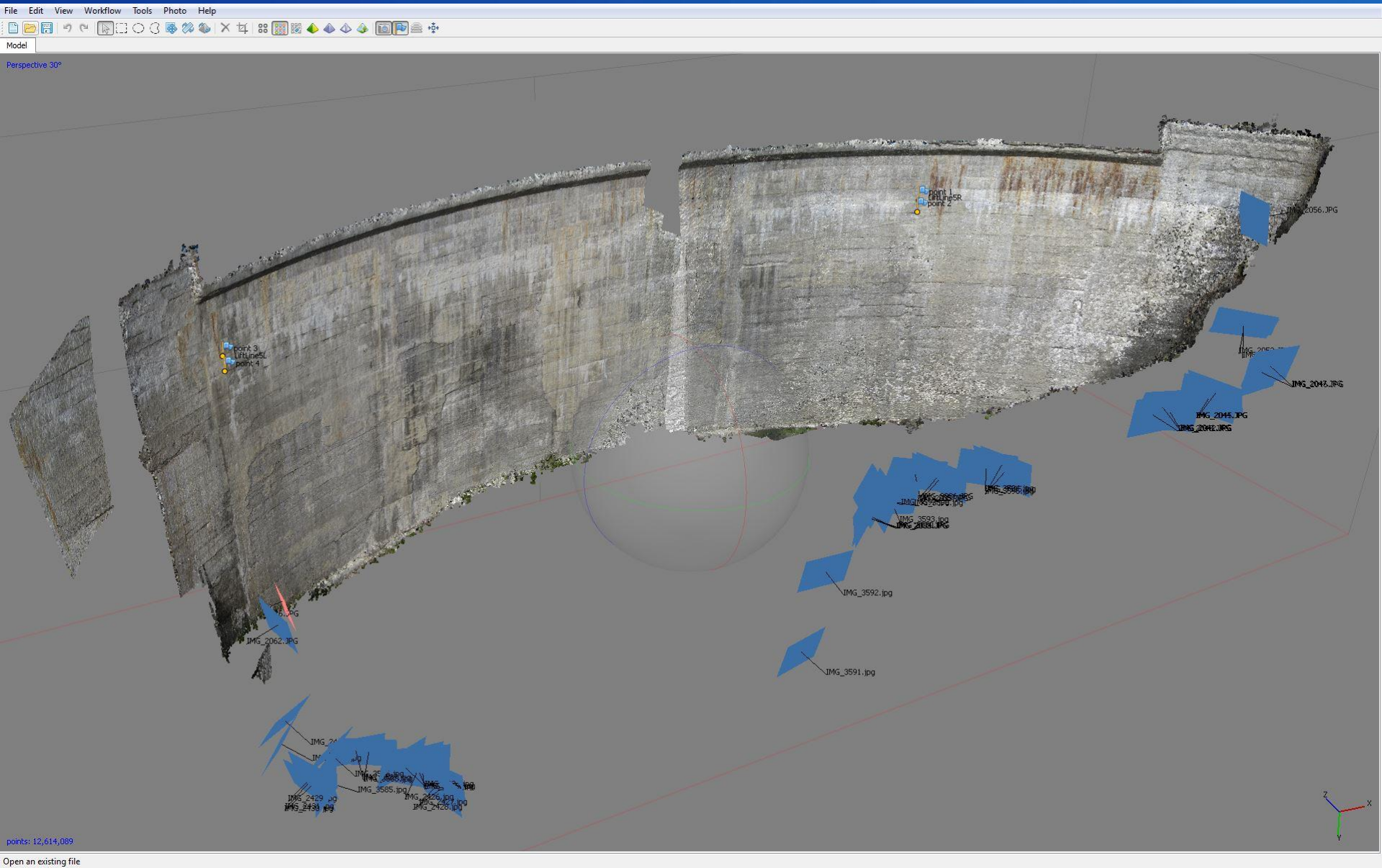


Crack Mapping

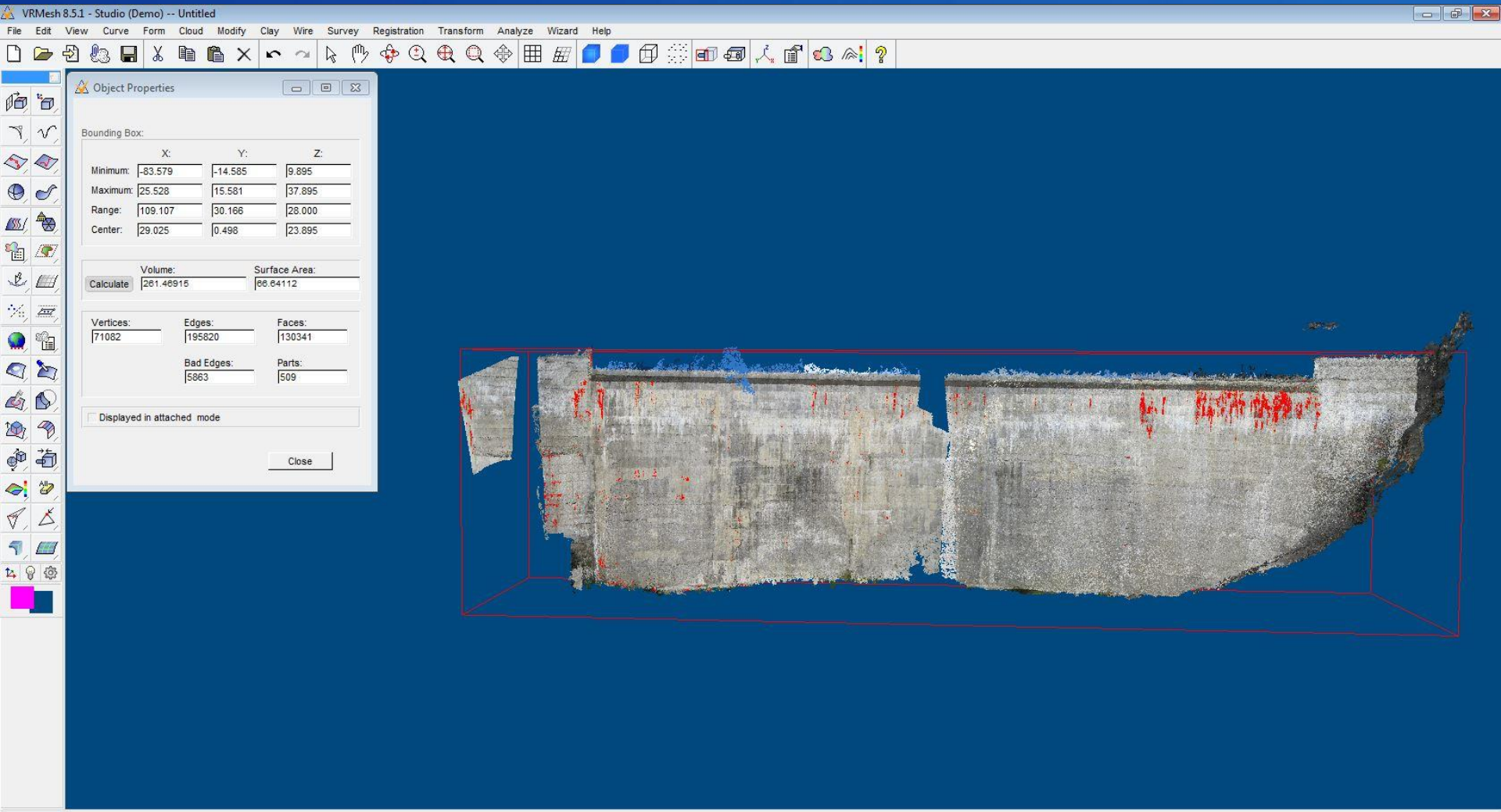


Delamination Detection

Corrosion Detection



Corrosion Detection

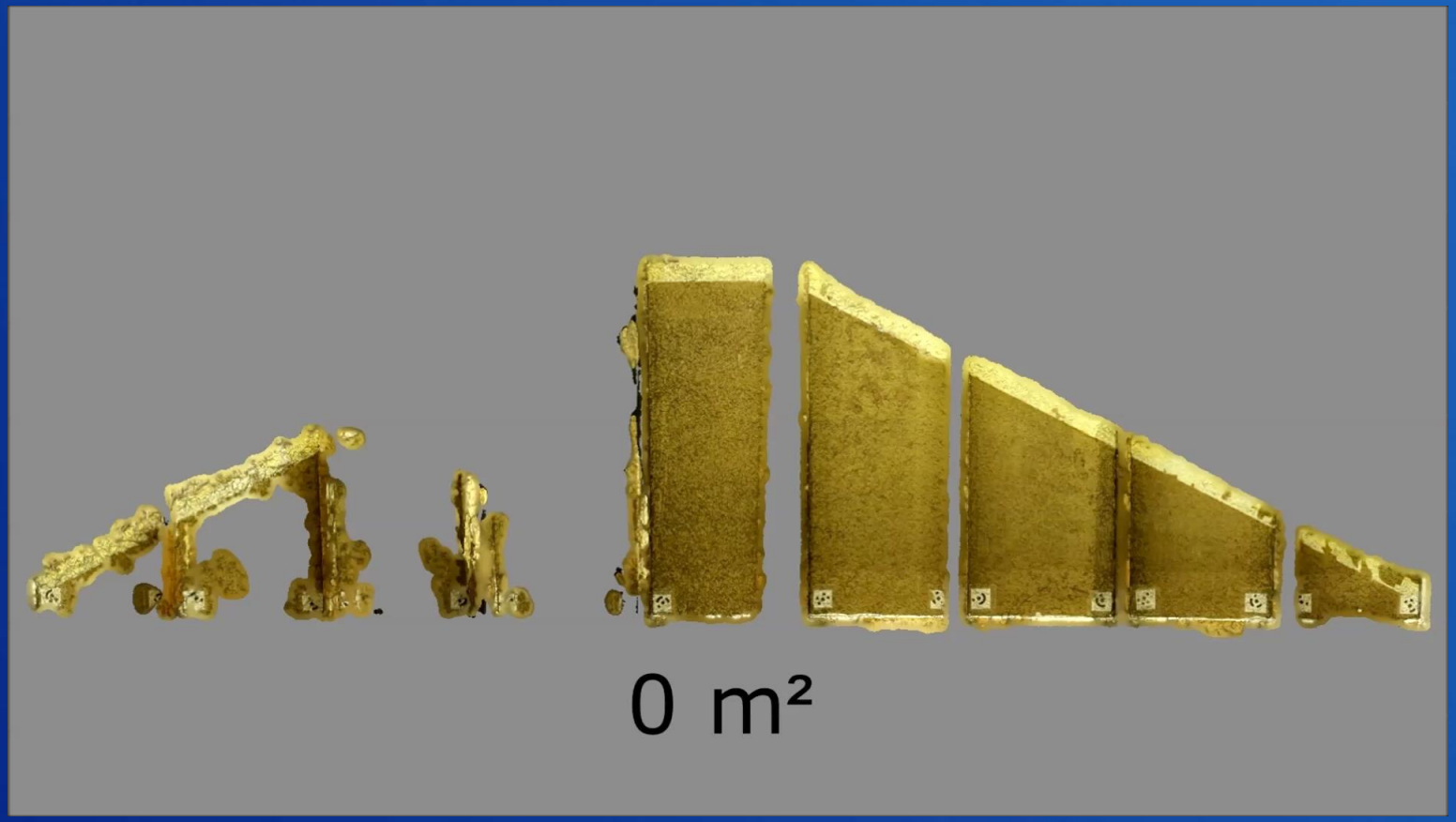


Measuring Movement

Measuring Movement

4D Modeling

4D Modeling



Questions?

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