State of California
Alfred E. Alquist
Seismic Safety Commission

The Field Act and Public School Construction: A 2007 Perspective

February 2007

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Errata #1
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There is an error on page 9 of **"The Field Act and Public School Construction: a 2007 Perspective."** The sentence under the section heading Performance of Public Schools Under the Field Act reads:

> " The Northridge earthquake (1994) caused the California State University System's (CSUS) Northridge campus to suffer an estimated $750 million in damage, and needed rebuilding."

The sentence should read as follows:

> " The Northridge earthquake (1994) caused the California State University System's (CSUS) Northridge campus to suffer an estimated $400 million in damage, and needed rebuilding."

Commission staff notes that the $750 million figure was discussed at public hearings conducted in the preparation of this report, in discussions amongst the Field Act Report Committee, and in conversations between Commission staff and the project contractor.

The best estimate of the damage sustained to the CSUS Northridge campus and source for the $400 million figure is found in "Effective Disaster Plans: Response, Mitigation and Continuity" by Mary M. Finley, CSU Northridge in the 10th Annual Federal Depository Library Conference of October 14-17, 2001. On page 7 of Ms. Finley's report she stated that after the Northridge earthquake, $407 million was spent on recovery on the campus of CSU Northridge.
(http://www.access.gpo.gov/su_docs/fdlp/pubs/proceedings/01pro30.html)

The project contractor, Bob Olson Associates, inc. notes that the $750 million was an error that should have been verified and should now be corrected.

The Commission and Commission staff regrets this error.

California Seismic Safety Commission

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Executive Summary

The Alfred E. Alquist Seismic Safety Commission (Commission) has for many years urged the Legislature to support the provisions of the Field Act for construction of all K-14 public schools. In 2006, Assembly Bill 127 (AB 127) was passed, giving Community Colleges the option of choosing to design and construct under local building departments or under the Field Act. This report evaluates the effectiveness of the Field Act, how it is administered, and the advisability for community college construction oversight to come under the jurisdiction of local building departments under AB 127.

Post-earthquake studies conducted by engineers and researchers over the past 20 years **(1998 EERI Forum: Manage Field Act at State Level)** have conclusively proven that public schools constructed under the Field Act, when subjected to destructive earthquakes, save lives, reduce property damage, and lower reconstruction costs. A significant ancillary benefit of Field Act-constructed buildings is that public school facilities can also serve as temporary emergency shelters and as places to assist the community in recovery. Not one public school building constructed under the Field Act has collapsed nor has anyone died in earthquakes. This exemplary performance is directly attributable to the stringent seismic design, thorough plan review, and strict inspection provisioned by the Field Act.

In 2006, the Seismic Safety Commission held public hearings over a five-month period to receive testimony regarding the Field Act. Issues raised during public hearings included:

- Delays due to the length of time required by the Division of the State Architect (DSA) review processes.
- Inconsistency of interpretations of codes/regulations by the different DSA offices statewide.
- Increased costs due to the requirements of the Field Act.
- Increased costs due to delays in plan approvals and to the consistently skyrocketing costs of construction and materials.
- Discrepancies between technical accuracy of plan reviews and the interpretations of design professionals.

Improvements made or underway by DSA to address these problems as follows:

- Is expanding its collaborative processes and involving all stakeholders.
- Implementing electronic plan reviews and document submittals.
- Completed Partnering Agreements with the Los Angeles Unified School District, San Diego Unified School District and Los Angeles Community College District to achieve quality and timely plan reviews and consistent code interpretations.
- Has instituted plans to hire contract plan reviewers to handle peak workloads and for sharing the workload among its regional offices to reduce peaks.
- Hired additional staff to handle the 150 percent increase in workload generated by recent increases in school construction funding.

Because of proven benefits from meeting Field Act Requirements and the corrective actions taken by DSA to address the issues above, the Commission opposes any legislative actions that would remove public school buildings from the Field Act.

The Commission makes four findings:

- Finding #1 The cost of compliance with the Field Act is incremental and minimal.
- Finding #2 Timeliness, consistency, accuracy, and communication are being improved by the Division of the State Architect.
- Finding #3 The exemplary performance of public school buildings is directly attributable to the stringent seismic design provisions through Enhanced Plan Review and field inspection/testing required by the Field Act. These provisions are not embodied in the standard building codes enforced for non-Field Act buildings. Performance of Field Act buildings during damaging earthquakes should be compared with non-Field Act buildings through a research program.
- Finding #4 No public school should be exempt from the Field Act such as court schools and some charter schools.

The Commission makes six recommendations:

1. Support for research using benefit-cost methodologies to analyze the full range of factors associated with Field Act statutes and administration in order to recommend improvements or alternatives to existing practices.
2. Support for administrative efforts that improve timeliness and technical accuracy of plan reviews, provide for consistent regulatory interpretation, and improve communications with implementing agencies.
3. Support for the Division of the State Architect's efforts to design and implement collaborative workload management processes that reduce planning and construction delays and, therefore, costs.
4. The Division of the State Architect's newly created training academy should expand its workshops to include all stakeholders—local government building departments, architectural and engineering firms, and the construction industry—to acquaint them with the provisions of the Field Act and its implementation.
5. Support comparative research to evaluate public school buildings constructed to Field Act and buildings constructed to non-Field Act standards.
6. No public school building in California should be exempt from the Field Act.

It should be noted that the Field Act has raised the level of knowledge and expertise in the architectural and engineering professions by requiring that they use more stringent seismic design requirements than required under the Uniform Building Code. In addition the San Fernando earthquake of 1971 increased awareness of nonstructural building components such as suspended ceilings, bookcases, air conditioning and heating ducts, lighting and other similar items. Under the Field Act DSA monitors the safety of nonstructural components when installed in school facilities, and the design professions have adopted these increased standards into general practice.

Background Of The Field Act

The Field Act has its genesis in the 6.3 magnitude Long Beach earthquake of March 10, 1933. In that earthquake, more than 230 school buildings were either destroyed, suffered major damage, or were judged unsafe to occupy. The buildings had been poorly designed and were not constructed to resist earthquake forces. Fortunately, it was 5:55 a.m. on a Friday evening, and schools were closed. It was lost on no one that a disaster had been averted by fewer than four hours.

Governor James Rolph, Jr. and the Legislature responded quickly by enacting the Field Act (named after Assembly member Don C. Field), which required earthquake-resistant design and construction of all public schools. It was enacted on April 10, 1933, exactly 30 days after the earthquake. It has since governed the planning, design, and construction of billions of dollars of public school (K-14) building investments.

Implementation of the Field Act is a complex interrelationship with dispersed responsibilities between state departments and agencies, school districts, local government building departments, the educational community, and the construction industry.

In 2006, Assembly Bill 127 (AB127) was passed, giving Community Colleges the option of choosing to design and construct under local building departments or under the Field Act.

This report evaluates the effectiveness of the Field Act, how it is administered, and the advisability for community college construction oversight to come under the jurisdiction of local building departments under AB 127.

Figure 1 Jefferson Junior High School damage after the 6.4 magnitude 1933 Long Beach earthquake.

Field Act Requirements

The Field Act (Education Code §§17280-17317 and 80030-81149) is built on four major principles:

- Seismic design standards
- Plan review
- Construction inspections
- Special tests

More specifically, the Field Act requires:

- The Division of the State Architect must write design standards for public schools.
- Public school building construction plans must be prepared by qualified California-licensed structural engineers and architects.
- Designs and plans must be checked by DSA for compliance with the Field Act before contracts for construction can be awarded.
- Qualified inspectors, independent of the architecture and engineering contractors and hired directly by the school districts, must continuously inspect construction and verify compliance with the approved plans.
- Responsible architects and/or structural engineers must observe the construction periodically. Changes to plans (if necessary) must be prepared by the responsible architects and/or structural engineers and are subject to approval by DSA.
- Special tests, if needed, must be ordered by DSA and performed by certified testing laboratories.
- Architects, engineers, inspectors, and contractors must file reports, under penalty of perjury, that verify that actual construction complies with approved plans.

Public Hearings Held

In 2006, the Alfred E. Alquist Seismic Safety Commission (Commission) conducted four public hearings to hear testimony from interested parties regarding the Field Act. These hearings sought to:

- Determine how effective the Field Act is in protecting California's school buildings and schoolchildren.
- Look into how the Field Act is enforced in regional DSA offices.
- Hear and address complaints that the DSA review process is too lengthy.
- Determine whether community colleges or any other public school should be exempt from the Field Act.
- Find ways to improve the Field Act and its implementation.

Issues raised during public hearings included:

- Delays due to the length of time required by the Division of the State Architect (DSA) review processes.

- Inconsistency of interpretations of codes/regulations by the different DSA offices statewide.
- Increased costs due to the requirements of the Field Act.
- Increased costs due to delays in plan approvals and to the consistently skyrocketing costs of construction and materials.
- Discrepancies between technical accuracy of plan reviews and the interpretations of design professionals.

The Seismic Safety Commission took public testimony regarding these issues and what the Department of the State Architect is doing to respond to them. A list of those who gave testimony before the Commission is on page 3 of this report.

Performance Of Public Schools Under The Field Act

Since 1940, school buildings constructed under the Field Act have performed extremely well in earthquakes. No Field Act building has either partially or completely collapsed, no school children have been killed or injured in Field Act-compliant buildings. ***(1998 EERI Forum: Manage Field Act at State Level)***

Nearby, however, commercial buildings suffered collapse and heavy damage.
For example after the 1989 Loma Prieta earthquake the Marina Middle and John Swett schools, both located in San Francisco's heavily damaged Marina District, were used as emergency shelters and disaster assistance centers.

The Northridge earthquake (1994) caused the California State University System's (CSUS) Northridge campus to suffer an estimated $750 million in damage, and needed rebuilding. Two community colleges in the San Fernando Valley, Pierce and Mission Colleges, of similar age and type of construction to the Northridge campus, were subject to very similar shaking in that earthquake, but had only $5 million and no damage respectively. In addition **there was no partial or complete collapse of any public school in this event.**

Similarly, the Landers Elementary School experienced only minor damage during the Landers earthquake (1992) and was capable for reuse almost immediately while several homes nearby were greatly damaged. It should be noted that Landers Elementary School is located less than one-half mile from the fault that generated the major (7.3 magnitude) earthquake that resulted in 12 feet of horizontal surface rupture that continued for about 45 miles.

Figure 2 Marina District Apartment building damage during the 6.9 magnitude 1989 Loma Prieta earthquake**.** Two nearby public schools were not damaged and were used as emergency shelters.

Figure 3 California State University Northridge parking structure built in the early 1990s collapsed after the 6.7 magnitude 1994 Northridge earthquake.

Figure 4 Landers Elementary School with minor non-structural damage and immediate reuse after the 7.3 magnitude 1992 Landers earthquake. There has been no partial or full collapse of any public school building constructed to the requirements of the Field Act since 1933.

Field Act Administrative Process

The Division of the State Architect (DSA) is headquartered in Sacramento, with regional offices in Los Angeles, Oakland, Sacramento, and San Diego. The agency is headed by an appointee of the Governor who must be a California-licensed architect. DSA is authorized by the Field Act to adopt and interpret rules and regulations governing public school design and construction. The technical regulations are contained in Title 24 of the California Code of Regulations (CCR), Part 2 of the California Building Code (CBC). Design professionals (architects and engineers) must comply with these regulations when they design and construct public school buildings.

Approximately 90 of the Division of the State Architect's technical staff members are licensed Senior Structural Engineers. DSA is also assisted with plan review under contract with 100 private structural engineering companies. DSA also contracts with over 200 certified and inspected testing and inspection facilities and about 1,600 certified Project and Assistant Project Inspectors. DSA also is assisted with its access and energy compliance reviews by technical staff members from other state agencies, including the California Geological Survey (CGS) and the Office of the State Fire Marshal.

The Division of the State Architect's administrative process for the Field Act involves several steps:

- School buildings are required to be designed and signed by California-licensed architects and/or structural engineers.
- "Submittal packages" must be complete—building plans and specifications, supporting calculations, and site-relevant geotechnical and soils reports. Division of the State Architect engineers closely check submittal packages to ensure that designs comply with current code requirements and that calculations are consistent with drawings. The details of construction must be coordinated, and design plans must be integrated from the many disciplines involved in construction—structural, mechanical, electrical, and fire protection engineering; grading and foundation construction; framing and roofing installation; plumbing, electrical, heating and cooling construction; and others. If not complete, plans must be revised.
- Once school building plans are approved, the Division of the State Architect closely monitors and inspects construction. Construction oversight includes continuous inspection by certified independent Project Inspectors and periodic site visits by DSA structural engineers—this is in addition to the normal construction supervision responsibilities of the involved architecture and engineering firms.
- If testing and/or special inspections of building components such as welding, reinforced masonry, concrete, etc., are necessary, DSA orders them from independent testing laboratories that must meet and maintain stringent qualifications. All laboratory test results are submitted to DSA for review, and all deficiencies must be corrected during construction.

Field Act Implementation

Local building departments enforce the Uniform Building Code, plus any other local or state provisions. The generally good performance in earthquakes of most buildings constructed since 1933 shows that local building departments are enforcing the Uniform Building Code (which

mitigates seismic hazards in general). The provisions of the Field Act, however, go beyond the requirements of the Uniform Building Code by:

- Requiring better design engineer qualifications
- Ensuring better plan checker qualifications.
- Providing more thorough and consistent plan checks.
- Requiring the signature of an Inspector of Record.
- Requiring continuous construction inspection.
- Specifying higher earthquake resistant requirements (about 15 percent higher than those called for by local building codes).
- Providing oversight by a District Engineer.
- Serving as an effective independent reviewer.

Under current law, the Division of the State Architect has the authority to certify that local building safety agencies have the necessary capabilities to effectively administer the Field Act. Local government personnel and procedures must meet the standards and practices required by the Field Act and DSA so that consistency is ensured and the expectations of safety in public school buildings are maintained. However, DSA reports that local agencies have expressed little interest in becoming certified.

Finding #1: Cost Of Compliance

Complying with the Field Act's requirements does cost slightly more than complying with the local building regulatory processes. A 1992 DSA-sponsored cost impact study entitled: *Work Group Report on the Field Act Cost Impact Study* and another 1992 study of the Field Act by the Milton Marks Commission on California State Government Organization and Economy (the Little Hoover Commission) entitled *No Room for Johnny, A new Approach to the School Facilities Crises,* determined that incremental design and construction costs are about 3 to 4 percent. These costs are, however, miniscule compared to lower building lifecycle costs, safer buildings, fewer fatalities and injuries, and vastly lower repair and reconstruction costs.

Conclusion #1: The real impacts of Field Act compliance—both initial construction and long-term benefits—should be studied further.

Finding #2: Timeliness, Consistency, Accuracy, And Communication

The review and approval of public school building plans is an iterative process involving meetings, revisions, and resubmittals, and depends largely on the quality and completeness of the initial submissions. Public testimony and historic criticism indicate that this process takes far too much time. However, the Division of the State Architect's experience demonstrates that high quality and complete initial submissions receive rapid approval. DSA information also shows that the project design and construction information is incomplete in about 15 percent of initial submissions and must be returned for further work. When revisions are required, DSA data indicates that about 70 percent of the additional time required for plan revision is spent by the submitting architects and engineers firms' offices and the remaining 30 percent involves further

DSA review of the revised plans. Plans submitted by architecture and engineering firms that are experienced in complying with the Field Act require fewer corrections and receive more rapid approvals, both of which reduce time and costs.

Timeliness of Plan Reviews. The Commission realizes that design and construction are very costly, complex, and time consuming. Time truly is money, which is reflected in the increased cost of materials in 2005-06 compared to 2003-04. The increases include, for example, plastic construction products (20 percent), copper and brass products (88 percent), concrete products (11 percent), dry wall and gypsum products (23 percent), and diesel fuel (26 percent). Higher costs are being driven by a robust construction industry and global competition for limited resources.

To address this problem, the Division of the State Architect is expanding its collaborative processes and involving all stakeholders. DSA is also implementing electronic plan reviews and document submittals and has completed model Partnering Agreements with the Los Angeles Unified School District, San Diego Unified School District and Los Angeles Community College District to achieve quality and timely plan reviews and consistent code interpretations. DSA has also instituted plans to hire contract plan reviewers to handle peak workloads and for sharing the workload among its regional offices to reduce peaks. It has also hired additional staff to handle the 150 percent increase in workload generated by recent increases in school funding.

Consistency of Regulatory Interpretations. The Division of the State Architect has created teams to address issues of consistency between its regional offices, established an "academy" to train hundreds of DSA employees, inspectors, architects, and engineers, and implemented an intranet and internet process for disseminating interpretations of regulations, circulars, policies, and procedures (http://www.dsa.dgs.ca.gov). The databases will soon be searchable.

Technical Accuracy of Plan Reviews. The Division of the State Architect's new training academy emphasizes technical accuracy; thoroughness of plans reviews, and knowledge of the applicable codes and standards. DSA's senior staff members regularly provide quality assurance services by checking the work of DSA's own and external contract plan reviewers. DSA is improving its codes and standards training and expanding the training of external plan reviewers and school building designers.

Effectiveness of Communication. The Division of the State Architect's new academy stresses processes and standards for clearly and consistently communicating its comments on the plans it receives. DSA has instituted a web-based project status reporting system, and is considering opening satellite offices when needed for major projects. In addition to establishing its new training academy, DSA is improving communications between it and other stakeholders, developing collaborative processes and partnering agreements, providing improved electronic submittal and other procedures, regularly updating its website, and participating more frequently in professional and technical meetings and conferences.

Conclusion #2: The Division of the State Architect and affected stakeholders are collaboratively addressing the principal areas of Field Act concerns expressed in public testimony. Support for administrative efforts to increase timeliness, consistency, technical accuracy, and communication with all affected parties must continue.

Conclusion #3: The submittal packages required by the Division of the State Architect, its plan reviews, and construction inspections provide a high level of quality assurance and have contributed greatly to the successful performance of public school buildings in earthquakes since 1940. DSA efforts aimed at streamlining the administrative process and effectively accommodating its increasing workload should be augmented and continued.

Conclusion #4: The Division of the State Architect should expand its use of the newly created training academy to acquaint all interested parties with the provisions of the Field Act and its implementation.

Finding #3: The Exemplary Performance Of Public School Buildings Is Directly Attributable To The Stringent Seismic Design Provisions Through Enhanced Plan Review And Field Inspection/Testing Required By The Field Act. These Provisions Are Not Embodied In The Standard Building Codes Enforced For Non-Field Act Buildings. Performance Of Field Act Buildings During Damaging Earthquakes Should Be Compared With Non-Field Act Buildings Through A Research Program.

It has been historically proven past earthquakes investigations have shown that schools built under the Field Act are safer than those built under local building codes. **(*1998 EERI Forum: Manage Field Act at State Level*).** Damage to public schools was minimal in the Imperial Valley (1940), Coalinga (1983), Loma Prieta (1989), Landers (1992), Big Bear (1992) and Northridge (1994) earthquakes, providing real-life tests of the Field Act's value.

Conclusion #5: Comparative research should be done to evaluate the differences in performance during earthquakes of buildings constructed under the Field Act and those constructed under local building codes.

Finding #4: No Public School Should Be Exempt Such As Court Schools And Some Charter Schools.

Many local building departments have limited financial and technical resources, poor enforcement practices, lack technical expertise, or simply don't have enough staff to consistently enforce the stringent seismic provisions of the Field Act.

Conclusion #6: All California schools K-12 and community colleges should be subject to the Field Act. No public school should be exempt from it, nor should any public school be exempted by the Legislature. Since local building departments have not shown interest in becoming certified as Field Act-compliant, design and construction standards for California schools have the potential to go backward if enforcement is left to local jurisdictions—school buildings would actually become less seismically safe.

Recommendations

The Seismic Safety Commission strongly supports the continued success and implementation of the Field Act in preventing school collapses and promoting the protection and safety of schoolchildren. The Commission opposes any legislative actions that would remove public school buildings from the Field Act. Furthermore, the Commission believes it is appropriate that the state provide oversight of public school design and construction to ensure Field Act consistency and uniformity of enforcement.

The Commission recommends:

1. Support for research using benefit-cost methodologies to analyze the full range of factors associated with Field Act statutes and administration in order to recommend improvements or alternatives to existing practices.
2. Support for administrative efforts that improve timeliness and technical accuracy of plan reviews, provide for consistent regulatory interpretation, and improve communications with implementing agencies.
3. Support for the Division of the State Architect's efforts to design and implement collaborative workload management processes that reduce planning and construction delays and, therefore, costs.
4. The Division of the State Architect's newly created training academy should expand its workshops to include all stakeholders—local government building departments, architectural and engineering firms, and the construction industry—to acquaint them with the provisions of the Field Act and its implementation.
5. Support comparative research to evaluate public school buildings constructed to Field Act and buildings constructed to non-Field Act standards.
6. No public school building in California should be exempt from the Field Act.