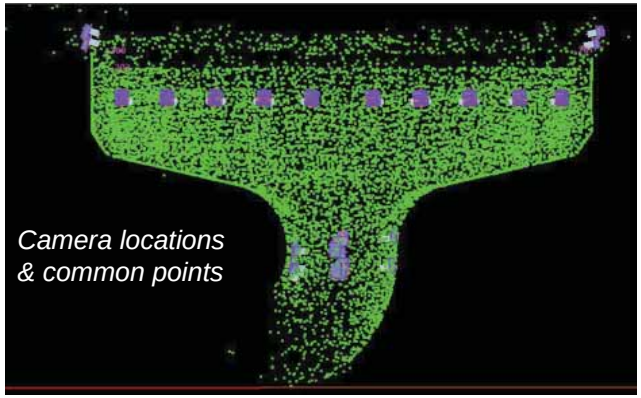
Use of Helium Balloon for Photogrammetry Mapping

8 ft. diameter helium balloon can carry up to about 12 lbs. at 12,000 ft. elevation

Photomosaic



Camera locations & common points

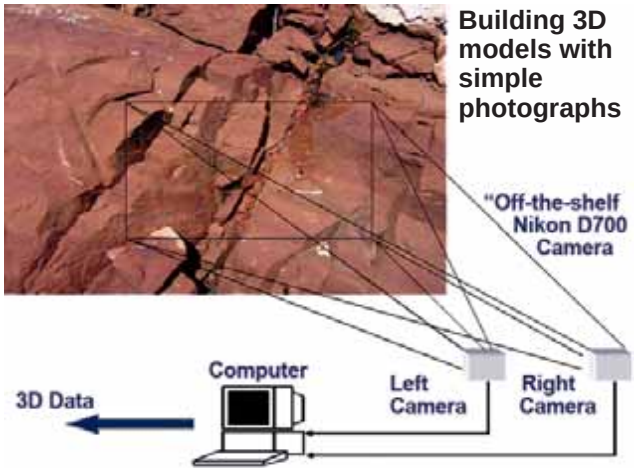
Gurnsey Dam South Spillway intake

Terrestrial Photogrammetry

The measurement, contour delineation or 3D reconstruction with photographs captured by a camera.

- Digital Terrain Models
- Contour Generation
- Volume Measurement
- 3D Modeling
- Rapid Geologic Mapping

DTM points and contours of the rock mass between two penstocks of Grande Coulee.



Building 3D models with simple photographs

We can provide onsite demonstrations, technical support, and training.

For more information see our Web site at http://www.usbr.gov/pmts/geology/3d.html

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RECLAMATION
Managing Water in the West

PHOTOGRAMMETRY

DIGITAL 3D MAPPING

Photogrammetry Research Team

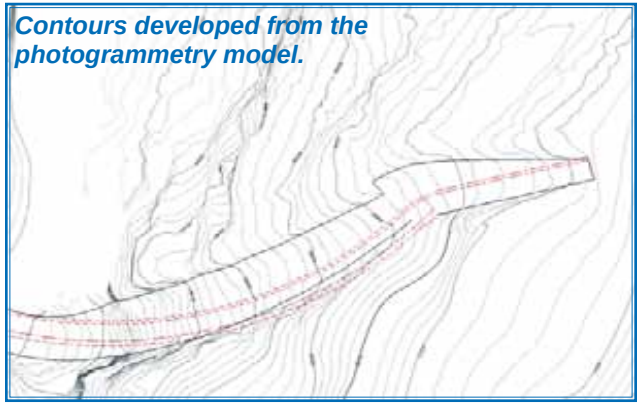
Geotechnical Services Division
(86-68000)
Technical Service Center
Denver, Colorado

U.S. Department of the Interior
Bureau of Reclamation

Field work that used to take many days, can now be performed in hours

- Hundreds of joints can be measured in the same time that it previously took to measure only a few
- Statistical confidence improves greatly
- Rope Access can be minimized, improving safety
- Topography can be developed at the same time
- Joint planes can be added to the model to see where they intersect the ground surface
- Geologists can quickly evaluate multiple projections and see the results on the 3D photo to compare with outcrops, etc
- Archival 3D Photogrammetric Models can be invaluable once geology can no longer be viewed after construction.

One day's field work, accuracy to within a few inches



Accurate 3D model can be developed without survey control.

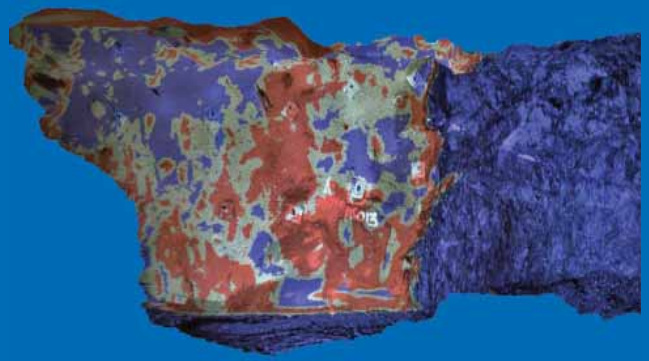
The known orientation and length of the 6 ft. ruler in the above images was used to scale the model for joint roughness determination.

Applications of Photogrammetry for Infrastructure Measuring and Monitoring

Limited only by imagination

- **Foundation Documentation and Geologic Mapping**
- **Borrow Quantities**
- **Concrete Deterioration Quantification**
- **Shotcrete Thickness Measurements**
- **Dam Removal Sedimentation Monitoring**
- **Structure Deflection Monitoring**
- **Embankment Deformation Measurements**
- **Concrete Dam Deformation**
- **Plant and Structure Measurements**

Finding removable blocks (key block) in steep jointed rock mass



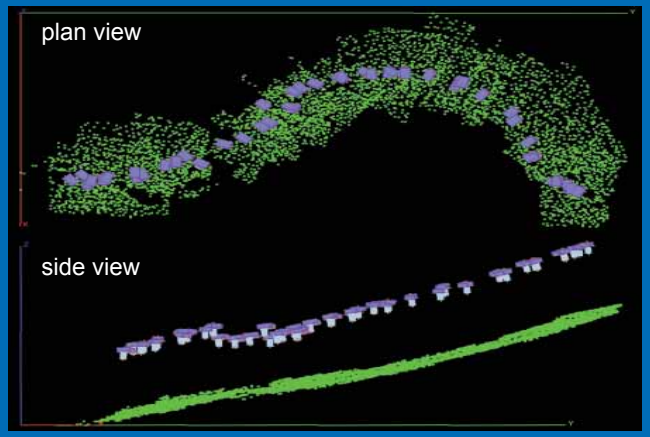
Shotcrete thickness measured using a difference model

Partial List of Reclamation's successful terrestrial photogrammetry projects in the past 8 years

- **Hungry Horse Dam**
- **East Canyon Dam**
- **Grand Coulee Dam**
- **Crystal Dam**
- **Anchor Dam**
- **Arrowrock Dam**
- **Folsom Spillway and Bridge**
- **Loco Dam and Guayo Dam (Puerto Rico)**
- **Guayabal Dam (Puerto Rico)**
- **Warm Springs Dam**

Folsom construction

Balloon Photogrammetry along the Middle Fork John Day River



Views of common points and camera positions along the John Day River