RECLAMATION

Managing Water in the West

Cost Savings Associated with using Photogrammetric Methods in the Laboratory

Folsom Model

The 1:48 scale Folsom Dam confluence model was built to analyze and evaluate the design of the new auxiliary spillway. During the model study a change in the concrete topography of the model was required. The proposed spillway and access haul road needed to be removed in order to model the original river channel (Figure 1). Photogrammetry was used to develop an as-built digital terrain model (DTM) of the existing model. AutoCAD Civil 3D was used to create a difference map between the current topography and the desired modification to identify changes required in the model. Plywood templates were cut and placed directly on the existing model, and new wire mesh and concrete were then placed (Figure 2). Traditionally this modification would have required removal of the concrete topography and construction of the new topography. By using photogrammetry approximently 2 weeks of construction time and labor ($13,000) associated with that time was saved during this modification (Figure 3).

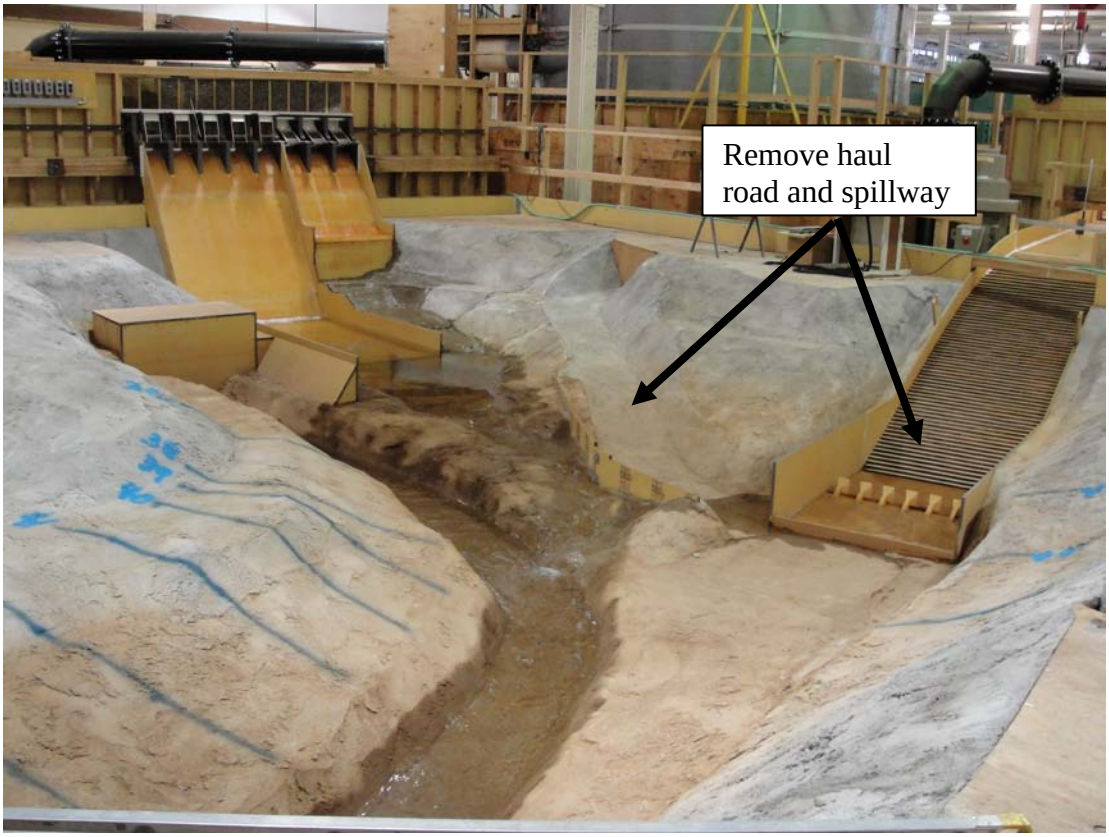

Figure 1. Folsom model showing the auxiliary spillway and haul road before modification for future testing.

Figure 2. Templates were cut to be placed on top of the old topography.

Figure 3. Finished model modification.

Guernsey Model

The 1:47 Guernsey Dam model was built to analyze and evaluate the south spillway for a new gate/ weir configuration, and higher water surface elevations and discharges than the spillway was originally designed for. The spillway has two 64 foot drum gates that pass water into a basin and then into a 30 foot diameter tunnel (see Figure 4 and Figure 5). Due to the cost of a needed major rehabilitation on the gates, one of the gates will be removed and replaced with a concrete, constant height weir. Along with the evaluation of the new design features and flow conditions a rating curve for the spillway was also developed.

Figure 4. Guernsey Dam south spillway.

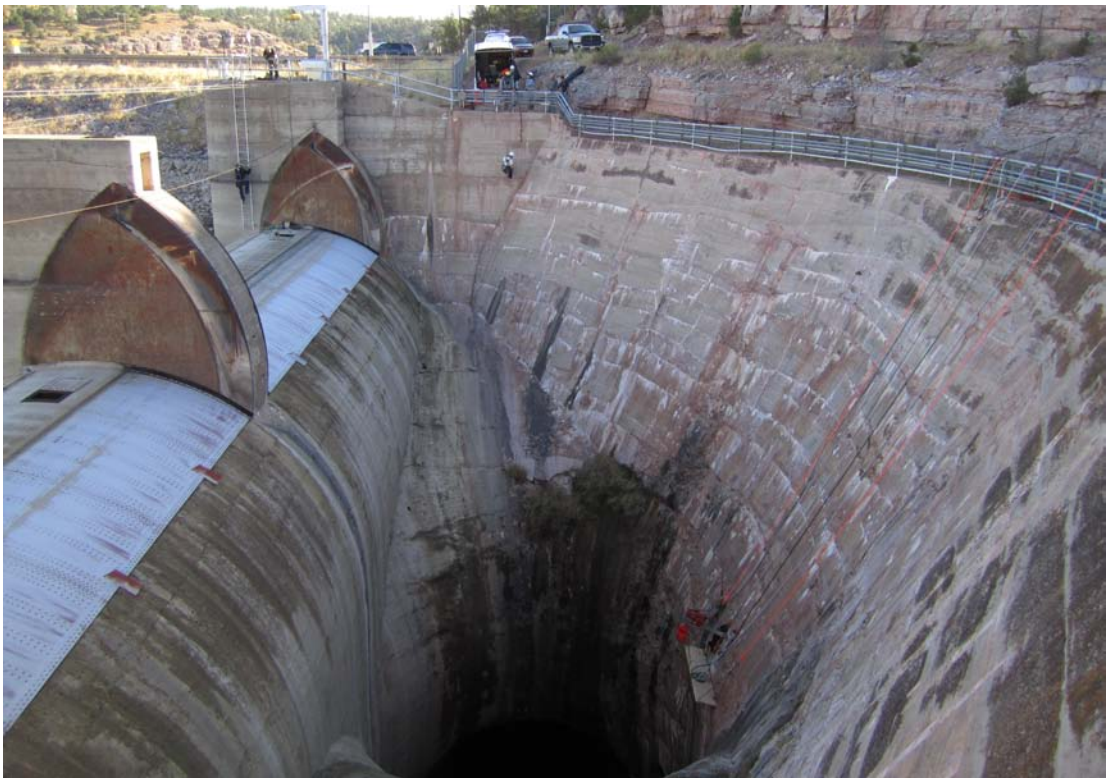

Figure 5. Guernsey Dam south spillway, showing entrance to 30 ft diameter tunnel.

Photos of the spillway were taken and a photogrammetric analysis was preformed to develop a DTM of the spillway, which was used to evaluate the condition of the concrete. The reason this data was collected was unrelated to the model study. Building a physical model of the spillway with standard construction practices appeared to have many challenges due to the complex geometry. An unplanned byproduct of the concrete evaluation was that the spillway DTM was used to build the physical hydraulic model. The DTM of the spillway was scaled down to the model size, and topography lines at intervals of the thickness of marine grade plywood were created using AutoCAD Civil 3D. The topography lines were then transferred to the plywood and the spillway shape was formed (Figure 6). Bondo, an auto body repair filler material was used to "fill in" the gaps between the edges of plywood (Figure 7). This method of model construction saved approximately 1 week worth of design and construction time and labor costs ($9,000).

Figure 6. Guernsey Dam model, south spillway, topography lines from the DTM were transferred to ply-wood and then cut out to shape the spillway basin.

Figure 7. Guernsey Dam model, south spillway. Bondo, auto body repair material, was used to create a smooth surface from the ply-wood templates. The downstream bay (left) is modeling the drum gate in the down or open position. In the upstream bay the drum gate has been removed and the concrete weir is being modeled.

Photogrammetry has been successfully used for moveable bed analysis, model verification, and model construction for physical models in the Bureau of Reclamation's hydraulics laboratory. Once properly set up and calibrated, photogrammetric techniques are faster than typical model data collection techniques and provide far more data points than can be collected with traditional laboratory methods.