UCSF Ray and Dagmar Dolby Regeneration Medicine Building

By Michael Gemmill, S.E. and Steve Marusich, S.E.

Forell/Elsesser Engineers, Inc. and Nabih Youssef Associates were both Outstanding Award winners for the Ray and Dagmar Dolby Regeneration Medicine Building project in the 2011 NCSEA Annual Excellence in Structural Engineering Awards Program (Category – New Buildings over $100M).

Courtesy of Bruce Damonte.

At first glance, most would never guess that a building could be constructed on the steep hills behind the dense Parnassus Medical Campus of UCSF. The desire to efficiently use one of the last remaining slivers of land on the campus, combined with a daring architectural and structural design, resulted in the recently completed $123M Ray and Dagmar Dolby Regeneration Medicine Building (RMB), which houses new laboratories for the University's emerging stem cell research program.

The project team was tasked with a significant challenge: develop a showcase building on a demanding and steeply-sloping site that is constrained by myriad obstacles located just 6 miles from the powerful San Andreas Fault. The entire team collaborated to develop a design which follows the curve of the adjacent roadway and floats above the existing terrain, which slopes up to 65 degrees. The final result is a 700-foot long by 65-foot wide serpentine-shaped building with a form that is largely derived from the site topography.

The architect's dramatic vision for the building to appear to float above the hillside had to be balanced with the UCSF's desire for enhanced seismic performance. The final result is a relatively economical solution using a base-isolated steel space truss substructure topped with a conventionally-framed steel superstructure. The space truss is versatile enough to accommodate the varying slope of the hillside, and curves in plan while still maintaining a level platform to economically construct the conventional steel framing above. The team's integration of architecture and engineering essentially created a building on what could have easily been viewed as an otherwise un-buildable piece of land.

The use of seismic isolation provided the desired enhanced level of seismic performance, permitting the building to be designed with limited damage in a Maximum Considered Earthquake. "Triple Pendulum" isolation bearings, manufactured by Earthquake Protection Systems of Vallejo, California, were selected because of their ability to limit the torsional response of the long and narrow structure. Based on non-linear response history analysis, the structure is anticipated to move a maximum of 26 inches laterally and 2 inches vertically in the Maximum Considered Earthquake.

Initial analysis indicated that the narrow building configuration resulted in the tendency for the structure to "tip" during an earthquake. Since the isolation bearings cannot resist tension directly, the team had to conceive a solution that could resist the required 200-kip tension force at any point of the building's travel while being fabricated using structural steel techniques. Forell/Elsesser, in collaboration with Schuff Steel, created a custom dynamic uplift restraint device. The device consists of two pairs of rollers that ride on curved tracks, which are interconnected by an articulating linkage assembly. The performance of the uplift restraint was successfully verified by shake table testing at the University of California, San Diego.

RMB is connected to the 9th floor of the adjacent Health Sciences Building by a 140 foot long steel bridge. The bridge utilizes plate girders to span the 100 foot main span. The bridge is vertically supported by an 8-foot diameter concrete shell at the north end and a steel service elevator tower to the south. The concrete shell and steel tower also provide lateral support for the bridge by cantilevering more than 90 feet from their foundations. The bridge is seismically separated from RMB and the Health Sciences Building to permit the anticipated 3 feet of differential lateral movement.

RMB achieved LEED Gold Certification. The building is the first LEED Gold Certified project to receive an Innovation-in-Design (ID) Credit for High Performance Seismic Design. The design-build team was able to show that the base isolated design resulted in a 40% reduction of structural materials and 43% reduction of CO_2 over a conventionally designed structure of equal seismic performance.

The successful completion of the project was the result of close collaboration between UCSF, the Design-Build team of DPR Construction, SmithGroupJJR, and Forell/Elsesser Engineers, and the Bridging-Design team of Rafael Viñoly Architects and Nabih Youssef Associates Structural Engineers. Together the team was able to deliver the project $20M under the original budget and two years ahead of schedule.▪

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