

Implementing the California Vital Infrastructure Vulnerability Assessment Project

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ABSTRACT

The California Vital Infrastructure Vulnerability Assessment (Cal VIVA) project, undertaken by engineering and planning faculty at California Polytechnic State University-San Luis Obispo (Cal Poly) in support of the California Governor's Office of Emergency Services (Cal OES), has established an approach to identify and mitigate seismically vulnerable state-owned buildings. The Cal VIVA project developed a standardized screening and earthquake vulnerability assessment methodology using industry standards. Due to the large number of state-owned buildings, the Cal VIVA project focused on buildings identified as critically necessary for response and recovery efforts. Cal VIVA concluded that the most direct institutional knowledge about physical characteristics of individual buildings resides with state agencies and departments, and there is a greater likelihood for successful implementation of Cal VIVA methodology if building assessments focus at the department level, rather than at the statewide level. Based on this conclusion, the Cal VIVA project developed and tested a process by which individual state departments can systematically address critical building vulnerability and implement potential mitigation measures on a long-term basis. The project also developed a State Reporting Plan to facilitate planning and monitoring the statewide progress of seismic vulnerability mitigation. The intended outcome of the Cal VIVA project is implementation of a statewide coordinated plan to reduce seismic vulnerability and increase natural hazard resiliency of state-owned buildings. Although the Cal VIVA project developed a feasible concept, the implementation of the process will be complex due to the sheer size of the state and the current organization plan.

Introduction

The California Vital Infrastructure Vulnerability Assessment (Cal VIVA) Project is a hazard-mitigation project funded by National Earthquake Hazard Reduction Program (NEHRP) through the Federal Emergency Management Agency (FEMA) and sponsored by the California Governor's Office of Emergency Services (Cal OES), with administrative support by the Earthquake Engineering Research Institute. Cal VIVA is an implementation element of the 2013 California State Multi-Hazard Mitigation Plan (SHMP). The 2013 SHMP describes past and current hazard mitigation activities and outlines goals, strategies, and actions for reducing future disaster losses. It emphasizes that California's resiliency (i.e., ability to survive and recover from a disaster) strongly depends on the State's capacity to maintain or restore operations of its infrastructure, including state-owned buildings, and that systematically assessing the condition of infrastructure is an important step toward mitigation.

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The goal of the Cal VIVA project is to systematically identify state-owned buildings that are vulnerable to natural hazards and pursue mitigation measures which protect their resilience and functionality, thereby reducing disaster losses, enhancing response, and facilitating recovery. The Cal VIVA project focused on the seismic vulnerability of state-owned buildings vital to response and recovery operations, although in the future it is the intent to expand the project to include the vulnerability of all state-owned building for all natural hazards, such as earthquake, winds, flooding, and wildfire.

Cal VIVA was initiated by acknowledging the extraordinary challenge of determining the seismic vulnerability of over 24,000 state-owned buildings. Therefore, the project first focused on the development of a standardized screening approach and an earthquake vulnerability assessment methodology for individual state-owned buildings identified as critically necessary for response and recovery operations. This screening approach/methodology was tested on 19 buildings from four departments: Department of Forestry and Fire Protection (CAL FIRE), California Highway Patrol (CHP), California Department of Transportation (Caltrans), and California Department of Water Resources (DWR).

Using the methodology for assessing and mitigating seismic vulnerability of individual buildings and also the institutional knowledge that resides at the department level, Cal VIVA developed and tested a framework for a Department Seismic Mitigation Plan. This plan created a systematic, prioritized departmental approach to reducing that department's seismic vulnerability for its vital buildings.

Cal VIVA also developed a framework for a State Reporting Plan to transmit summary findings to the California Governor's Office of Emergency Services (Cal OES) for State Hazard Mitigation Plan updates and progress monitoring. Through this plan, necessary seismic mitigation actions for state-owned buildings can be identified, implemented, and monitored.

Cal VIVA Department Seismic Mitigation Plan

The Cal VIVA Department Seismic Mitigation Plan outlines a systematic approach a department can undertake to assess its building stock's seismic vulnerabilities and prioritize improvements to that inventory. Since the numerous State entities owning building stock vary in mission, size, and access to engineering knowledge, this plan defines a general approach that can be tailored to an individual need. Application of this approach results in an action plan that clearly defines the extent of a department's building assets' seismic vulnerabilities, prioritizes the needed retrofit improvements, and identifies costs and associated construction funding. The following five main process steps define the Department Seismic Mitigation Plan:

1. **Vital Facility Screening.** Develop a listing of state-owned buildings that are vital for post-earthquake response and recovery operations by a department.
2. **Site Seismicity & Vulnerability Screening.** Screen vital buildings to identify those that are potentially seismically vulnerable.
3. **Building Seismic Assessment & Mitigation.** Assess identified buildings to determine the extent of their seismic vulnerability, and, as necessary, develop retrofit schemes and associated construction costs.

4. **Department Seismic Mitigation Plan.** Develop a prioritized department-wide plan to mitigate those seismically vulnerable buildings over time.

Cal VIVA State Reporting Plan

As work on Cal VIVA continued, there was recognition of a need to develop a statewide inventory of the seismically vulnerable state-owned buildings so that the State's overall vulnerability can be understood and mitigated over time. This need was addressed by proposing the establishment of a state-managed repository for building assessment information, known as the State Reporting Plan. Through this plan, necessary seismic assessment and mitigation actions for state-owned buildings can be identified, implemented, and monitored. The implementation of the State Reporting Plan will be divided into two phases: Phase One will focus on recording and maintaining data for buildings vital for response and recovery, and Phase Two will focus on recording and maintaining data on all state-owned buildings.

Conclusions

The Cal VIVA Project developed and tested the framework of Department Seismic Mitigation Plan which incorporates a systematic approach to consolidate a department's vital building stock vulnerability and to prioritize mitigation efforts. The project also developed the framework of a State Reporting Plan to synthesize the results of those Department Seismic Mitigation Plans. The development of these Department Seismic Mitigation Plans requires a significant investment of staff time and department resources. Implementation of the Cal VIVA process will need to overcome numerous hurdles.

- A critical step in implementing the Cal VIVA process will be the acknowledgement among the various State entities that the process must be implemented. While there is general agreement that detailed knowledge of the seismic vulnerability of state owned buildings is vital for response and recovery, this is seen as secondary to the day-to-day missions of the departments and agencies. One of the more feasible methods to ensuring implementation of the process would be to issue an "executive order" from the Governor that mandates each entity to create a Seismic Mitigation Plan.

Cal VIVA developed and tested a template to aid a department in the development of its Department Seismic Mitigation Plan. Using this template will simplify the process and create more uniformity in the plans. However, preparation of the plans is a complex and time-consuming effort that requires staff time and additional resources, such as training workshops and, for some departments, external consultants. Some of the practical challenges for departments in developing their respective plans include the following.

- Identification of vital buildings is an ongoing process for many of the departments due to changing emergency response responsibilities.
- Plan development is also strained by the lack of existing engineering data and site knowledge of individual buildings sites.

- Construction data for buildings is often difficult to locate and, in some cases, not obtainable, which requires additional engineering effort.
 - Once the assessments are complete, a significant investment of senior staff time will be required to develop, prioritize, monitor, and obtain funding for necessary mitigations.
- As Cal VIVA moves beyond buildings that are vital to earthquake response and recovery and into the review of the seismic vulnerability of all state-owned buildings, the need for additional staff time will become more acute. The extent and resultant cost of the effort may be partially addressed by the implementation of a rapid-screening system, like the system documented in FEMA 154 Rapid Visual Screening of Buildings for Potential Seismic Hazards.
 - The State Reporting Plan is a viable framework to record and measure the seismic vulnerability of state-owned buildings in a way that is useful for the individual departments and for the California Governor's OES at a statewide level. Development of the department plans and implementation of the State Reporting Plan will require approval and coordination at many levels of state government. Therefore, the State will need to determine the need for uniformity among the Mitigation Plans developed by the separate departments, boards, and agencies. Unless strict criteria is developed, it will likely be very difficult to draw any comparison between the plans.
 - Funding for the development of the Department Mitigation Plans and the State Reporting Plan will likely need to be addressed at the statewide level. Currently, each department is responsible for securing funding for its own building improvements. The most promising potential funding sources for the seismic upgrade of state-owned buildings are either FEMA Hazard Mitigation Grants or capital program funding by an individual agency or department. Once the extent of needed mitigations and associated funds is known, it may be that a different approach to funding will be required, such as statewide bonds.
 - Implementation of the Cal VIVA process is essential to ensure that the State can respond in an effective and timely manner after an earthquake. Each department that has emergency functions will need to participate in this effort. Staff time at all levels will be required to make the process a success.

Increasing the resiliency of the State of California must be a goal for all its citizens. In the past, an enormous amount of work has been done to reduce seismic vulnerability and improve the safety for its constituents. That work continues today in State agencies, counties, cities, homes, and businesses across the public and the private sector. The Cal VIVA project developed and tested a unified approach that will, over time, reduce the seismic vulnerability of all state-owned buildings. Implementation of two main areas of Cal VIVA – development of Department Seismic Mitigation Plans and enactment of a State Reporting Plan – will create a framework that will reduce disaster losses, optimize response, and improve the resiliency of the State. Working together, we can increase our knowledge, work to secure funding, and systematically reduce the seismic vulnerability of California.