Vision of the FUTURE

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Various engineering and science disciplines come together under one roof in a modern, steel-framed research facility with a goal of creating materials of the future.

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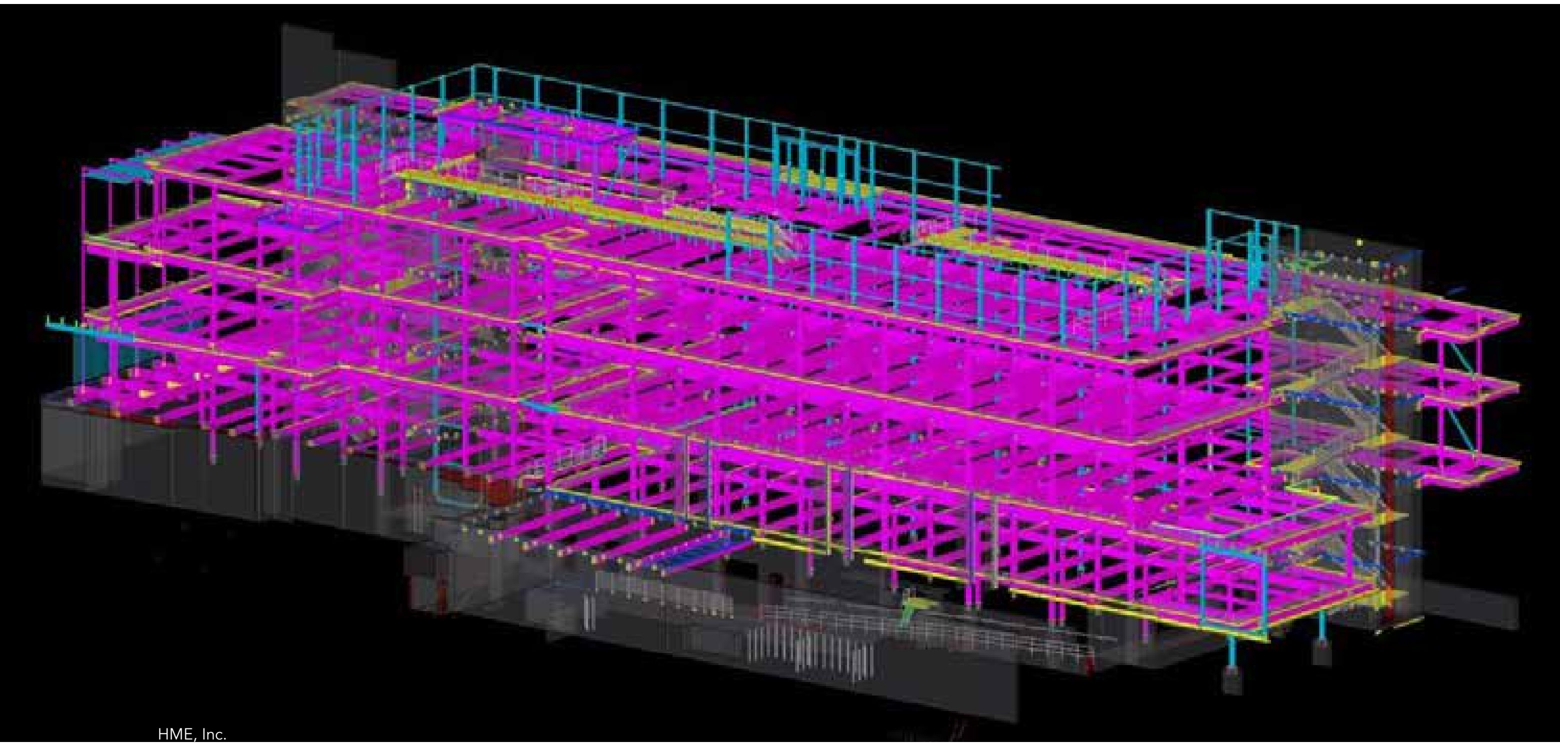
WHILE THE COORS NAME is typically associated with beer, in the case of the Colorado School of Mines, it is also a symbol of innovation and collaboration.

The school's new steel-framed CoorsTek Center for Applied Science and Engineering features lab and classroom spaces encouraging interactive, hands-on learning while focusing on collaboration between many departments, including physics, chemistry, geochemistry, chemical engineering, biological engineering, nuclear science and metallurgical and materials engineering. The state-of-the-art interdisciplinary academic and research building, which just opened in time for the spring 2018 semester, was made possible thanks to the largest donation in the school's history—$27 million—from the CoorsTek Corporation, in addition to $14.6 million in funding from the State of Colorado. The donation helped fund the new facility's construction as well as the CoorsTek Research Fellows Program.

History Lesson

The relationship between the school and the Coors family (also owners of Coors Brewing Company) began in the 1800s, and the two continue to have a successful working relationship to this day. In 1872, Adolph Coors started the Coors Brewing Company in Golden and launched other businesses as his brewing empire grew. One of those ventures began when John Herold, an Austrian immigrant and founder of Herold China and Pottery Company, leased space from Adolph Coors. While Herold was growing his pottery company, Herman Fleck, head of the chemistry department at the Colorado School of Mines,



asked Herold to create ceramic laboratory equipment for use in his research. Adolph Coors soon saw the potential growth of the ceramics market and invested in the Herold China and Pottery Company. In 1915, John Herold left Golden, and the pottery company was solely managed by Adolph Coors, who renamed the company "Coors Porcelain."

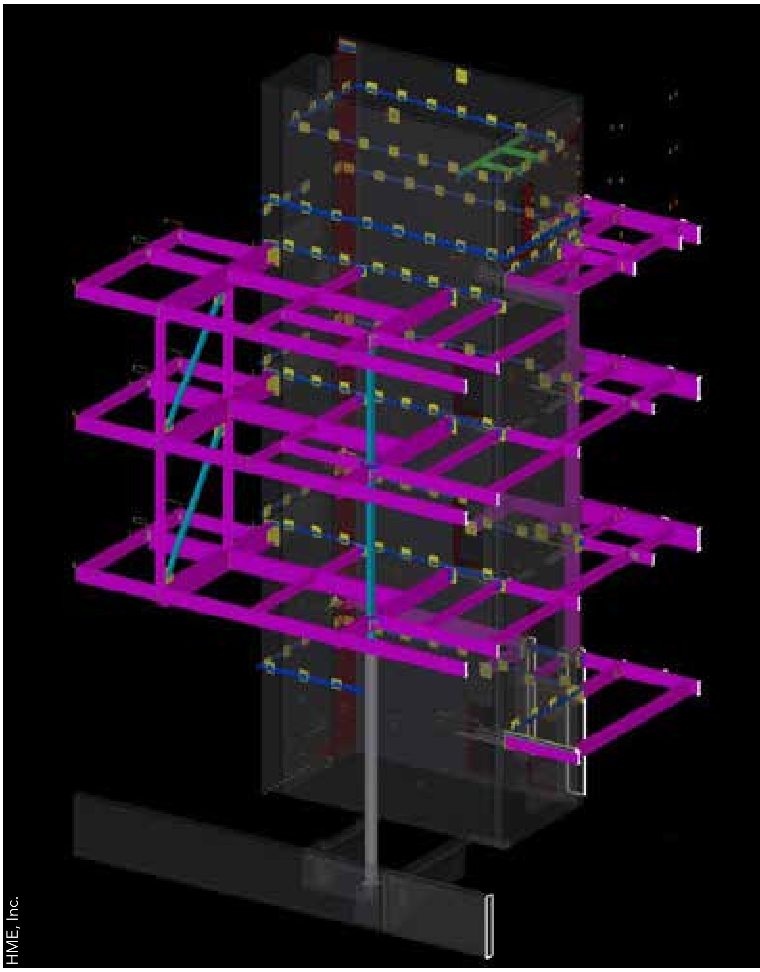
Coors Porcelain produced many commercial and consumer products, including scientific and analytical lab ware, dinnerware and hotel ware, metals (including developing the first recyclable aluminum beverage can), consumer products like vases, ashtrays, mugs, golf putters and drivers, cleats, shirt buttons, knife sharpeners and even ceramic armor. In 2000, Coors Ceramics changed its name to CoorsTek and affirmed its mission to "push the frontiers of materials science into the future." CoorsTek continues to produce advanced labware and ceramic components for many industries including electronics, energy, defense and security, equipment and machinery, food and agriculture, medical and transportation.

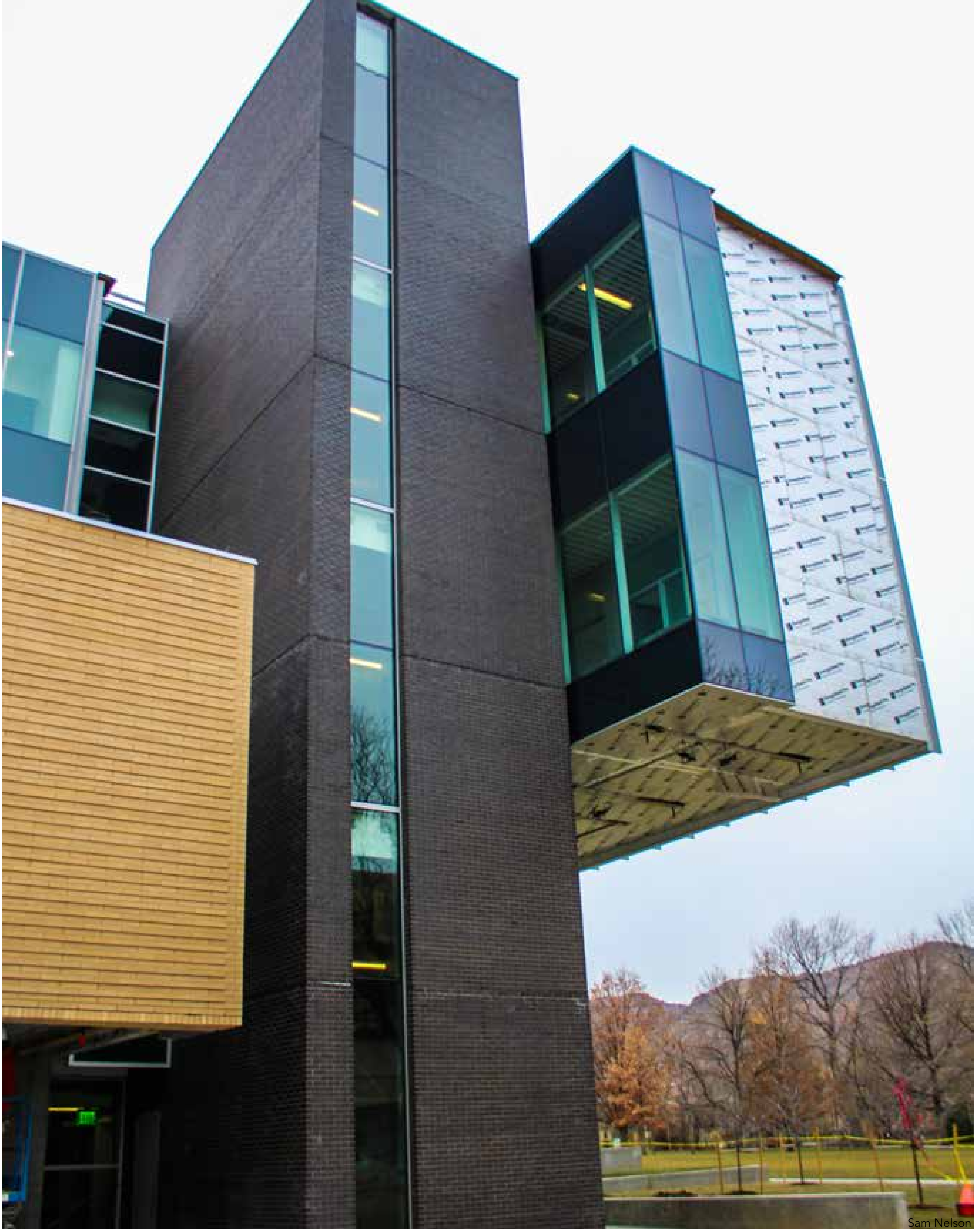
Consistent Style

Upon receiving the donation from CoorsTek, the Colorado School of Mines selected the same architectural team that designed the adjacent steel-framed Marquez Hall (see "Thinning Out" in the September 2014 issue, available at **www.modernsteel.com**): Bohlin Cywinski Jackson, which has designed several high-profile university projects across the country, and Anderson Mason Dale Architects, which has designed multiple buildings on the school's campus. The design team created a modern, 94,000-sq.-ft, four-story, steel-framed structure (using approximately 550 tons of steel in all) with an exterior façade consisting mostly of brick and glass curtain wall. On the northern façade, the glass curtain wall steps in and out while facing Kafadar Commons, the main campus quad and gathering space.

▲ Steel framing as seen from the building's southeast corner.

▼ A closer look at the cantilevered corner.





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▲ The cantilevered section at the northeast corner of the building.

CoorsTek's donation also funded high-tech equipment purchases, including one of the most advanced electron microscopes in the nation. With vibration performance being a primary design consideration, lab equipment was placed on thick vibration-isolated slabs-on-grade where the space allowed. Lab spaces on steel-framed floors were also expected to receive vibration-sensitive equipment. Because of this, AISC Design Guide 11: *Vibrations of Steel-Framed Structural Systems Due to Human Activity* (available at **www.aisc.org/dg**) recommendations were followed to design a floor structure with a maximum velocity limit of 2,000 micro-in./second. At each lab space, a slab-on-metal-deck consisting of 4½ inches of concrete over 2-in. metal deck spans 10-ft, 6-in.- to 41-ft- long, 27-in.-deep beams spanning to 21-ft-long, 27-in.-deep girders.

Steel fins on the south façade mirror those of adjacent Marquez Hall.

Meeting vibration criteria was only the first of many design challenges for this structure. At the northeast corner of the building, the floor plate extends outward over an open space, leaving the upper three levels of the building cantilevering out from the nearest concrete core wall. The steel framing cantilevers 20 ft north from the core wall, and a perpendicular cantilever extends the floor another 10 ft to the east. For the steel cantilevering from the north face of the core, moment connecting the beams to the core would not sufficiently control deflections. The solution was to add braced frames between levels, effectively creating one large cantilevered frame instead of three levels cantilevered independently. The resulting overturning moment from the frame is carried by the concrete core wall to drilled piers below, and link beams in the east core wall also carry a portion of the force to the south wall of the core.

Floating Fins

Another unique steel solution arose from the need to support six exterior vertical glass fins projecting from the south façade of the building. With varying dimensions of up to 5 ft by 19 ft, the glass fins required the introduction of W8 posts spanning between the first and second levels. The posts create a continuous support for the long edge of the fins, carrying the weight of the fins as well as wind loading. Bolted to the south flanges of the W8 posts are two back-to-back angles that provide a clamped connection for the glass, and neoprene sheets adhered to the angles protect the glass. Bolts spaced at 24 in. on center through both angle legs and the glass, when tightened, provide a clamping force to hold the glass in place. Plates welded at the exterior of the W8 shape (parallel to the web) create a closed shape capable of carrying torsion induced by wind loading on the fins. The result of this design is that the steel support is hidden behind the brick veneer, and the viewer at the exterior of the building sees the glass as "floating" out from the façade.

Though the steel support for the glass fins (and much of the primary structure) is concealed, other steel building features were exposed, including the feature stair connecting Levels 1 and 2 in an open atrium overlooking Kafadar Commons. The exposed stair structure consists of built-up steel stringers supporting precast concrete treads and glass panel guardrails. Vibration criteria for the 35-ft span of the stringers necessitated added support at the intermediate landing, though aesthetic concerns led to supporting the landing with beams cantilevering from posts hidden in the adjacent wall. Steel plate caps the bottom of these beams and turns up to form the guardrail at the landing, creating a juxtaposition of steel and glass elements.

Steel also takes a decorative form at the west terrace as a three-story trellis, where W6 posts extend from the ground level to just below the roof and connect to W6 beams that tie back to the primary structure. Plates extending through the façade at levels 2 and 3 brace the posts for buckling and lateral loading, and closely spaced HSS2×2 horizontal members form the slats that provide shade for terrace occupants.

Whether exposed or hidden, structural steel made the signature design components of this building possible. The result is a sophisticated building that not only visually anchors the main quad of the campus, but also signifies collaboration—both between engineering disciplines and between CoorsTek and the Colorado School of Mines. The end design is contextual while also representing the mission of CoorsTek to create materials of the future. ■

Owner
Colorado School of Mines, Golden, Colo.

General Contractor
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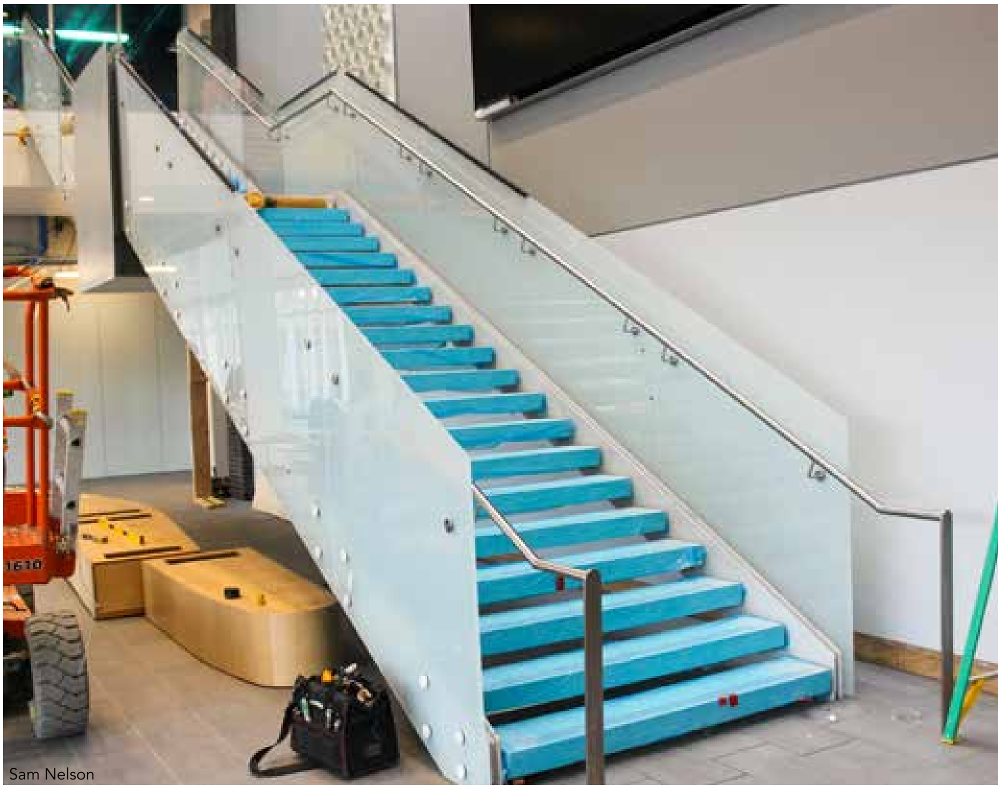
Architect of Record
AndersonMasonDale Architects, Denver

Structural Engineer
Martin/Martin, Inc., Lakewood, Colo.

Steel Fabricator and Detailer
HME, Inc., Topeka, Kan. AISC CERTIFIED FABRICATOR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The feature stair connecting levels 1 and 2.