Base Isolation of the Utah State Capitol
by Jerod Johnson, Reaveley Engineers and Associates

In the Fall of 2002, the design for the seismic base isolation of the Utah State Capitol Renovation project officially began. Leading off the design effort was a series of 18 workshops involving the entire design team and the construction manager. The purpose of each workshop was to zero in on a specific project issue, get input and feedback of all involved, and arrive at a set of common goals and potential solutions for each renovation issue.

One of the first workshops, entitled "Seismic Issues", lasted for three days and dealt with the complex science of integrating a seismic base isolation system into the existing State Capitol Building. Prior studies, including an intensive historic structures evaluation and report, had concluded that a base isolation system coupled with new stiffening walls in the superstructure would be the best approach for renovation in terms of both cost and performance.

Design of a base isolation system for this complex structure was not the only challenge. The designers and the construction manager also had to find a way to temporarily support the building while existing footings and foundations were removed, allowing the installation of base isolators and along with new footings and foundations. Through the "Seismic Issues" workshop, and a series of meetings which followed, an innovative approach for load transfer was developed. This consisted of using a series of deep foundation elements call "micropiles" to provide jacking points for load transfer. These were strategically placed to enable the minute lifting of the building on structural jacks. Large reinforced concrete load transfer beams were cast in a grid running each direction just above the existing foundations encapsulating each existing building column. Upon placing the jacks between the micropiles and the load transfer beams and activating the jacks, the temporary support of the building was incrementally accomplished.

Upon being load transferred, the footings corresponding to each column were removed. Base isolators (typically one below each column) were then "hung" into place. Following the isolator placement, a new reinforced concrete mat foundation was

placed below the isolators. Upon reaching adequate strength, the column load was then released back to the new isolator and mat foundation. The large load transfer beams remain as a permanent building component and may be used for future removal and replacement of isolators should the need arise.

The base isolation system, comprised of 265 isolators in total, has the effect of de-coupling the building from the ground. This enables the building to move in relative independence of the horizontal motions that typically accompany an earthquake. It is expected that the base isolation system will dramatically reduce earthquake motions thereby reducing forces and vastly improving the expected seismic performance of the structure. Studies indicate that the total seismic impact on the building, in terms of maximum expected seismic force, is reduced by roughly 75 to 80 percent. This equates to a vast improvement in consideration of life safety for building occupants. In addition, the building itself, the most valuable and historic of buildings owned by the State of Utah, is far more likely to remain intact during an earthquake and capable of providing years of continued service afterward.