The Field Act

History and Issues for California Schools

Daniel Barclay
1854 Doris Drive
Menlo Park, CA 94025
(650) 853-1711
daniel@danielbarclay.com

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INTRODUCTION

California's Field Act, setting seismic safety standards for pubic and private schools, has been a central element of that state's earthquake preparedness policy for decades. However, it remains a controversial and much-debated issue. Various state officials and regulatory agencies have alternatively supported the legislation as a guardian of students' security, denounced it as being too stringent, and criticized it as not being stringent enough.

This report discusses the Field Act, its history, and current relevant issues. The first section discusses the history of various California earthquakes and their relation to several pieces of legislation passed in response to them, including the Field Act. The second section discusses current policy issues relating to the Field Act, namely its applicability to various types of schools, its applicability to relocatable and leased buildings, and its relation to the Uniform Building Code. The report concludes with a discussion of the relative merits and shortcomings of the Field Act, as well as similar measures taken in other regions.

HISTORY OF THE FIELD ACT

THE LONG BEACH EARTHQUAKE

The 1933 Long Beach, California earthquake (M 6.3) graphically demonstrated the vulnerability of school buildings (Figure 1). A contemporaneous account reported:

> "More significant than the damage to commercial buildings, residences, and other types of structures, was the exposure of the general weakness of the schools in which the children of all families congregate each day. In Long Beach, in Compton, in Huntington Park – in fact in every community where the earthquake was at all intense – severe damage to school buildings was general. Auditoriums collapsed, walls were thrown down, and the very exits to safety were piled high with debris which a few moments before had been heavy parts of towers and ornamental entrances. It is sufficient to suggest the terrible consequences had the same earthquake occurred a few hours earlier."
>
> (USDC, 1973)

Schools throughout the southern Los Angeles area suffered catastrophic damage, with an estimated 75% or higher enduring severe damage (Jephcott, 1986). According to the California Office of the State Architect, 300 schools experienced minor damage, 120 major damage, and 70 schools were destroyed entirely (USDC, 1973). Buildings constructed of brick or unreinforced masonry, often modeled after East Coast schoolhouses, were especially susceptible to collapse. Those schools constructed on alluvium or landfill were usually completely destroyed. Had the earthquake occurred during school hours, the loss of lives would undoubtedly have been appalling.

THE FIELD ACT

The California state Legislature took action following this disaster. Legislation proposed by Assemblyman Charles Field, AB 2342, mandating statewide seismic safety standards for public schools, was enacted within a month of the earthquake. This law, known as the Field Act, established both a building code and a regulatory procedure. In summary, the Field Act requires:

- approval or rejection by the state Department of General Services of all construction proposals
- supervision of construction work by the Department of General Services in cases exceeding $25,000 (originally $10,000)
- supervision of all new school construction work by the Department of General Services
- ongoing review of existing school buildings for seismic safety when requested by either the local school board or at least 10% of local parents
- in cases exceeding $25,000, review of the construction process according to a fixed procedure by a paid team of state architects, engineers, contractors, and inspectors

(USDC, 1973)

The Field Act establishes a stringent procedure for the review of school construction, summarized here by D.K. Jephcott. First, plans must be prepared by a qualified person who knows the principles of structural engineering. Second, the design must be checked by an independent state agency, usually the Division of the State Architect, and design errors corrected before construction starts. Third, construction must be continuously inspected by a qualified person in the employ of the school board who ensures compliance with the plans. Fourth, the responsible architect or engineer must personally supervise the work and change the plans as necessary to accommodate field conditions. Lastly, the architects, engineers, inspectors, and/or contractors associated with the construction must submit verified reports, under penalty of perjury, that they complied with the state-approved plans (Jephcott and Hudson, 1974).

The Field Act itself does not include technical building standards. It does, however, mandate the formulation of and compliance with a strict set of standards. There is a partial listing of these technical requirements later in this report.

THE GARRISON ACT

The Field Act went into effect with few problems, and new school construction followed its standards and provisions. However, many critics noted that since the Field Act did not adequately protect existing schools, the majority of school buildings were still structurally unsafe. A major loophole in the legislation was the fact that local school boards could avoid having to meet its standards by pleading lack of funds. To attempt to remedy this problem, the state Legislature passed the Garrison Act in 1939. The Garrison Act primarily outlined a procedure for school boards to follow for their pre-Field Act schools. It first required that school boards conduct immediate examinations of such schools, to be overseen by a state architect or engineer (Mann, 1979). Then, it ordered non-Field Act-compliant structures to be modernized. If there was a shortage of funds, the school board must attempt to obtain a bond issue to procure them. Should the bond issue fail, or should other circumstances intervene beyond the control of the board members, the Garrison Act absolved them of personal liability for administering unsafe buildings, provided that they were following the safety procedures delineated by it and the Field Act (USDC, 1973). A key problem with this legislation was its lack of time limits or deadlines for renovating old schools. As such, many school boards simply ignored it. This situation would, however, be remedied later.

EARLY TESTS

The first test of the effectiveness of the new Field Act came in the form of the Imperial Valley earthquake of 1940. Although this earthquake was of magnitude 7.1, larger than the Long Beach earthquake, not one of the sixteen Field Act school buildings subject to intense shaking reported any significant damage. Total monetary damage to these schools and school property did not exceed 1% of valuation. By contrast, damage to pre-Field Act schools and other types of buildings averaged 29% of valuation (Jephcott, 1986). An even more compelling case is that of the Kern County earthquake of 1952, when the damage figure for Field Act schools remained under 1% of valuation, but pre-Field Act schools suffered damage of over 50% (Jephcott, 1986).

DEVELOPMENTS IN THE 1960s

The Field Act had apparently proven to be at least a moderate success, and seismic legislation continued throughout the 1960s to build upon it. In 1963, the state Attorney General reinstated liability for school board members in districts failing to comply with the Field Act, indicating a higher level of expectations in regards to seismic safety. In 1967 and 1968, the state Legislature passed two related pieces of legislation known collectively as the Greene Acts, which strengthened the Garrison Act by setting deadlines for school compliance. The first Greene Act mandated that a statewide structural examination of all school buildings be made by January 1, 1970, on a pass/fail system. The second Act forbade the use of those failed buildings for school purposes after June 30, 1975. The Greene Acts significantly strengthened the Field Act by setting a schedule for seismic retrofitting, which the latter act had previously lacked (Mann, 1979). The Field Act was also strengthened by a 1967 statute prohibiting the construction of new schools over known active

faults – which had often happened previously due to the lower cost of land in such areas (USDC, 1973).

RECENT "FIELD" TESTS

The San Fernando earthquake, relatively similar in magnitude and location to the Long Beach quake thirty-eight years earlier, was a more useful gauge of the Field Act's effectiveness than earlier rural earthquakes. Nearly all of the buildings in the Los Angeles Unified School District, where most of the ground shaking took place, had been built in compliance with the Field Act. In addition, a more complete record of its nature and effects exists due to advances in seismic techniques and technology prior to that time, especially the system of placing monitoring equipment in private buildings.

636 school sites lay within a 25-mile radius of the earthquake's epicenter, comprising 8,600 buildings valued at over one billion dollars. The total of all damage amounted to $2.7 million, under three-tenths of one percent of valuation (Jephcott and Hudson, 1974). Nearly all of these costs were incurred by nonstructural damage. By contrast, other publicly owned structures not built to the seismic safety standards of the Field Act, especially hospitals and highways, suffered extensive harm. The Olive View Hospital alone, in spite of being newly constructed, partially collapsed and accounted for approximately $31 million in damage. The ability of school buildings to withstand intense ground motion in the San Fernando earthquake seemed remarkable, and in fact sparked new legislation extending seismic safety standards to hospitals and other types of state-owned buildings (Table 1).

Field Act-compliant school buildings have withstood subsequent earthquakes with negligible structural damage as well. Private buildings averaged a high loss of 18% of valuation in the

Coalinga earthquake of 1983, but local schools suffered little or no damage (USGS, 1990). No school structural damage of any kind was reported in the Morgan Hill earthquake of 1984, and total damages for all schools were under $30,000 (CSSC, 1985). In the 6.9 Loma Prieta earthquake of 1989 only five schools reported serious damage. Of these schools, three were constructed before the Field Act and one was damaged by the collapse of a nearby elevated freeway. One room in Loma Prieta Elementary School was destroyed, the first and to date only instance of a Field Act school being severely damaged in an earthquake (Shepherd, 1990). In the 1994 Northridge earthquake, only 24 buildings in a total of 127 affected schools were estimated to have suffered any significant structural damage (Reitherman *et al.*, 1995).

CURRENT POLICY ISSUES

VARIOUS TYPES OF SCHOOLS

There is a controversy over whether private schools, charter schools, and community colleges should have to comply with the standards of the Field Act.

Currently, the Field Act is applied to private schools but not to charter schools. Private and charter school administrators have long sought exemptions from the provisions from the Field Act, arguing that, as privately owned or independent schools, they do not need to comply with government standards. The state Legislature has disagreed in the former case, passing the Private Schools Act of 1990, which mandates private school compliance with the Field Act. The basis for this act reflects the original motives of the Field Act; to protect small children who are unable to protect themselves. Accordingly, the state Legislature and other seismic safety advocates favored

public safety over the independence of the private sector. However, in the case of charter schools, they have generally taken the opposing view. California's Charter Schools Act of 1992 (SB 1448) holds that charter schools are exempt from Field Act provisions unless their charter specifically dictates otherwise. Many charter schools are not located in typical school buildings but in whatever space is available, and might be forced to shut down if forced to comply with Field Act standards. For this reason, and the fact that relatively few students attend charter schools, there is generally a consensus that charter schools should be granted an exemption (although some groups, like the California Seismic Safety Commission, suggest otherwise). The private school issue, however, remains more seriously disputed.

The Field Act currently applies to all K-14 schools, encompassing community colleges as well as high schools and primary levels of education. Therefore, nearly all existing community colleges in California are Field Act-compliant. However, the growth of community colleges in recent years has prompted many to question the necessity of maintaining such strict seismic safety standards for them. These critics argue that the Field Act, as originally passed, was intended primarily to safeguard young children who would be vulnerable in the event of an earthquake. Community college students, usually being at least 18 years of age, would be better able to fend for themselves. Critics further argue that, unlike K-12 students, community college students are not forced to attend their school but do so of their own volition. Some legislators are pushing cost-saving legislation that would ease Field Act restrictions on community colleges, such as permitting community college students to take classes at California State University campuses not complying with its standards, and allowing the use of local instead of state authorities for inspection work. Others wish to go further and reduce seismic safety standards for community colleges to that of the Uniform Building Code (UBC), or even eliminate them entirely.

Critics of this aspect of the Field Act believe that community colleges do not necessarily fit into the same mold as K-12 schools and therefore may not necessarily require the same safety standards. However, supporters of existing policy maintain that there would be consequences to removing those standards. For example, the California State University at Los Angeles, not subject to Field Act standards, was severely damaged in the Whittier Narrows earthquake of 1987, despite being built at the relatively late date of 1958 and with plentiful funds. Earthquake damages amounted to $20.5 million – greater than the entire structural earthquake damages to California public schools since 1933, combined. The damages included "substantial structural damage" to various buildings on campus, the release of dangerous levels of asbestos in two buildings, elevator shutdowns, the closing of one particularly unsafe building for years, and the death of a student (Taly, 1988). Had the earthquake occurred during school hours, supporters point out, many more lives could have been lost.

RELOCATABLE AND LEASED BUILDINGS

The Field Act's original intent was to bring all public school buildings up to statewide seismic safety standards. However, the recent explosion in the student population, coupled with the desire to save money, has led many to believe that Field Act standards should not be universally enforced, and that waivers should be given in certain cases. In essence, the usage of waivers takes a small risk that an earthquake will not occur until new, Field-Act compliant structures can be built. Local school boards have requested waivers of the Field Act for relocatable buildings (portable classrooms) and leased commercial buildings.

Currently, waivers are permitted in both areas. The waiver on Field Act standards for relocatable buildings has been in effect for several years. Recently extended by the state legislature

until 2007 (SB 1469), this latest waiver is quite lenient, allowing exemptions of the Field Act for relocatable buildings that have been in use for only a year (May 2000), and meet only very basic safety standards. A restricted leased building waiver was renewed in 1998, permitting schools to lease non-Field Act compliant buildings for instructional purposes when the lease is from the federal or state government (California Ed. Code §17070.71(a)).

Opponents of waivers argue that they present an unnecessary risk, and that it is a more vital priority to provide additional protection to the students in the event of an earthquake than to gain a little short-term convenience. Waiver supporters contend that, in the cases of rapidly-growing schools, to do otherwise would crowd the students and hinder instruction. Some supporters also point out that, due to California law, schools that apply Field Act standards to their relocatable buildings might be penalized unless this requirement were waived.

Relocatable buildings have a waiver from Field Act standards for budgetary reasons as well. If relocatable buildings meet Field Act standards, they are considered "adequate school construction" (Ed. Code §17071.30) and are counted as permanent facilities for 20 years. (After twenty years of use, portable classrooms are legally considered true permanent facilities). The problem is that this reduces the amount of funding eligible for that school to construct additional permanent buildings. Many school officials have argued that it is ridiculous to count portable buildings as permanent facilities, and that this aspect of the Field Act should be modified. They point out that unsafe relocatable and leased buildings are not counted as permanent facilities, effectively penalizing schools with safe buildings. One possible remedy that they have suggested is to computationally increase the number of classrooms in a school district by 10% or 20%, and then not count relocatable buildings as classroom space. Supporters of existing policy argue that this change would encourage dependence on portable use and discourage the construction of permanent school buildings.

Relocatable buildings are more costly and space-consuming in the long run, and there is general agreement that they should not be used unless necessary. However, the surge in school enrollment in recent years has often outpaced the rate of permanent school building construction, often necessitating their use. Waivers of the Field Act in this situation permit this use, but possibly at the cost of encouraging the use of portable classrooms.

THE UNIFORM BUILDING CODE

Another question that frequently arises is whether the Field Act standards should be replaced by those of the Uniform Building Code. The Uniform Building Code, established in 1927, is currently the basis of the design of construction of many state-owned and privately owned buildings. (Other systems such as the International Building Code have also been promoted recently, but the Uniform Building Code remains dominant in California.) While it generally has an excellent safety record overall, the Uniform Building Code has significantly less stringent seismic safety standards than the Field Act (Table 2). Perhaps the two most notable differences are the provisions of the Field Act standards that require a full time inspector and that guard against certain types of nonstructural damage. The California Seismic Safety Commission cites the former requirement as one of the "key element[s]" of the Field Act which distinguishes it from the Uniform Building Code (http://www.seismic.ca.gov/pub/Field%20Act%20Findings%20 .pdf). According to Alan Williams, "The Uniform Building Code design requirements are expected to safeguard against loss of life and complete collapse of structure, subjected to a major earthquake, but not to limit damage, maintain function or provide for easy repair" (http://www.cashnet.org/Resource%20Center/Section%203/3-4-10.htm).

Many proponents of the Uniform Building Code argue that it is folly to have two separate sets of standards, one for schools and one for all other buildings, thus sacrificing uniformity and efficiency for a little extra protection. Field Act supporters assert that the double standard is justified by superior performance of Field Act-compliant buildings in earthquake situations. In recent history, California public schools have consistently outperformed other buildings as a whole, even those built to the standards of the Uniform Building Code. As Leroy Greene, author of the Greene Acts, points out,

> "On the face of planet Earth, the very safest place to be during a major earthquake anywhere would be in a relatively new California public school building . . . . During the Loma Prieta earthquake in the San Francisco Bay Area a few years ago, the hardest hit area was the Mission District – Many homes, businesses, and overhead freeways were destroyed. People were homeless but the Mission Middle School, built in the mid-1950's, was used as a safe haven for the homeless."
>
> (http://www.cashnet.org/membersonly/news/1999/19990914.htm)

However, such additional safety does not come without cost. The provisions of the Field Act add approximately an additional 1.5% to 5% to the regular costs of construction, which may seem little but amounts to millions of dollars. In contrast, the costs of complying with just the Uniform Building Code are significantly less than that amount. Supporters of the Field Act respond to this argument by pointing out that reduced reconstruction costs after earthquakes actually saves money in the long run. Then again, the slated lifespan of school buildings is only fifty years, not very long to recoup losses. On the other hand, and unlike most other types of structures, most school buildings are in fact used significantly more than fifty years. The issue remains unresolved.

EXPERIENCES OF OTHER REGIONS

Schools in other regions have also been impacted by earthquakes, prompting a variety of policy responses. In particular, Canada, Pacific Rim states, and states near the New Madrid fault have taken precautionary measures. Alaska and Missouri have created seismic safety commissions similar to California's. Arkansas has gone one step further and has mandated that all new construction for public structures, including school buildings, comply with state seismic standards. Washington, Idaho, and Canada provide three examples of how authorities in other areas have handled the earthquake preparedness issue.

The M 7.1 Puget Sound earthquake in 1949 catalyzed seismic safety in Washington state as the 1933 Long Beach earthquake had for California. Thirty schools in the Puget Sound area were damaged, and two students killed, even though most schools were not in session. In Seattle alone twelve schools were damaged, ten closed for repair, and three destroyed beyond repair (May, 1993). Following this earthquake the Washington state legislature required school buildings to comply with the Uniform Building Code, a step not as drastic as the Field Act but still significant. Following a 1965 earthquake, it extended that requirement to include all public buildings. But due to the relatively late date of the former legislation, many Washington schools remain seismically unsafe.

The 7.3 magnitude Borah Peak, Idaho, earthquake of 1983 shook a large portion of the central region of the state. School buildings were especially hard hit, with damages amounting to $10 million. Even though the earthquake occurred in a low-density area, three schools were condemned, thirteen others damaged, and two students killed (Adham and Ballif, 1985). However, due to the relatively low seismic risk and population density of Idaho, legislators deemed it

unnecessary to set rigorous seismic safety standards for public school buildings. Instead, the Idaho state legislature enacted a two-part program which focuses mainly on reducing nonstructural damage and conducting emergency preparedness and response training for teachers and students (Breckenridge, 1988). Drastically unsafe school buildings (those unable to withstand intensity VI ground movement) would be renovated.

In contrast to the widely varying approaches taken to safeguard school buildings by the United States, Canada has adopted a relatively straightforward policy. For the stated purposes of protecting young children and providing makeshift post-disaster relief shelters, especially in the seismically active western provinces, Canadian legislators have modified their National Building Code to require that schools be constructed with 130% of the seismic resistance of standard buildings. The resulting seismic importance factor of schools in Canada is thus 1.3, compared to the value of 1.5 given to emergency centers such as hospitals (National Building Code of Canada, 4.1.9.1.). School buildings throughout Canada are consequently quite solidly built, even in regions with little seismic risk.

DISCUSSION

Despite the apparent success of the Field Act, there is a continuing dispute over whether it should be kept in place, which revolves around a number of issues. Generally, opponents of the Field Act criticize its regulations and monetary costs, and supporters argue that such measures are necessary for public safety.

The Field Act entails many regulations and regulatory procedures. Many who favor a limited government oppose the Field Act for this reason, deeming the rules "Byzantine . . . slow, and cumbersome" (http://www.pacificresearch.org/capital/98-07-16.html). California's Little Hoover Commission, a state oversight agency, has stated that the construction approval process "micro-manages school construction projects, delaying the completion of and driving up the costs of school facilities" (http://www.lhc.ca.gov/lhcdir/153/schoolfacil.pdf). Supporters of the Field Act argue that the Field Act's regulations are actually not that oppressive, and are an intrinsic part of the state approval process – in other words, that reducing the amount of regulations could compromise the procedure. Alternatively, some supporters acknowledge that the regulations may be excessive, but say they are necessary to ensure the safety of the students. These supporters often cooperate with the Field Act's critics to reduce the bureaucracy involved while trying not to compromise the integrity of the Act. Over the past decade, the Office of Public School Construction has reduced the approval process to require only nine steps and four forms, down from 63 steps and 82 forms in 1992 (http://www.lhc.ca.gov/lhcdir/153/schoolfacil.pdf).

Critics also charge that the Field Act is too costly, with estimates ranging from 1.5% to 10% of construction costs. Some say that it is not practical to increase expenditures to provide increases in safety which, in their eyes, is marginal at best. Others, such as the Little Hoover Commission above, say that government interference necessarily results in higher costs. For example, state employees required to oversee construction are covered by California's wage law, thus increasing wage expenditures (http://www.pacificresearch.org/capital/98-07-16.html). Supporters defend the monetary costs of the Field Act in three main areas: (1) that expenditures are justified by the additional safety provided to students, (2) that the costs of the Field Act are relatively low (citing, for

example, the Little Hoover Commission's estimate of 1.5% of construction cost), and (3) that the Field Act in the long run saves money by reducing reconstruction costs following earthquakes.

Some critics have levied a variety of other minor charges against the Field Act. It has been alleged that the legislation: (1) results in school buildings equal to or even lesser in safety than the Uniform Building Code, (2) requires the usage of allegedly incompetent state employees, and (3) entails a complex approval process that discriminates against smaller schools which have less experience with the paperwork. Supporters of the Field Act flatly reject the notion that Uniform Building Code standards are more effective, pointing to a large body of evidence to the contrary; note that possibly incompetent state employees have not significantly harmed the seismic safety element of the public schools; and argue that smaller schools are less likely to need to construct facilities anyway.

Field Act supporters argue that the costs of the Field Act are not that great, and even if they were, regulations would still be necessary to guarantee the safety of the students. Supporters of the Field Act considerably outnumber its opponents, and so it appears as if the Field Act is here to stay.

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Figure 1. Jefferson Junior High School following the Long Beach earthquake of 1933. Courtesy of the Portland Cement Association.

TABLE 1
The Field Act and Related Legislation

Year	Legislation	Effect
1933	Field Act	Sets seismic safety standards for new public school buildings.
1939	Garrison Act	Required overhaul of existing, unsafe public school buildings.
1967	First Greene Act	Set deadline for inspecting pre-Field Act public school buildings.
1968	Second Greene Act	Set deadline for upgrading pre-Field Act public school buildings.
1972	School Building Sites Act	Requires school districts to consider seismicity in selecting school sites.
1972	Seismic Safety Element Act	Requires city and county general plans to include a seismic safety element.
1972	Alquist-Priolo Act	Prohibits the construction of new buildings across known active earthquake faults.
1973	Hospital Seismic Safety Act	Sets seismic safety standards for new hospitals.
1977	Earthquake Hazard	Set broad goals for reducing earthquake hazards. (Federal

TABLE 1

The Field Act and Related Legislation

Year	Legislation	Effect
	Reduction Act	legislation)
1985	Earthquake Hazards Reduction Act	Required the California Seismic Safety Commission to develop a statewide plan to reduce earthquake hazards.
1986	Essential Services Building Act	Sets seismic safety standards for critical facilities.
1990	California Seismic Hazards Mapping Act	Requires the design and use of seismic hazard maps in general plans.
1990	Private Schools Act	Extends the Field Act to new private schools.
1992	Charter Schools Act	Makes Field Act provisions optional for charter schools.

TABLE 2

Comparison of the Field Act and Uniform Building Code

Attribute	Field Act	Uniform Building Code
Load factor design for steelwork	Not allowed	Allowed
Aspect ratio of plywood diaphragms	3 : 1	4 : 1
Aspect ratio of plywood shear walls	2 : 1	3.5 : 1
Shear resistance of gypsum board	Not allowed	Allowed
Empirical masonry design	Not allowed	Allowed
Repetitive design of wood member	Not allowed	Allowed
Engineering geologic reports	Required	Optional
Force factor for wall anchors	1.2	0.75
Minimum size of framing member for highly loaded shear walls and diaphragms	3 x	2 x

TABLE 2 Comparison of the Field Act and Uniform Building Code		
Attribute	**Field Act**	**Uniform Building Code**
Full time general inspector	Required	Not required
Continuous special inspector of prestressed concrete	Required	Not required
Continuous inspector of glued laminated timber	Required	Not required
Continuous inspection of manufactured wood trusses	Required	Not required
Inspection of steel shop fabricated member	Required	Not required
Continuous special inspection of masonry	Required	Optional
Maximum height of masonry grout pour	4 feet	6 feet
Frequency of concrete testing	50 cubic yards	150 cubic yards
Testing of prestressing tendons	Required	Optional
Testing of reinforcement	Required	Optional
Steel deck diaphragm thickness	20 gage minimum	No minimum
Masonry core testing	Required	Not required
Masonry, grout, and mortar testing	Required	Optional
Ceiling and lighting fixtures bracing	Required	Not required
Anchorage of cabinets 5 feet or higher	Required	Not required

Compiled by Alan Williams, courtesy of the Coalition for Adequate School Housing.