

CALIFORNIA'S HOSPITAL SEISMIC SAFETY ACT

John F. Meehan (I)
Presenting Author: John F. Meehan

SUMMARY

Because of the good performance of public school buildings during earthquakes, which were constructed under the provisions of the Field Act, the California legislature enacted the Hospital Act and patterned it after the Field Act. Portions of the Hospital Act, its enforcement and accomplishments are presented.

INTRODUCTION

The California State Legislature, aware of the high probability of major or stronger earthquakes within the state boundaries and the obvious probability that many people will be in critical need of acute hospital services immediately following the disaster, enacted the Hospital Act in 1972. The California Legislature has long known of the hazards of earthquakes within the state. This first came about after the 1933 Long Beach 6.3 M earthquake where some 70 public school buildings collapsed or partially collapsed in the Long Beach and nearby area. The death toll to pupils and teachers in the public school buildings would have been devastating to thousands of families had the earthquake occurred during the school day. Fortunately it occurred at 5:54 on a Friday afternoon when the school building occupancy was low. The California legislature recognizing its responsibility to provide safe school buildings enacted, within a month, the Field Act (Ref. 1). The Field Act establishes within the state government a group to enforce its provisions, requires an independent peer review of the contract documents for conformance with the State Building Code; requires the design to be under the responsible charge of a California registered architect or structural engineer; requires continuous inspection by approved inspectors; authorizes the adoption of regulations; requires the responsible design professionals to observe the construction; requires verified certificates of conformance by design professionals, the inspector and contractor; establishes that persons who file false reports or who do not follow its provisions are guilty of a felony; and it establishes a fee based upon the project construction cost.

As a continuance of its recognition of seismic hazards the California State Legislature, in 1969, established the Joint Legislative Committee on Seismic Safety (Ref. 2). The purpose of this committee was to "develop seismic safety plans and policies and recommend to the Legislature any needed legislation to minimize the catastrophic effects upon people, property and operation of our economy should a major earthquake strike any

(I) Principal Structural Engineer, Research Director
Structural Safety Section, Office of the State Architect, Sacramento,
State of California

portion of the State of California. This joint committee was chaired by Senator Alfred E. Alquist who has been responsible for many of California's earthquake legislative measures. Some 80 or more highly capable people were enrolled within the five advisory groups which encompassed Engineering Considerations and Earthquake Sciences, Disaster Preparedness, Post Earthquake Recovery and Redevelopment, Land Use Planning, and Governmental Organization and Performance. During the deliberations of the Advisory Group on Engineering Considerations and Earthquake Sciences, chaired by Karl V. Steinbrugge, it was clearly recognized that the services of hospitals following a destructive earthquake would be in great demand. Further it was well known that the past performance of hospital buildings in earthquakes left much to be desired, whereas public school buildings constructed under the provisions of the Field Act have performed very well (Ref. 3, 4 and 5).

THE HOSPITAL ACT OF 1972

This author was assigned, at the request of the Advisory Group on Engineering Considerations and Earthquake Sciences, the task to prepare a draft of legislation for constructing hospitals similar to that currently applicable to public school buildings. This was done prior to the 1971 San Fernando earthquake. It became Senate Bill 352 and was introduced shortly after this earthquake where 50 people or 85% of those killed in this earthquake were either patients or employees in hospital buildings (Ref. 6) and a total of 17 hospitals were damaged. This legislation failed to pass because it placed the enforcement responsibility in the Department of General Services which parallels the Field Act for public school buildings. The following year, in 1972, the legislation was amended and reintroduced as Senate Bill 519. This bill placed the responsibility of administration and enforcement for hospital construction within the Department of Health and required that the Department of General Services perform, under contract, the review of the structural design and construction observation of hospitals as is done under the Field Act for public schools. This version of the Hospital Act (Ref. 7) was signed into law and became effective March 7, 1973.

Upon reorganization of the Department of Health, the administration and enforcement of the Hospital Act was delegated to the Office of State-wide Health Planning and Development (OSHDPD). Similarly, the Department of General Services delegated the responsibilities and duties of the Hospital Act to the Structural Safety Section in the Office of the State Architect (SSS/OSA).

This statute stated, "It is the intent of the Legislature that hospitals, which house patients having less than the capacity of normally healthy persons to protect themselves, and which must be completely functional to perform all necessary services to the public after a disaster, shall be designed and constructed to resist, insofar as practicable, the forces generated by earthquakes, gravity, and winds . . .".

The statutes required, in part, that all hospital drawings and specifications shall be prepared under the responsible charge of a California

registered architect or structural engineer or both; it required that a structural engineer shall prepare the structural design and sign drawings and specifications related thereto; it required a geologic hazards report on all but the small one story wood frame buildings; it required the geologic data to be reviewed by an engineering geologist and the review of the structural documents by a structural engineer; it established a filing fee based upon the estimated cost and a further fee based upon the final cost; it required the administration of the construction project to be under the responsible charge of such structural engineer and architect; it required continuous on-site inspection by approved personnel; it required signed certificates from all principals involved in the construction which certify that the construction of the project is in conformance with the approved documents; it further authorized the Department of Health to adopt regulations with the advice of the Department of General Services to carry out the provisions of the bill; and it established a Building Safety Board to advise and act as an appeals board with regard to seismic safety. This bill became Chapter 1130 of the 1972 Statutes and is given in Division 12.5, Chapter 1, Sections 15000 through 15023 of the Health and Safety Code.

Effective January 1, 1980 the statutes, currently Section 15073 Health and Safety Code, were amended to require that all fixed hospital equipment installed in any hospital shall be anchored in accordance with anchorages approved by the Department of Health. This authorized the Department to establish a procedure whereby equipment manufacturers, designers or suppliers may obtain a pre-approval for anchorage of equipment.

Regulations

The first building regulations adopted under the Hospital Act were prepared with the assistance of private and public sector consultants reflecting the legislative intent; i.e., the buildings "must be completely functional to perform all necessary services to the public after a disaster, shall be designed and constructed to resist, insofar as practicable, the forces generated by earthquakes, gravity and winds".

The general thrust of the regulations was toward the control of damage of both structural and nonstructural elements. The regulations also recognized dynamic analysis and required it for all buildings of unusual shape or those over 160 feet in height. The dynamic analysis must consider all natural modes of vibration greater than 0.05 seconds and be based upon the ground motion prescribed for the site in a geotechnic report. The report must consider the seismic event that could be postulated with a reasonable confidence level within a 100 year period. The regulations also permitted a static analysis similar to the 1973 Uniform Building Code requirements for buildings with a regular configuration in plan and elevation. There were a number of additional requirements placed in the regulations upgrading the basic code to reduce damage, such as those established for drift control ; they also required that the base shear of the dynamic analysis should not be less than 80% of the base shear determined by static code forces. In addition, the hospital regulations required that all aseismic moment resisting frames must be ductile; however, in one and two

story buildings when the KC value used in the design is 0.30 or more, the frames need not be ductile but the columns must be ductile. The regulations also covered anchorage requirements for piping, elevators, emergency generators, cabinets, ceilings, etc.

THE HOSPITAL SEISMIC SAFETY ACT OF 1982

The original Hospital Act which became effective March 7, 1973 required plan review and construction supervision by the State. It did not clearly limit the powers of the local enforcing agencies. This resulted, in some geographical areas, of a second plan review, fee and inspections by the local building departments. In 1982 Senate Bill 691 was passed and titled it the "Hospital Seismic Safety Act of 1982" and among other changes clearly pre-empted from all local jurisdiction the enforcement of all building standards published in the State Building Standards Code including plan checking and inspection of design and details of architectural, structural, mechanical, plumbing and electrical systems and observation of construction relating to the regulation of hospital projects and assigned these duties to the OSHPD. If local agencies have more restrictive regulations than those adopted by the State, the more restrictive regulations shall be enforced by the State in that jurisdiction.

The legislative intent was also modified. The original statute stated the buildings "...must be completely functional to perform all necessary services to the public...". The new legislation states "...must be reasonably capable of providing services to the public...". This later version is much more appropriate. Senate Bill 961 became Chapter 303 of the 1982 statutes and is given in Division 12.5, Chapter 1, Section 15000 through 15093 and 19026 of the Health and Safety Code. The legislation became effective January 1, 1983 (Ref. 8).

The new statutes retained the requirement for the structural plan review and construction supervision to be performed by SSS/OSA and added that the State Fire Marshal (SFM) must perform the plan review and construction supervision, under contract to OSHPD, for fire and panic safety. It requires the OSHPD to enforce all building regulations which includes architectural, mechanical, plumbing and electrical regulations including inspection of this work. The new statutes also permit OSHPD to conduct research directed toward reduction or elimination of earthquake safety hazards in hospital buildings. It increased the fee from a maximum of 0.70 per cent of the cost of construction to a maximum of 2.0 per cent of the cost of construction and established the fee for the SSS/OSA work of 0.7 per cent for projects under \$1 million and 0.6 per cent over \$1 million.

The original Hospital Act applied to all health facilities licensed under Section 1250 of the Health and Safety Code. The Act was amended in 1976 and excluded separate buildings in which only outpatient services were provided and one story type 5 nursing homes and intermediate care facilities. Those buildings were entirely under local enforcement agencies. The 1982 statute places all of these buildings entirely under the jurisdiction of OSHPD and requires the buildings to meet the provisions of the latest edition of the Uniform Building Code.

The Building Safety Board membership, Section 15081 H & S Code, was increased to 15 members consisting of two structural engineers, two architects, one engineering geologist, one soils engineer, one seismologist, one mechanical engineer, one electrical engineer, one person from any of the above mentioned professions, one hospital administrator, one building official and three public members. The appointments are made by the Director of OSHPD from nominees of the various technical or parent associations. Six non-voting ex-officio members are appointed consisting of the Director and Chief of the Division of Facilities Development of OSHPD, State Architect, State Geologist, Chief Structural Engineer of SSS/OSA, and the State Fire Marshal. This board is to provide advice to OSHPD and act as a board of appeals relative to the enforcement of the Act.

The Act authorizes OSHPD, Section 15091 H & S Code, to stop any work which does not meet the provisions of the Act. It also authorizes OSHPD, Section 15092 H & S Code, to examine the buildings and premises if it is believed that there exists any condition or violation of any applicable building standard which makes the building or premises unsafe, dangerous or hazardous.

Section 15093 H & S Code authorizes OSHPD to order vacating any building or structure found to have been in violation of the adopted regulations.

The penalty, Section 19026 H & S Code, for violating any provisions of the Act is a misdemeanor as was the previous Act.

Regulations

The structural building regulations being adopted pursuant to these statutes is the 1979 Uniform Building Code, with amendments. These regulations are published in the Building Standards Code which is Title 24, California Administrative Code (CAC). The emphasis of the regulations, as were the original regulations is directed toward damage control of structural and nonstructural components. Under dynamic analysis it is required that every structure shall be designed to prevent damage from the maximum probable earthquake or that event which has a 80 per cent probability of not being exceeded within a 100 year period. As an outer bound, the regulations require that the building shall not collapse under a maximum credible earthquake which may be expected at the building site within known geological framework. The basic building regulations are given in Part 2, Title 24, CAC; the mechanical regulations in Part 3; the plumbing regulations in Part 4; the electrical regulations in Part 5; and elevator regulations in Part 7 (Ref. 9).

METHOD OF OPERATION

After obtaining a Certificate of Need for a hospital from the OSHPD, the application for building permit, fee, drawings, specifications, geologic report, soils report and structural design calculations are filed with OSHPD, Division of Facilities Development. Upon receipt of this material, OSHPD retains a set of drawings and specifications for their

review of the architectural, mechanical, plumbing and electrical requirements and anchorage of a pre-determined list of components which consist mainly of mechanical and electrical equipment. OSHPD then forwards a set of drawings and specifications to the State Fire Marshal for their fire and panic review. The OSHPD also sends a copy of the drawings, specifications, geologic report, soils report and structural design calculations to SSS/OSA. The SSS/OSA forwards a copy of the geologic report to the California Division of Mines and Geology (CDMG) for their review. CDMG reports their findings to SSS/OSA who in turn forwards a copy of the CDMG report to the responsible design team. The SSS/OSA reviews the structural drawings and certain nonstructural items which are closely related to the structural performance such as wall panels, partitions, ceilings, elevators, stairs, etc.

Frequently a preliminary meeting is held prior to submitting the required documents with the design team, the OSHPD and the SSS/OSA representatives, to discuss possible problems and to develop a preliminary agreement of critical design criteria and procedures. Occasionally the Fire Marshal and CDMG representatives may be present at these preliminary meetings. Such preliminary reviews are very beneficial to all parties.

The submitted documents are reviewed and marked by the respective agencies for conformance with the adopted regulations and returned to the responsible designer with requests for corrections. The tracings are reviewed for the corrections and stamped when agreement is reached. Upon receipt of copies of the corrected drawings and specifications the approval of the application is issued by OSHPD and the building permit is issued. Construction may start after the building permit is issued. The project inspector must be approved by the responsible design professional and the SSS/OSA prior to start of construction. Periodic visits are made to the construction project by representatives of SSS/OSA, OSHPD and SFM.

Upon receipt of the required final verified reports by the responsible design team, the inspector and the contractor and the receipt of certificates of off-site inspection, the construction project is approved and a certificate of occupancy is issued by OSHPD.

VOLUME OF CONSTRUCTION

The total volume of work constructed, under construction, and in the plan review process by SSS/OSA since the original Hospital Act became effective March 7, 1973 to July 1, 1983 amounts to \$3.64 billion projected to 82/83 dollars.

PAST PERFORMANCE OF HOSPITALS CONSTRUCTED UNDER THE HOSPITAL ACT

The August 1, 1975 Oroville 5.7 M earthquake was the first to test a hospital building constructed under the provisions of the Hospital Act. The emergency addition to the Medical Center in Oroville, completed a few months before the earthquake, performed very well. A few hairline cracks may have been caused by the earthquake in the plaster finish at the corners of openings. There was no other known damage in the approved portion.

The August 13, 1978 Santa Barbara 5.1 M earthquake produced no damage of any kind to the \$4.7 million addition to the St. Francis Hospital of Santa Barbara which was constructed under the provisions of the Hospital Act.

A \$3 million building for the El Centro Community Hospital was constructed under the provisions of the Hospital Act and was completed about a year before the October 15, 1979 6.4 M El Centro earthquake. No damage occurred in this building.

The Valley Medical Center Hospital in Livermore had a half million dollar addition constructed under the provisions of the Hospital Act prior to the January 24, 1980 earthquake of 5.9 M. This addition performed excellently without any kind of damage.

The \$1.8 million Southern Mono District Hospital in Mammoth Lakes was constructed in 1978 under the provisions of the Hospital Act. This hospital, a one story wood and steel frame building, was exposed to the May 25, 26 and 27, 1980 earthquakes and the January 10, 1983 earthquake swarms having magnitudes up to 6.7. The building had no visible structural damage and only very nominal nonstructural damage consisting primarily of plaster cracks in wall corners and at door openings, spilled materials from shelves, a few plastic light fixtures fell, and a one inch steam pipe broke. A sprinkler pipe in the penthouse machine room was not installed in accordance with the approved documents. It was supported by toggle bolts through the plaster. The toggles failed and the line pulled away from the ceiling.

Based upon the above, it appears that the legislation is accomplishing its intent.

ACKNOWLEDGEMENTS

The many helpful suggestions, comments and recommendations are gratefully acknowledged for the review by Donald K. Jephcott, Chief Structural Engineer SSS/OSA and M. Neal Hardman, Senior Architect, OSHPD.

REFERENCES

1. Field Act, Sections 39140 through 39156 and 81130 through 81146, Education Code, California Statutes.
2. California State Joint Committee on Seismic Safety "Meeting the Earthquake Challenge", 223 pages. State of California, January 1974.
3. Steinbrugge, K. V. and Moran, D. F. "An Engineering Study of the Southern California Earthquake of July 21, 1952 and its Aftershocks". Bulletin of the Seismological Society of America, Volume 40, November 2B, pages 225-267, 1954.

4. Meehan, John F., "Public School Buildings", San Fernando, California Earthquake of February 9, 1971, U.S. Department of Commerce, Volume I, Part B, pages 667-684, 1973.
5. Jennings, Paul C., Editor. "Engineering Features of the San Fernando Earthquake, February 9, 1971", California Institute of Technology, EERI 71-02, page 484.
6. Steinbrugge, K. V. et. al. "San Fernando Earthquake, February 9, 1971", Pacific Fire Rating Bureau, page 2, 1971.
7. Hospital Act, Sections 15000 through 15023, Health and Safety Code, California Statutes.
8. Hospital Seismic Safety Act of 1982, Sections 15000 through 15093 and 19026 of Health and Safety Code, California Statutes.
9. State Building Standards, Parts 2 through 5 and Part 7 of Title 24, California Administrative Code, State of California, General Services Publication Section.