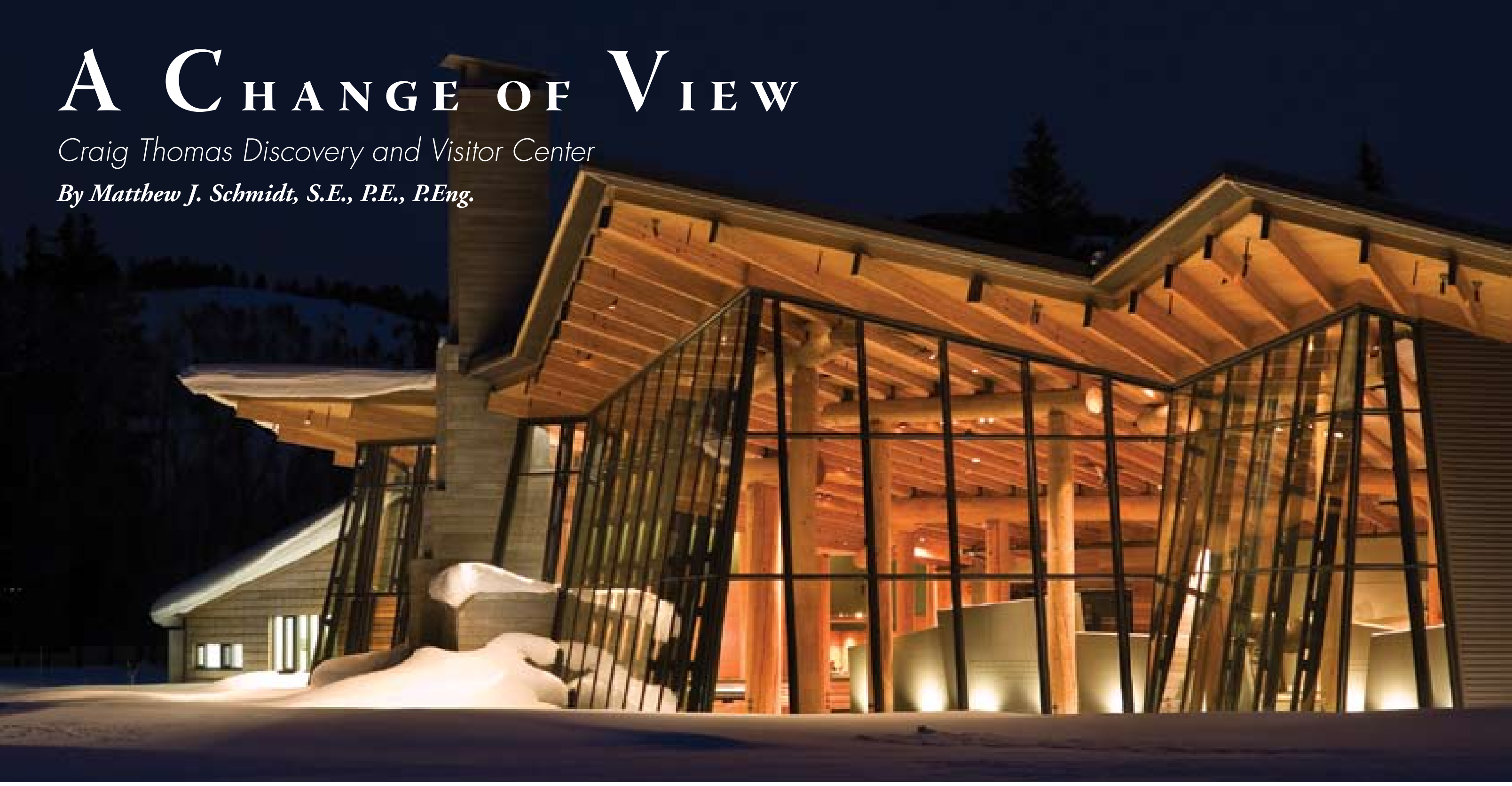
A Change of View

Craig Thomas Discovery and Visitor Center

By Matthew J. Schmidt, S.E., P.E., P.Eng.



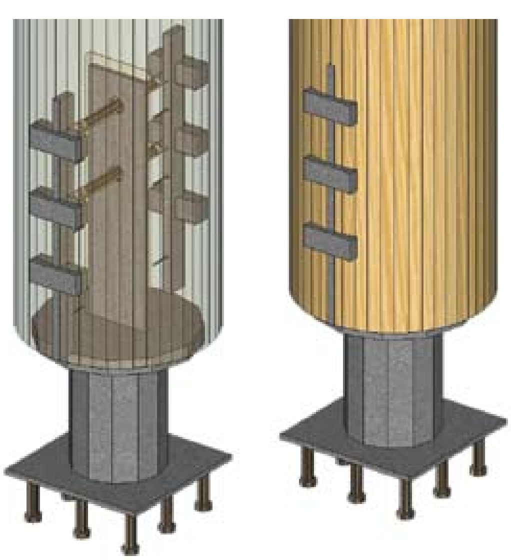
West window wall and fireplace chimney. Courtesy of Nic Lehoux Photography.

Grand Teton National Park is a spectacular place to work and play, and is appreciated by many as one of our nation's greatest natural treasures. Not only is the scenery breathtaking and the Park's environment magnetic, the nearby Jackson Hole resort offers world-class skiing and accommodations. A spectacular mix of pristine lakes, diverse wildlife and the magnificent Teton Range, the park draws nearly 4 million visitors per year. Encouraged by this widely shared love of the park and troubled by an aging visitor center, the Grand Teton National Park Foundation, together with the Grand Teton Association, spearheaded a fundraising effort that generated over half the needed funds and provided the incentive to break ground on a unique national park building.

For years, the National Park Service (NPS) maintained a visitor center at Moose, WY that began to shrink – literally, as portions of the building were abandoned following a roof collapse from high snow loads in the 1980s. Additionally, the facility had little connection to the exterior, let alone aesthetic appeal. The time was right for the facility to be replaced.

The goal of the new Visitor Center is to present a new and improved view of the Tetons to park visitors. "It's about establishing a sequence", says architect and project manager Ray Calabro of Bohlin Cywinski Jackson. Upon leaving the highway, visitors enter a parking area and are guided through native landscaping on a meandering path leading to the Visitor Center. "The colonnade of Doug fir logs surrounding the courtyard welcomes the visitor to a calm and intimate place in the vast Teton landscape".

Once entering the facility, visitors are surrounded by a forest of log columns with the breathtaking Teton Range framed as a backdrop through a thirty-foot wall of glass and steel. According to Calabro, "One of our goals with the design of the Visitor Center is to relate to historic national park architecture without copying it."



Transparent modeling view of typical log column base.

To accomplish this goal, the building combines natural materials with a bold geometry that draws similarities to the stark beauty of the Teton Mountains. Exterior walls and roof lines mimic the shapes created by the jagged peaks, while large log column and timber elements soften the environment to create a welcoming feel.

Tucked under the high roof are box-like structures that mimic agrarian sheds seen throughout the valley. Administrative offices, restrooms and meeting rooms are housed in these lower spaces of the building.

Also uncommon to NPS facilities is the large fireplace incorporated within the view window. The intent of the fireplace is to allow for a comfortable area where people can gather and listen to park rangers and naturalists give interpretive talks.

A Harsh Environment

Moose, WY is indeed a beautiful area. It is also an extreme environment for building design. Ground design snow load is 160 psf at the park's entrance and it goes up significantly from there based on elevation. In addition, the site is located in an active seismic zone just a few miles from the Yellowstone Caldera.

Matrix IMA provided a climatologic study, aiding the design team in determining more precise snow loading scenarios used to design the roof structure as well as plan for site areas prone to ice and snow build-up. In combination with the requirements of ASCE 7, the study was used to determine minimum and realistic snow loading for the roof.

IMA used historic climatology data, combined with the building shape and orientation, to formulate snow loading contours for the roof structure. "The storms in the valley typically generate from the southwest; however, non-storm winds often come from the

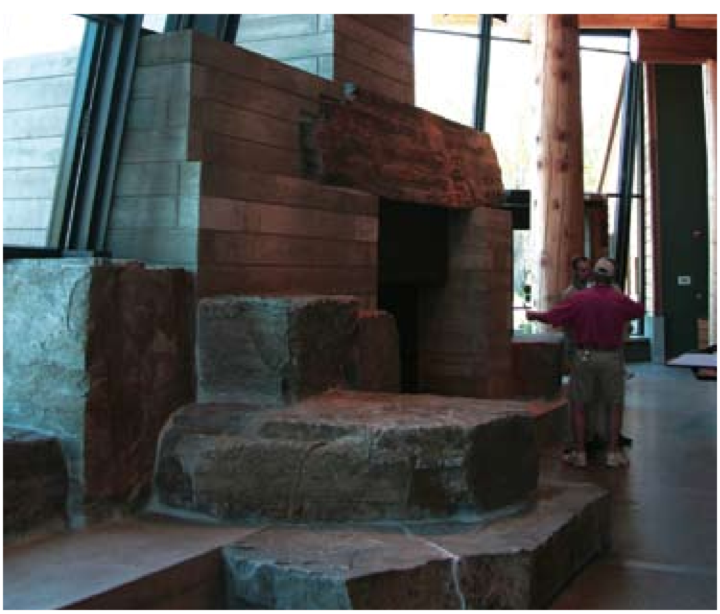
View towards Teton Mountains at interpretive area. Courtesy of Nic Lehoux Photography.

north to northeast direction creating an interesting snow drift scenario", says Rick Flood with IMA.

Further influencing the predicted snow-drifting areas on the roof is the low 3:12 slope of the roof, its length, as well as solar angles in winter months. "The snow will tend to melt more rapidly on the south facing roof over the book store, while drifts will maintain themselves on the north facing roof", concludes Flood.

The roof framing is designed to withstand a minimum of 101 psf of snow, with drifting loads approaching 300 psf in valleys and low roof areas. In addition, the IMA study concludes that cornice loads on the leeward edges of the sloping roof can exceed 1,200 pounds per foot.

Designed under the 2000 edition of the International Building Code (IBC), the building can withstand seismic design category D and 90 mph exposure "C" lateral forces. Up to 50% of the roof-design snow load is included in the structural weight for seismic lateral force calculations. Needless to say, the structure will be tested over the coming years.



Interior view of the fireplace and chimney.

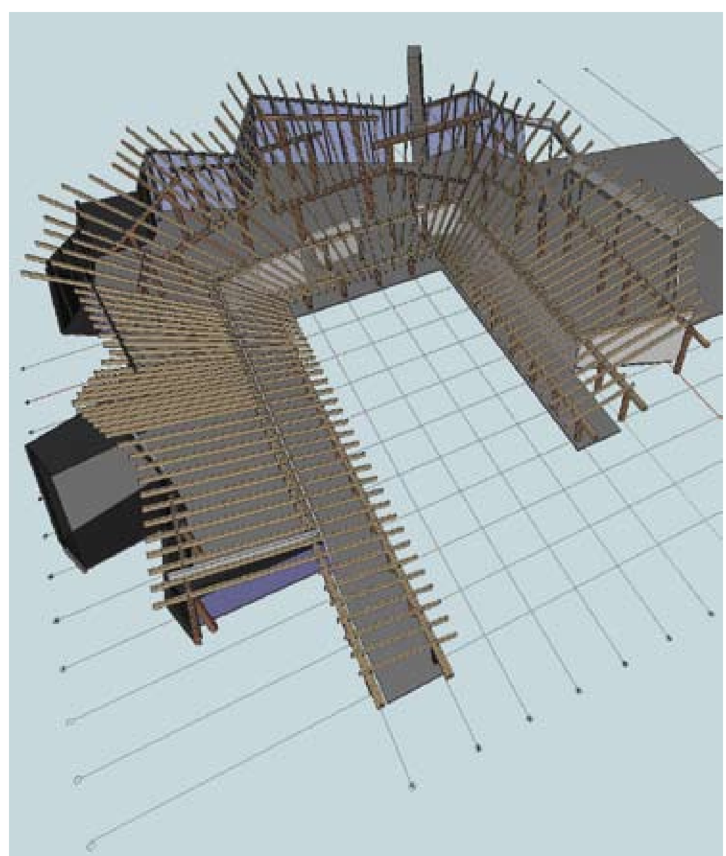
Combining the Old and New

The architectural aesthetic combines traditional wood materials such as logs and timber elements that frame into and around modern window walls and angular accents. This creates a 19,500-square foot shell that houses 5,000 square feet of interpretive area, with the balance of floor space for a classroom, art gallery and administrative offices, as well as a bookstore.

The substantially exposed structure led to a highly collaborative effort within the design team that nets a very efficient and pleasing product. "It was important that the wood structure be exposed throughout the public spaces of the building, and this requires a close coordination between architect and structural engineer", says Calabro. "Innovative and expressive uses of the structure creates an enhanced result."

From the visitor's perspective, the roof rafters and exposed concrete joint lines on the floor point in a radial fashion towards the Teton Mountains through the massive window wall to the west. This radial pattern of framing starts as a tight spacing of rafters on the courtyard side and culminates to wider spacing as they span upwards on a mono-slope towards the mountains.

All rafters over the interior space are of consistent size, which required the design team to explore several iterations of log frame support locations to balance changing rafter spans for drifting snow loads, while not over-loading framing members. The net effect is an



Model rendering of the upper roof framing.

East Courtyard with view towards Teton Mountains. Courtesy of Nic Lehoux Photography.

organic log frame layout with consistent and straight lines of framing members over the top.

Above the glulam rafters is a layer of manufactured I-joists that transfer loads to supporting members and also serve as the insulation layer. The topmost layer of framing is an additional set of I-joist framing that runs parallel to the roof slope, serving as a the "cold roof" barrier for the inside of the building via open lines of venting between the ends of the roof.

"We want to encourage air flow and maximized benefit by utilizing deeper joists in the cold roof", says Flood. To accomplish this, the cold roof is framed with 9½-inch joists that have metal bridging and frequent holes drilled for cross ventilation. While labor-intensive to construct, the balance between cold roof framing concepts and load transfer are integral to the success of a large roof structure in a snow country environment.

Competing Forces

The primary backdrop for the interpretive area is a massive floor-to-roof window wall that meanders in an angular fashion along the mountain-view side of the building. Further accentuating this element is a gradual slope of the wall back towards the building as it reaches the roof framing.

Over the window wall and throughout the leading edge of the upper roof and around the three sides of the building, the roof framing cantilevers up to 18 feet in a varying fashion that further mimics the shape of the Tetons. This also makes for unusual member design. Many of the rafters are doubled to handle the more aggressive cantilevered areas.

The combination of window wall and roof slopes creates a "lean-to" effect for gravity loads. In essence, this effect pre-loads the roof diaphragm, increasing lateral load resistance requirements.

Lateral loads are resisted by a combined system of OSB-sheathed stud walls and steel concentrically braced frames hidden within framed walls. In some areas of the building, the predicted lateral loads exceed the capacity of sheathed walls and, for that reason, the steel braced frames are substituted.

A Team Approach

Due to the nature of project funding, the NPS encouraged involvement of the Grand Teton National Park Foundation with the design team, with the Foundation essentially becoming the

client in the Schematic and Design Development phases. "The Board of Trustees at the Foundation is a savvy group, and our collaboration created a fresh approach to the NPS design process", according to Calabro.

This "hands-on" approach employed during the design and construction process isn't common for this type of project. It was, however, an integral piece of the project's success.

During construction, representatives of PBS&J, NPS' contracting agent, provided coordination between the design team and the builders. Due to the complexity of the structure and the required employment of numerous trades, coordination issues can create onerous stumbling blocks.

These issues were creatively resolved through the team effort between the contractors and design team prior to and during construction. A notable example of collaboration was dealing with the complex roof structure. General contractor Intermountain Construction hired Spearhead Timberworks to fabricate and erect the timber package for the building.

Spearhead used a Computer Aided Manufacturing (CAD-CAM) system to model the entire structure in 3-D prior to fabrication. This model was also used to fabricate the steel mullion system for the window wall, due to intricacies of the interface between those trades. "Modeling is a powerful tool and is important for a project of this complexity", says Spearhead project manager Ron McDougall.

The design team worked closely with Spearhead during the modeling process to effectively work out construction details. "You really see the possible conflicts and hash out solutions through the modeling process", continues McDougall. Certainly, this collaboration becomes a powerful tool on modern building projects.

The Craig Thomas Discovery and Visitor Center is a unique building project that utilizes innovative design and construction processes to achieve design and structural goals. Collaboration between private and public agencies, as well as world class craftsmanship, contributed to the project's success. That collaboration serves as an excellent model for future building endeavors.▪

Visitors use interpretive areas of the center.

Project Credits

Owner:
National Park Service
US Department of the Interior

Owner Representative:
PBS&J

Architect:
Bohlin Cywinski Jackson
Seattle / Wilkes-Barre / Pittsburgh / Philadelphia / San Francisco

Structural Engineer:
Beaudette Consulting Engineers, Inc.
Missoula, MT

Mechanical/Electrical Engineer:
GPD, Inc.
Great Falls, MT

Civil Engineer:
Nelson Engineering
Jackson, WY

Snow Country Consultant:
Matrix IMA
San Francisco, CA

General Contractor:
Intermountain Construction, Inc.
Idaho Falls, ID

Timber Fabricator and Erector:
Spearhead Timberworks, Inc.
Nelson, BC Canada

Matthew J. Schmidt, S.E., P.E., P.Eng. is president of Beaudette Consulting Engineers, Inc. He has 15 years experience in design of large commercial buildings utilizing reinforced concrete, structural steel, log, timber framing and masonry structures in high seismic and snow country areas. Matthew may be reached at ***matts@bceweb.com****.*