PREPARING CALIFORNIA FOR MAJOR EARTHQUAKES

What we learned from the infamous Northridge earthquake

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Several recent press releases mentioned predictions of a major earthquake in California, which may reach a magnitude 8 or above on the Richter scale. Unsurprisingly, such predictions have sparked a renewed call for disaster preparedness—similar to what we saw just over two decades ago. In 1994, Southern California was hit with an earthquake event dubbed "the Northridge earthquake," which caused the collapse of several freeway bridges. Following that event, there was public outcry for the immediate review of the structural integrity of existing and new freeway bridges to ensure the continued safety of the freeway system.

There were countless lessons learned following the Northridge earthquake, including some that were both fortunate and surprising. Although several freeway bridges statewide suffered permanent and irreparable damage, thousands of statewide freeway bridges successfully remained upright despite suffering major structural damage. Most importantly, the Northridge earthquake prompted a comprehensive and immediate statewide effort by the

State of California, Department of Transportation ("Caltrans") to retrofit existing bridges and to improve the safety of all new freeway bridges being designed and constructed.

Design Changes

Along with the ambitious Caltrans retrofitting projects for existing bridges, there were immediate design changes made to the proposed new freeway bridges that were ready for or already under construction. Immediate design changes were made to reflect the new seismic information collected following the Northridge earthquake.
Many of the new freeway bridges planned to heavily utilize concrete freeway bridge support columns, which are engineered steel rebar cages encased in concrete. New concrete freeway bridge support columns were going to add more steel rebar-reinforcement. More rebar into the designs meant more welds into each new support column. The additional rebar and welds translated into a quality control inspection nightmare for both Caltrans and the contractors building the concrete freeway bridge support columns.

Quality Control

For most freeway bridge construction projects, the steel rebar cages for the bridge columns are manufactured on site and all at once. Quality control of the rebar cages includes an initial visual inspection of all welds by a Caltrans engineer during fabrication, followed by a random sampling of the finished rebar cages for testing by x-ray, as well as destructive stress testing of the various weld joints to confirm the design strength and integrity of the rebar cages.

Increasing the number of required welds in the rebar cage design also created an unintended consequence: a shortage of qualified welders for constructing the rebar cages. The design changes to the contracts that required additional rebar and welding led to an immediate scramble among the working general contractors for the hiring of more welders. Alternatively, the contractors increased the welders' overtime hours to meet existing construction deadlines. Private industry adapted to the increased workload burdens caused by the new design changes by recruiting, training and adding more qualified welders to the workforce.

The Caltrans workforce, however, was not able to adapt as quickly to the increased workload. Adding qualified Caltrans personnel to conduct weld inspections has historically been a very slow and meticulous process. The combination of more welds, less experienced private welders and the static number of Caltrans weld inspectors and testing facility capacities was certainly not a recipe for success.

Overburdened

Several problems arose following the design change calling for more rebar and welds in the rebar cages. First, there was a steadily increasing number of welds being rejected by the Caltrans weld inspectors at the visual inspection stage. Part of the blame for defective welds could be traced to the influx of less experienced welders. Good welding is a craft born out of experience and familiarity with the materials used and the welding process. Additionally, the welds had to be completed within the given project timeframe. Although not specifically studied, there appeared to have been an increased error rate caused by welders asked to work an excessive amount of overtime hours. Nonetheless, project delays were occurring from the increase in the number of rejected welds.

Second, Caltrans weld inspectors were correspondingly being overburdened because of the increased number of visual inspections now being required in every freeway bridge job. The Caltrans' hiring process didn't keep pace with the need for qualified Caltrans weld inspectors. The shortage of weld inspectors led to construction contacts delay claims and thus increased project costs. Documentation of the weld inspections were less adequate and more abbreviated than required by the project auditors. Some Caltrans weld inspectors that did not meet the challenges of the increased workload were subject to the employee adverse action process.

Last, Caltrans had difficulty keeping up with the required secondary testing of the rebar cages. Working with limited lab equipment, engineers had to test twice the number of samples in the same amount of time. This overload caused an extreme backlog of the secondary weld testing and strained the capabilities of both the employees and the lab equipment.

The Legal Division became inundated from the handling of new administrative hearings for employee adverse action personnel matters. Contractor change order claims also increased dramatically. The Legal Division was called upon to draft, review and approve emergency contracts to repair the infrastructure damaged by the Northridge earthquake. And finally, there was a marked increase in Northridge earthquake-related tort claims against Caltrans for personal injury and property damage.

Looking Ahead

A major earthquake in California appears inevitable and will certainly result in even greater physical impacts than those caused by the Northridge earthquake. What will happen and how will we respond the next time? ✪

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