Intermountain Medical Center

Murray, Utah

By Dorian Adams, S.E.

Reaveley Engineers + Associates were awarded an Outstanding Project Award in the 2008 NCSEA Annual Excellence in Structural Engineering program (*Category – New Buildings over $100 million).*

Intermountain Medical Center is a 1.3 million square foot flagship hospital for Intermountain Healthcare, one of the nation's leading health care providers. Designed to replace two major Intermountain Healthcare hospitals in the Salt Lake City area, this world-class medical center has the latest 21st century medical technology and will stand among the most notable medical centers in the world.

Five Centers of Excellence and three support buildings make up the 110 acre campus:

- J.L. Sorenson Patient Tower, 15 stories, 586,000 square feet.
- J.L. Sorenson Heart and Lung Center, eight stories, 193,500 square feet.
- George S. and Dolores Dore' Eccles Outpatient Care Center, eight stories, 120,000 square feet.
- Carolyn Barnes Gardner Women and Newborn Center, four stories,190,000 square feet.
- Jon and Karen Huntsman Cancer Center, three stories, 48,000 square feet.
- Central utility plant, a plant operations building, a waste management facility and central laboratory.

Approximately five miles east of the hospital lies the active Wasatch Fault, capable of producing a 7.3 magnitude earthquake. The design and construction team was faced with the task of providing a cost-effective medical facility capable of serving the community after a large earthquake, with minimal disruption. It was essential that the design was both economical and would limit damage to structural and non-structural building components and medical equipment.

Distinct structural systems were adapted to meet the specific needs of each facility on campus, resulting in the use of a variety of lateral force resisting systems, including: buckling restrained braced frames (BRBFs), special concentric braced frames, special reinforced concrete shear walls, and special steel moment frames (bolted end plate and dog bone). A new BRBF connection was tested and utilized to meet strict project specific criteria, saving nearly $500,000 and shortening the schedule. Other creative cost-saving structural solutions included:

- Expanded polystyrene foam as backfill on the two-story deep foundation wall, reducing lateral earth pressure.
- High fly ash concrete in the large mat foundations.
- Precast concrete utility tunnel in lieu of cast in place concrete.
- Reinforced earth retaining walls to eliminate lateral earth pressure on some areas of the building.
- The hospital was constructed on a brown field site with a number of EPA and other restrictions that required creative and well-planned structural systems, including the use of smelter slag as structural fill.

Buckling restrained braced frames were chosen as the lateral force resisting system for four of the tallest buildings in the complex. BRBFs have the ability to absorb a tremendous amount of seismic energy as the braces go through compression and tension yielding cycles. The BRBFs are designed to yield while the columns and beams are designed to remain elastic during an earthquake. Testing has shown that BRBFs can withstand many cycles of large inelastic deformations while maintaining strength and absorbing energy in excess of that produced by major seismic events.

The configurations of the BRBFs in the facility are organized to work with the architect's layout of corridors, windows, stairs, and elevators. In many cases, corridors and doorways pass between the braced frame diagonals. There are 648 BRBFs on the project, making the project the largest of its kind in the United States at the time it was designed and constructed.

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Integration of the large steel columns with the concrete shear walls required careful planning and coordination.

Six full-scale BRBF qualifying tests were successfully completed at the University of Utah structures laboratory consisting of two 184 kip braces, two 414 kip braces, and two 920 kip braces. Testing followed the guidelines found in the AISC-SEAOC *Recommended Provisions for Buckling-Restrained Braced Frames*. Two of the test braces experienced cyclical loading at forces above 1.3 million pounds.

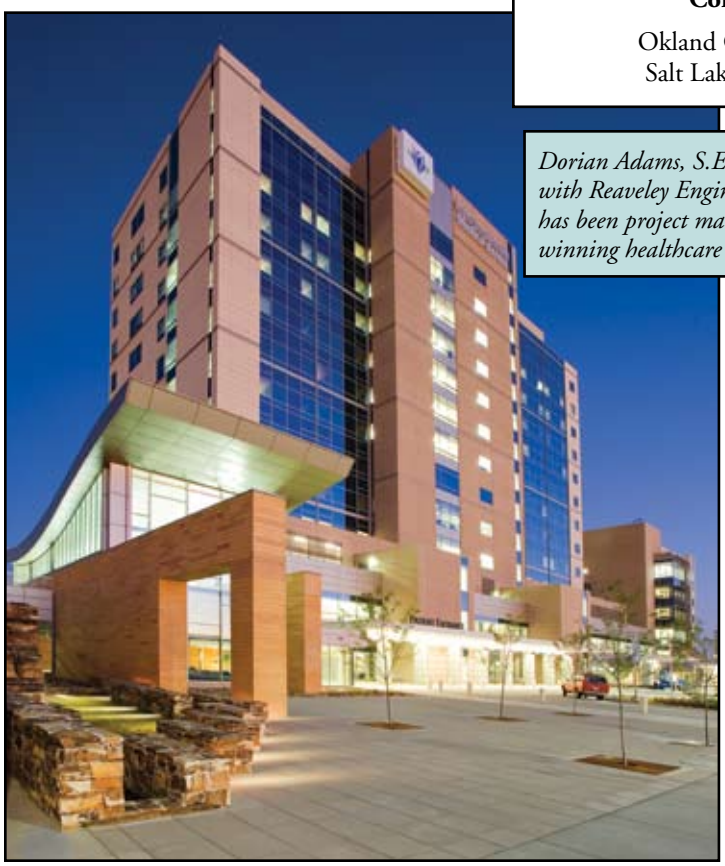
Innovative Solutions

- **Fast Track Construction** – The structural contract documents were developed and put out to bid within seven months. A fast-track construction method was implemented by bidding the project in several phases. Construction of the steel structure was underway while architectural, mechanical, and electrical contract documents were being completed. The architectural and engineering designs were developed and coordinated on a critical path format to meet the schedule of each bid package.
- **Construction and Sequencing Coordination** – The design and construction team worked closely with the steel erector and the rebar installers in a series of weekly coordination meetings for a proactive approach to solve potential construction challenges early. One result of this effort was a seamless integration of the steel and concrete at the complicated special seismic connections between the BRBFs and the concrete shear walls. The first tier of steel columns and additional tie-in steel was shipped to the site and erected shortly after the reinforcing steel for the special boundary elements in the concrete shear walls was in place. This allowed for structural steel erection to continue simultaneously with formwork and concrete placement, and kept the extremely aggressive schedule on track.

Stephen Dibble, IHC Director of Facility Planning and Construction said, "The project was built with a [CM/GC] agreement resulting in a savings of about $15 million dollars and shortening the schedule by more than a year. What made this possible was the responsiveness of the structural engineers and their ability to provide the drawings on a very tight schedule, and with an unprecedented attention to detail. The number of structural change orders [was] incredibly low, which is nothing short of amazing for this type of fast track project. This extra effort paid huge dividends for us as the owner. The structure was quickly erected and met or exceeded all of the stringent hospital needs, such as surgical equipment vibration control and stringent seismic safety."

Anchor rods up to three inches in diameter were used to resist the tremendous uplift forces from the BRBF columns.

Connections between BRBFs and reinforced concrete shear walls required special seismic detailing.



The 1.3 million square foot Intermountain Medical Center is a flagship hospital for Intermountain Healthcare, one of the leading health car providers in the nations.

Intermountain Medical Center is a place where the architects, engineers, builders, and health care providers teamed to create a healing environment, where patients can get the best possible care.▪

Team Members

Architect

Anshen+Allen
San Francisco, California

Structural Engineer

Reaveley Engineers + Associates
Salt Lake City, Utah

Structural Associate

ARUP
San Francisco

Mechanical Engineer

Van Boerum & Frank Associates
Salt Lake City, Utah

Electrical Engineer

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Dorian Adams, S.E. is currently a Principal with Reaveley Engineers Associates. Dorian has been project manager on several award-winning healthcare and laboratory facilities.