

Immediate Occupancy Seismic Upgrade of an Operating High-Tech Manufacturing Facility

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ABSTRACT

A design example is presented to illustrate the creative solutions implemented to achieve Immediate Occupancy performance for a voluntary seismic upgrade of a high-tech manufacturing facility, which is required to remain fully operational during construction. The owner desired to design for Immediate Occupancy (IO) performance for several reasons including risks associated with the use of hazardous chemicals and the crippling cost of a production shutdown.

The facility is located in the Silicon Valley, less than two miles from the Hayward Fault. The building is split level, with a two-story portion that is 45,000 square feet in plan, and a one-story portion that is 91,000 square feet. The entire ground floor of the building is occupied by operating clean rooms. The original lateral system of the building consists of exterior tilt-up concrete panel shear walls and steel concentrically braced frames with wood-framed roofs, which were found to be inadequate for the IO-level demands.

The design required careful consideration of the owner's objectives to upgrade the building while minimizing costs and providing continued operations. The upgrade utilizes exterior steel frame and concrete shear wall buttresses in conjunction with buckling restrained braces and link elements to improve performance without interrupting operations. The new exterior buttresses limit the drift demands to the existing braced frames and gravity columns, while the buckling restrained brace elements provide high ductility and limit demands to buttress foundations and collectors. New roof level collectors above the one-story portion are required to be six feet clear of the roof due to existing piping and equipment above and below the roof and also improve the strength of the gravity framing.

Three-dimensional modeling and analysis of the building followed the ASCE 41 procedures for linear static, linear dynamic, and nonlinear static analysis procedures. The analysis confirmed that the external buttresses efficiently enhance the building performance to achieve the owner's desired performance level.

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