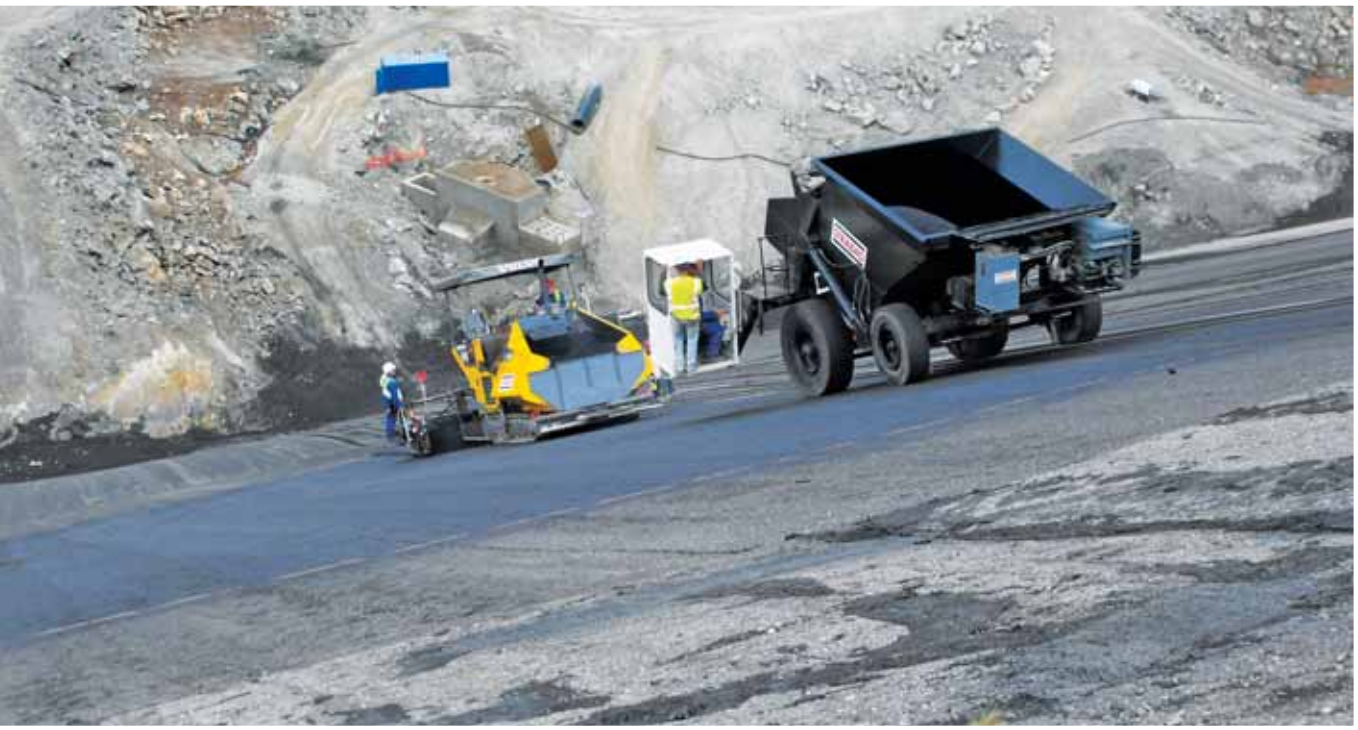


Difficult to face

Crews meet paving challenges on Homestake Dam

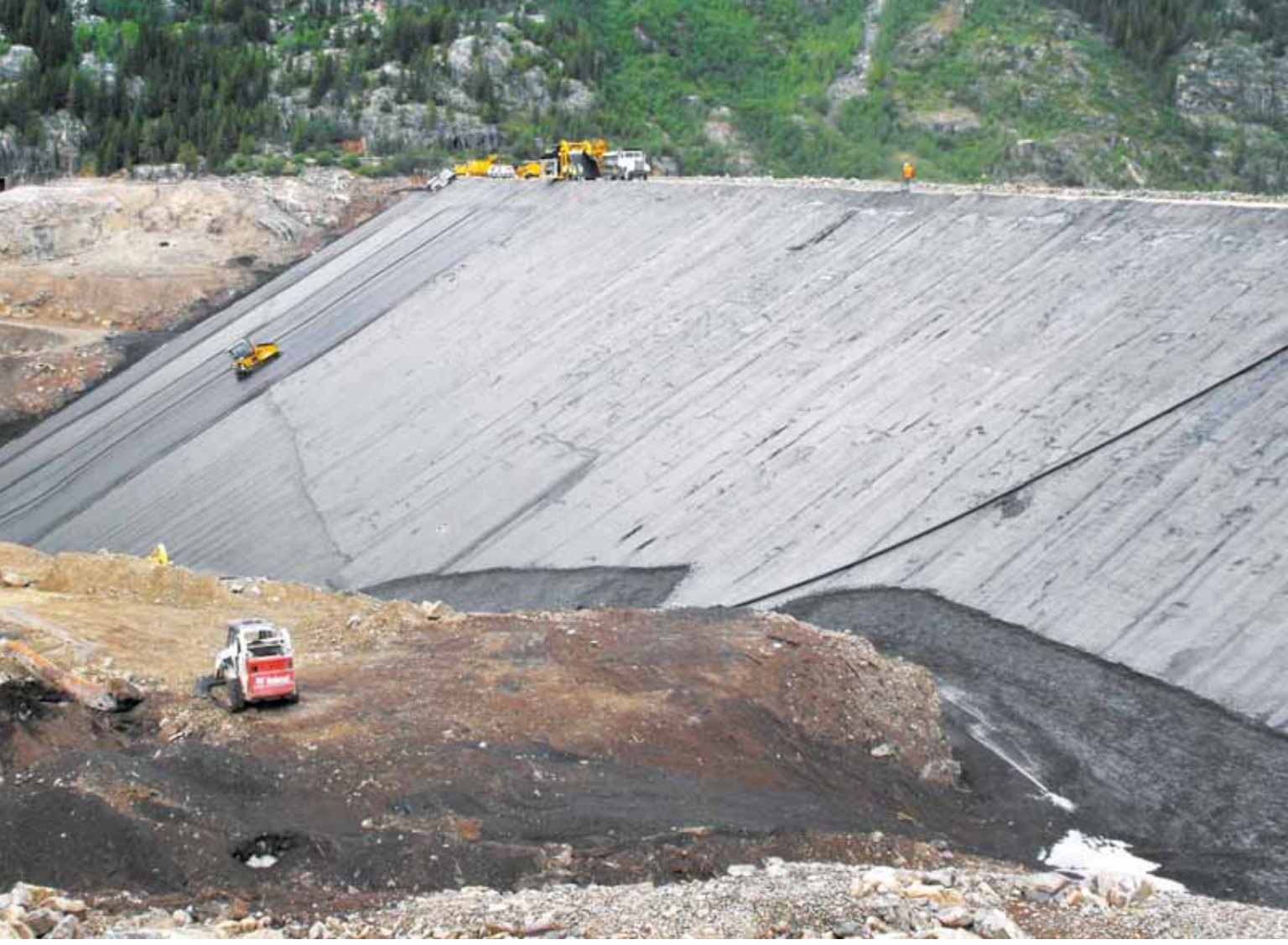
By Zachary Wirth, E.I.T.
Contributing Author

In 2011, after enduring more than 44 years of surface erosion and extreme swings in temperature and precipitation, the 231-ft-high Homestake Dam in Colorado's Rocky Mountain region was showing its age.

The asphalt-faced dam, which stores raw drinking water for Colorado Springs and Aurora, a suburb of Denver, had experienced a significant level of deterioration—most critically in the existing upstream asphalt concrete facing of the dam. To perform repairs, the upper crest of the dam was excavated to widen the crest, thus facilitating equipment access used to mill and repave the dam's entire face.

When Denver-based engineering firm CTL|Thompson was chosen to work with engineering, construction and technical services organization URS Corp., the engineer of record for the project, to provide routine quality assurance material testing, it was expected that the approach would be anything but conventional—and that presumption was right. The lessons learned from this important assignment have enriched the company's experience and are applicable to projects across the U.S. and beyond.

Providing engineering consultation and testing services during construction and repairing infrastructure is nothing new for CTL|Thompson; its employees have amassed extensive expertise working on other critical dam projects such as the Hinze Dam, located on the Gold Coast of Australia. Despite its location in CTL's relative backyard, on U.S. National Forest land, the project was "foreign" to the company, both literally and figuratively. Challenges presented by the project were unique relative to CTL's 40-year experience. Most similar projects—using asphalt for protecting this type of embankment—have been constructed outside the U.S., primarily in Europe, where the process is far more common. Further, crews would be working with the material on a steep embankment, requiring extreme care and caution.



No holding back

To outline and accomplish the necessary scope of work, all involved had to be mindful of the challenges inherent in working in a high-altitude region of Colorado, at approximately 10,000 ft of elevation. The dam and reservoir, Eagle County's largest, are subject to cold, wet weather patterns that significantly shorten the working season. The time spent on this project in 2011, for example, spanned just over two months, from September to November. With this and other constraints in mind, the combined team formulated the following three-year plan to complete the work, maintain quality of design and construction and reduce the risk of hydrologic and weather impacts to the project schedule:

- **Year 1 (2011; completed):** Work was done to remove the asphalt-concrete facing in the upper 5 ft of rockfill along the crest of the dam, the cast-in-place concrete parapet wall, the gabion baskets and the steel-reinforced soil cement embankment section;
- **Year 2 (2012; completed):** The team milled the existing facing, repaved the lower portion of the asphalt-concrete facing, and the facing was keyed into plinth to provide a seamless connection, preventing water from leaking around the edges of the dam. A new gate was installed and appurtenances developed at the Homestake Dam Tunnel intake, while the gate and appurtenances at the Homestake Dam outlet works were refurbished; and
- **Year 3 (2013; to be completed late in the year):** Embankment fill was to be reconstructed, the remaining existing asphalt-concrete facing was to be removed, the dam crest was to be repaved and the asphalt-concrete dam crest resurfaced, while parapet walls were installed.

Drainage of the approximately 43,000 acre-ft of water stored in the reservoir began in 2011 and reached a minimum level in 2012. Water collection in the reservoir is scheduled to begin again in April 2013, and restoration work around the dam should be completed in 2014.

In addition, the team has had to be mindful of the public's safety, as the reservoir and the area surrounding it are popular recreational areas. Access has been restricted while efforts are under way. For part of the project's duration, the U.S. Forest Service and other groups have gone to work removing hazardous trees, rehabilitating campsites along Homestake Creek downstream from the reservoir and carrying out other restoration and enhancement needs in the area.

Coming over from Europe

In addition to providing material testing, CTL assisted URS with observations

and measurements of construction during the resurfacing and placement of asphalt on the dam. The company foresaw several weighty challenges, which were overcome through the combined engineering team's collaborative expertise. Challenges included:

Some expertise would need to be imported. All involved understood that the perspective needed for an asphalt-faced dam project had to come from overseas, where asphalt facing is routine. For its hydraulic asphalt specialty contractor, URS enlisted the help of Strabag, the largest construction company in Austria and one of the largest in Europe. Subconsultants from Strabag participated in project design, provided technical support and consultation during construction and assisted with submittal review and other needs. In addition, they agreed to make site visits in 2012 and 2013 to support field staff in observing construction related to their area of expertise. The team of workers in the field initially were concerned they would experience language difficulties, but the combined team learned to listen carefully during conversations and while reviewing plans. The anticipated language barrier did not arise.

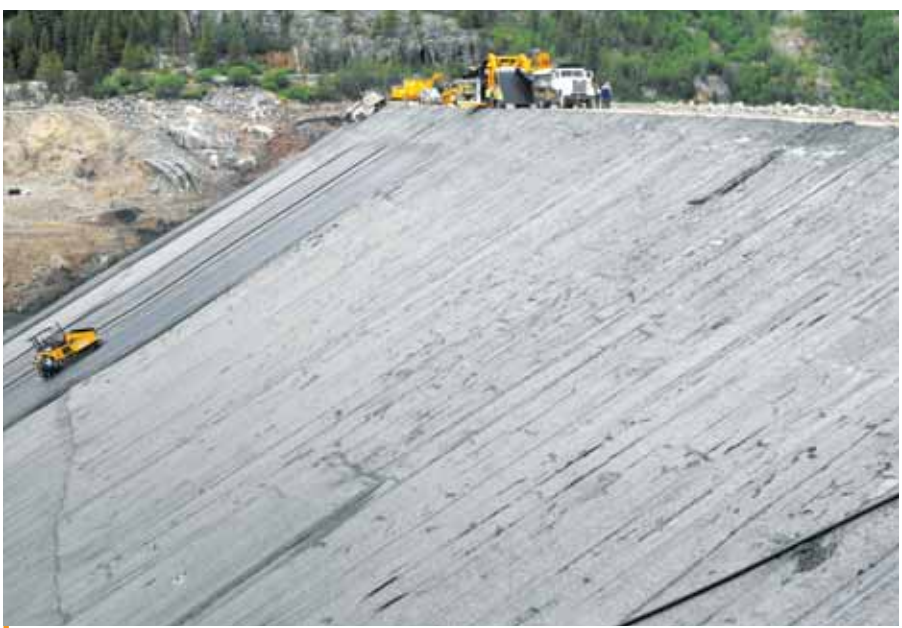
Some equipment would need to be imported. The subconsultants from Strabag noted that the most appropriate tools for a job like Homestake Dam were not located in the U.S.—and, consequently, would have to be brought in from overseas. As a result, much of the equipment used for this project was barged in from Europe, then carried over land by truck to arrive at the project site.

The inherent steepness of the dam required working with extreme caution. Homestake Dam's crest is nearly 2,000 ft long. Because of that fact—coupled with the angle of the dam face—the job could be likened to paving a parking lot at a 35° angle. To properly place and compact the asphalt, a team with Colorado-based ACA Moltz JV arranged for large pieces of equipment, including a paver and rollers, to be secured with cables attached to portable winches that allow the equipment to be either lowered from the top of the dam or raised up the face. Workers seeking to take density measurements of the material have had to rappel down the face of the dam. In dealing with expensive equipment and valuable lives, the team had to be certain that nothing would slide freely down the face of the dam—and that every movement was calculated with the utmost certainty and precision.

The asphalt concrete needed to complete the job had to be produced on-site according to strict specifications, stored properly and moved relatively quickly. To work with hot-mix asphalt concrete in cold weather while also adhering to the required environmental regulations governing the site, a 160-ton temporary batch plant was built at the base of Homestake Dam. The materials created there were transported on loaded trucks along a narrow road to the crest, a process that took about 10 minutes from the bottom to the top (and about 30 to 45 minutes for a complete round-trip). The mix had to be heated to between 355° and 375°F to accommodate the paving process and ensure the material remained hot enough to properly place and compact it. Incidentally, if its temperature drops below the aforementioned range, infrared technology can be—and was—used to heat the asphalt again, allowing work to continue without interruption.

The bulk of the repairs to Homestake Dam are expected to be completed at the end of October 2013, and the work crews will demobilize at that time. Weather conditions will dictate the length of time required to completely fill the Homestake Reservoir again; in the meantime, Colorado Springs Utilities and Aurora Water are continuing to monitor other resources that provide water to their customers to meet those cities' demands.

All participants on the team working to upgrade this invaluable natural resource are honored by the progress made to date, and everyone looks forward to the successful completion of this important project. Having applied lessons learned elsewhere while literally turning them on their side, CTL|Thompson has developed a level of confidence that enables the company to consider new, potentially less common applications of this technology in other locations. Rehabilitating this valuable piece of infrastructure required careful, measured teamwork on every level. Knowing that all participants in the project planned and acted together, the construction and design team will be proud to watch Homestake Dam's newest, impermeable asphalt layer weather the next half century. **AT**



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Wirth is a staff engineer with CTL|Thompson.