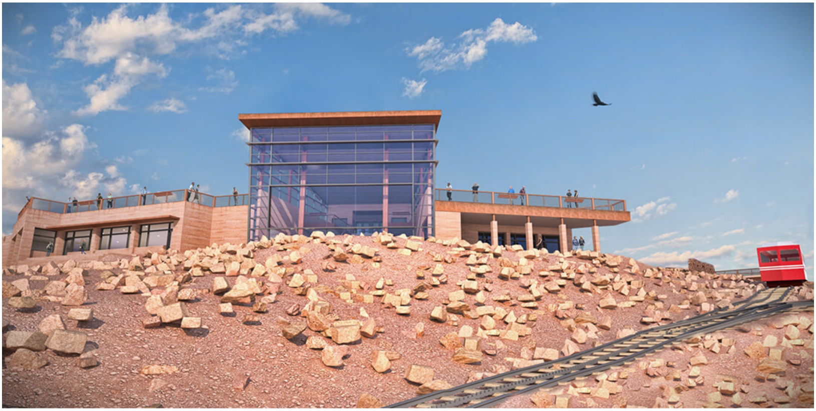
How Extreme Construction Surmounts America’s Most Challenging Landscapes

BY MATT ALDERTON CONSTRUCTION - JUL 11 2018 - 6 MIN READ



Pikes Peak will take your breath away. The tallest of the Rocky Mountains’ southern Front Range, it rises 14,115 feet just west of Colorado Springs, Colorado. At that height, everything is magnificent, and nothing is easy. Its allure was captured perfectly by Katharine Lee Bates, the professor and poet who penned the lyrics to “America the Beautiful” after a trip to the summit in 1893. But Pikes Peak isn’t just beautiful. It’s also brutal. Alongside spectacular views of “amber waves of grain” and “purple mountain majesties” are thin air, violent storms, and treacherous slopes. In that extreme environment, it’s hard to breathe, let alone build.

But that’s what Colorado-based construction firm GE Johnson will be doing for the next three years. In June 2018, it broke ground on a $50 million project, the 38,000-square-foot Pikes Peak Summit Complex at the top of the mountain. Scheduled for fall 2020, the site will include a new US Army High-Altitude Research Laboratory and Summit Visitor Center that will be the beloved crown on top of Pikes Peak’s hallowed head.

“Everything you do has to be at the next level because you’re in an extreme climate,” says Steve Eikanger, GE Johnson’s director of integrated services. Established in 1967, the firm has been building at high altitudes since 1975, when it constructed eight schools in rural Rocky Mountain communities for Colorado’s Eagle County School District. GE Johnson’s first mountain resort came in 1987: a Westin hotel in Vail, Colorado, where it built a $10.5 million addition during a brutal winter.

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With climate change promising to dramatically alter global environments, extreme construction skills may become more valuable than ever for work in challenging locations, climates, and conditions.

Forecasting Success

Perhaps the most obvious obstacle in extreme environments is weather. In the Rocky Mountains, there's snow—lots of it.

To cope, design teams must reconsider processes such as waterproofing, Eikanger says. Where a first-story roof meets a second-story wall, for example, a waterproofing membrane may need to extend four feet up on the wall due to the four feet of snow that will sit on the roof for most of the winter. That snow might also require snowmelt systems for public walkways and steel instead of wood-frame construction to accommodate its weight.

Builders and architects both make adjustments for extreme conditions. But while architects must pay attention to the minutiae of their designs, builders must pay attention to the minutiae of their schedules. For Pikes Peak, Eikanger says, "there will be days when no one can get to the top of the mountain—it will be physically impossible—and that obviously will slow some things down. But we've worked in the mountains for 43 out of our 51 years, so we've learned ways to work year-round."

A favorite strategy is enclosure, according to Eikanger, who recalls building an eight-story Sheraton hotel in Avon, Colorado, in the thick of winter. Instead of stopping work for the season, GE Johnson installed a temporary roof on the structure and enclosed it inside a massive tent. "All of the finish work—the windows, the stucco, the stone—went on inside a tempered area that surrounded the entire structure, so we never had to slow down the prefabricated construction schedule," Eikanger says.

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Instead of a tent, the team at Pikes Peak plans to utilize off-site construction. "We will be working on the project year-round; it just may not be at the summit," Eikanger says. Workers will spend winters prefabricating building components such as rebar cages, roof structures, and the exterior walls that will protect the interior. All modules will be constructed in nearby Colorado Springs, then transported to the jobsite in a special roll-off truck with an optimal length and turn radius ideal for navigating the extreme switchbacks of Pikes Peak's ascent.

Workforce Workarounds

Builders in extreme environments have to consider not only the weather but also

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the workers, according to GE Johnson Communications Director Laura Rinker.

“We have to manage how we tend to people working on the project, ensuring that their vital signs are good and that they have shorter work days than at a lower altitude,” Rinker says. On the Pikes Peak project, GE Johnson has partnered with University of Colorado Denver to develop a health and safety monitoring system for workers.

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Using student volunteers from the US Air Force Academy in Colorado Springs, researchers measured participants’ vital signs as they performed various occupational tasks at altitude. The result was a physiological baseline for workers. If they show signs of altitude sickness or other distress, an on-site emergency medical technician (EMT), safety specialist, or paramedic will intervene.

Similar risks exist at the opposite extreme: In California’s Death Valley, where GE Johnson recently completed a multimillion-dollar renovation of The Oasis at Death Valley, formerly Furnace Creek Resort. Because it’s located 148 feet *below* sea level, altitude isn’t a problem—but with summer temperatures reaching as high as 125 degrees Fahrenheit, heat is the killer. For their safety, crews worked evenings.

“We had to change the time of day that we do construction because it’s too hot,” Eikanger says. Evening shifts are not only safer but also more productive. “You can’t do a large concrete slab placement if you let it sit out in the sun,” he says.“At these temperatures, the surface will dry too fast to finish properly.”

Extreme locations also tend to be remote—places where labor can be as hard to attract as it is to protect. Again, prefabrication can help. In Death Valley, for instance, major building systems are prefabricated in Las Vegas and Fresno, California, where the trades and materials needed are more accessible.

“Oasis at Death Valley is hours from the closest town,” says GE Johnson Integrated Services Manager John Schwarz. In an incident where a broken pipe valve caused jobsite flooding, “it was three hours round trip to the nearest hardware store to pick up a part,” he says.“So preplanning is imperative.”

Technology Equals Efficiency

To plan efficiently, technology is a critical enabler for extreme environments, according to Eikanger. GE Johnson uses Autodesk Revit to visualize projects and Autodesk Navisworks to schedule and coordinate subcontractors. “We plan and replan and replan our projects before we’re ever out building them,” he says. “We look at virtual engineering and construction as a chance to build a job as many times as we want before we get on-site.”

Because resources in extreme environments are scarce, efficiency is paramount. “We have to make sure all systems get coordinated before they ever get built out in the field,” says Eikanger, who adds that virtual models allow general contractors to anticipate necessary labor, materials, and logistics.

Once the teams are in the field, technology also helps them communicate and manage quality control more efficiently. Using BIM 360, they create punch lists and QA checklists with photos, assign action items to team members, and send notifications.

Meanwhile, for the United States Olympic Museum in Colorado Springs—which it’s currently building at a 6,035-foot elevation—GE Johnson is using 3D laser scanning for quality control. Because heat and altitude may cause metals to expand slightly, the team scans exterior framing and interior panel walls twice a day—in the morning and afternoon—to verify dimensions and correct errors in real time.

At every stage of construction, success hinges on being proactive instead of reactive. “You cannot overemphasize the importance of planning,” Eikanger says. “From weather to labor shortages, you really have to understand the environment you’re working in.”

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