PS handout
Item 2b
Finance
3/14/19

April 17, 2018

Joe DeVries, President, Board of Trustees
Delvecchio Finley, Chief Executive Officer
Alameda Health System
1411 E. 31st St
Oakland, CA 94602

Dear Mr. DeVries and Mr. Finley:

The attached seismic report for the AHS Highland Campus buildings is alarming. The report states that the buildings that house the majority of our hospital's medical staff, including the departments of pediatrics, internal medicine, surgery and OB/GYN, are seismically unsound. We members of the medical staff, along with AHS administrators, have tried unsuccessfully to locate an updated report. So, it appears that this disquieting report is the most up-to-date assessment of these buildings.

According to the report:

"The wing buildings are connected at their North ends by reinforced concrete corridors. These corridors are much more rigid than the wings. During a major earthquake, torsional stress at the junctions between the wings and corridors would probably cause failure of the floor and roof diaphragms and "break loose" the wings from the corridors.

After diaphragm failure, the remaining share walls in the "broken loose" wings would be overstressed to the point of collapse.

Wing buildings A, B, C, D and E would be rated Poor to Very Poor according to the University of California Seismic Performance Rating System. ***These buildings represent a high life safety hazard in their present condition.****" (Emphasis in original.)*

We ask you to commence the seismic retrofit of these buildings, or disprove the report with an updated inspection, by July 1.

Our buildings appear to be a major safety hazard. It is crucial that the Highland medical staff is not incapacitated during an earthquake. Our patients and our community need us.

Sincerely,

1. Name: David a Flaffey Signature: [signature] Dept: IM Date: 4/17/18
2. Name: Lyn Berry Signature: [signature] Dept: IM Date: 4/17/18

	Name	Signature	Dept	Date
3.	Hena Borneo		Med	4/17/18
4.	Alejandro Diaz		MED	4/17/18
5.	Michael Ajuria		Med	4/17/18
6.	Claudia Landau		MED	4/17/18.
7.	Indhu Subramanian		MED	4/17/18
8.	Jessica Bloorge		MED	4/17/18
9.	c. Feeny	c. Feeny	[illegible]	4/17/18
10.	Laura Fernandez		Med	4/17/18
11.	Eliza Hagen		Med	4/17/18
12.	Sunita Mistry		Med	4/17/18
13.	David Tian		Med	4/17/18
14.	Natalie Curtis		Med	4/17/18
15.	Tamsin Levy		Med	4/17/18
16.	Zainab Mesbah		Med	4/18/18
17.	Scott Lynch		Med	4/18/18
18.	NICK NELSON		MED	4/18/18
19.	Maria Alvarado		Med	4/18/18
20.	Pulak Kumar	Pulak Kumar	Med	4/18/18
21.	Jennifer Hughes		Med	4/20/18
22.	Brandon Boosd		IM	4/20/18
23.	Steven Sockrider		Med.	4/25/18
24.	[illegible]		MED	4/25/18
25.	Kenn Kropf		Med	4/25/18
26.	JOHN HAYWARD			4/25/18

3. Name: Ann Tuttie CNM Signature: [signature] Dept: MCH Date: 4/25/18

4. Name: Debra Roisman Signature: [signature] Dept: OBGYN Date: 4/25/18

5. Name: Sara Mirahan Signature: [signature] Dept: MCH Date: 4/25/2018

6. Name: Molly Mekyunich Signature: [signature] Dept: MCH Date: 4/25/18

7. Name: Laurel Bernstein Signature: [signature] Dept: MCH Date: 4/25/18

8. Name: Elizabeth Schwartz Signature: [signature] Dept: OR Date: 4/25/18

9. Name: Rebecca Falik MD Signature: [signature] Dept: OBGYN Date: 4/25/18

10. Name: Kerry-Ann Kelly MD Signature: [signature] Dept: OBGYN Date: 4/25/18

11. Name: Meera Sharma Signature: [signature] Dept: OB/GYN Date: 4/25/18

12. Name: J. BRADDOCK Signature: [signature] Dept: MCH Date: 4/25/18

13. Name: S. Van Braden Signature: [signature] Dept: MCH Date: 4/25/18

14. Name: Renee Coleman Signature: [signature] Dept: OBGYN Date: 4/25/18

15. Name: Rekha George Signature: [signature] Dept: MCH Date: 4/25/18

16. Name: Diane Coleman Signature: [signature] Dept: [illegible] Date: 4/25/18

17. Name: Namita Singh Signature: [signature] Dept: MCH Date: 4/25/18

18. Name: John F. Vermox Signature: [signature] Dept: MCH Date: 4/25/18

19. Name: Reena Cho Signature: [signature] Dept: MCH Date: 4/25/18

20. Name: I. McClean Signature: [signature] Dept: EWC Date: 4/25/18

21. Name: Alyssa Nevin Signature: [signature] Dept: MCH Date: 4/25/18

22. Name: Denise Tukamme Signature: [signature] Dept: MCH Date: 4-25-18

23. Name: Sophie Shabel Signature: [signature] Dept: OB/Gyn Date: 4/25/18

24. Name: Terry White Signature: [signature] Dept: OB-GYN Date: 4-25-18

25. Name: Regina Lombardi Signature: [signature] Dept: Gyn Date: 4-25-18

26. Name: Karen Meyer Signature: [signature] Dept: OBGYN Date: 4/25/18

3. Name: Jessica Zitter Signature: [signature] Dept: IM Date: 4/25/18

4. Name: RUBERT WONG Signature: [signature] Dept: Med Date: 4/25/18

5. Name: Lynda Wilson Signature: [signature] Dept: MED Date: 4/25/18

6. Name: Mundee Tran Signature: [signature] Dept: IM Date: 4/25/18

7. Name: Gloria Hoang Signature: [signature] Dept: IM Date: 4/25/18

8. Name: FE IGNACIO Signature: [signature] Dept: IM Date: 4-25-18

9. Name: Marinor Protacio Signature: [signature] Dept: IM Date: 4/25-18

10. Name: LEIA MITCHELL Signature: [signature] Dept: IM Date: 4/25/18

11. Name: AMY MATECKI Signature: [signature] Dept: IM Date: 4/25/18.

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3. Name: Rachel Baden Signature: [signature] Dept: IM Date: 4/25/18

4. Name: Sophie Barbant Signature: [signature] Dept: IM Date: 4/25/18

5. Name: Thomas FROHLICH Signature: [signature] Dept: IM Date: 4/25/18

6. Name: Lily Indulkar Signature: [signature] Dept: IM Date: 4/25/18

7. Name: Jie Yang Signature: [signature] Dept: IM Date: 4/25/18

8. Name: John Puccini Signature: [signature] Dept: IM Date: 4/25/18

9. Name: Neha Gupta Signature: [signature] Dept: IM Date: 4/25/18

10. Name: Benny Liu Signature: [signature] Dept: IM Date: 4/25/18

11. Name: Christina Chou Signature: [signature] Dept: IM Date: 4/25/2018

12. Name:_____ Signature:_____ Dept:_____ Date:_____

13. Name: TAFY BHUKET Signature: [signature] Dept: IM Date: 4/25/18

14. Name:_____ Signature:_____ Dept:_____ Date:_____

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26. Name:_____ Signature:_____ Dept:_____ Date:_____

3. Name: Donna Carey Signature: [illegible] Dept: Peds Date: 4/19/18

4. Name: [illegible] Signature: Erin Tsuchimoto Dept: Peds Date: 4/19/18

5. Name: [illegible] Signature: David Hoffman Dept: PEDS Date: 4/26/18

6. Name: [illegible] Signature: A Sato Dept: PEDS Date: 4/27/18

7. Name: [illegible] Signature: Danielle Nguyen Dept: PEDS Date: 4/30/18

8. Name:____ Signature:____ Dept:____ Date:____

9. Name:____ Signature:____ Dept:____ Date:____

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26. Name:____ Signature:____ Dept:____ Date:____

	Name	Signature	Dept	Date
3.	Serene Chen	[signature]	EM	4/18
4.	Marc Henry	[signature]	EM	4/18
5.	David Mark	[signature]	EM	4/18
1.	Barry Simon	[signature]	ED	4/17/18
2.	Vicky Lu	[signature]	ED	4/17/2018
1.	V Sood MD	[signature]	Peds	4/18/18
2.	~~Sam~~ Singer MD	[signature]	Peds	4/19/18
1.	Carol Valente	[signature]	06/6W	4/18/18
2.	Laura Todaro	[signature]	[illegible]/6W	4/25/18
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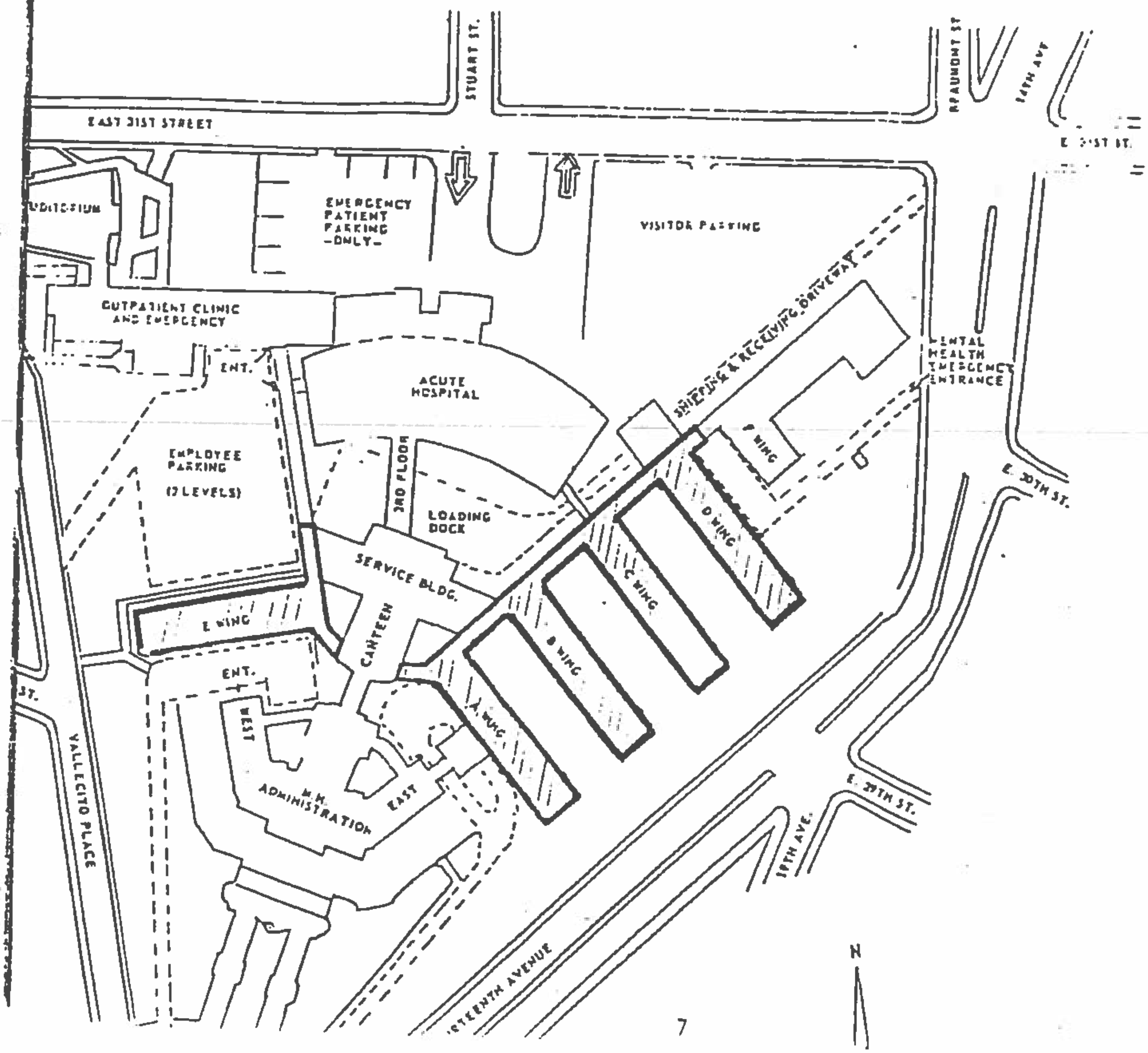
Note: Pages 1-6 are missing

PS Handout Item 2B finance 3/14/19

Wing Buildings A, B, C, D and E

Structural System

Wings A, B, C, D, and E each consist of a basement, three stories, and roof with penthouse. The wing buildings were designed by architect Henry Meyers, and built about 1921. Reinforced concrete beams, columns, bearing walls and concrete floor slabs support vertical loads. Reinforced concrete exterior walls, interior stair, and elevator shaft walls provide a minimal lateral load resisting system (see plans).



STRUCTURAL DEFICIENCES - CODE REQUIREMENTS

Wings A, B, C, D and E fail to meet the following current Title 24 structural requirements.

1. Wall reinforcement is less than code minimums.
2. Shearwalls have no trim bars at openings to resist lateral force bending moments.
3. Column tie size and spacing are inadequate.

STRUCTRUAL DEFICIENCES AT V = 0.14 W

At a lateral force level of V = 0.14 W, Wings A, B, C, D and E would have the following deficiencies:

1. Floor and roof diaphragms at the junctions between the wings and the corridors would be overstressed more than 125% in lateral force shear.
2. Shearwalls at both ends of the wings would be overstressed more than 700% due to lateral force bending moment.
3. Stairway and elevator wall foundations would be overstressed more than 200% in lateral shear transfer to ground. These walls have minimal footings.

STRUCTURAL DEFICIENCIES IN A MAJOR EARTHQUAKE

1. The wing buildings are connected at their north ends by reinforced concrete corridors. These corridors are much more rigid than the wings. During a major earthquake, torsional stress at the junctions between the wings and corridors would probably cause failure of the floor and roof diaphragms and "break loose" the wings from the corridors.

2. After diaphragm failure, the remaining shearwalls in the "broken loose" wings would be overstressed to the point of collapse.

3. We reviewed an earlier report on the structural capacity of the wing buildings. The report is by Blymyer and Sons, Consulting Engineers, dated 1 May 1964. They analyzed a typical column and beam frame for lateral loads at a force level of $V = .07W$, and found it to be adequate.

Blymyer's calculations neglect the rigidity of wall elements. By calculating the relative rigidities of frames and walls, we found that the frames all together take less than 10% of the total lateral load.

The reinforced concrete beam-and-column frames could act as a partial back-up system to resist lateral loads; however, the elements in the frames have not been designed to ensure adequate ductility, and the frames are much less rigid than the walls, so that an earthquake failing the walls could exceed the capacity of the frames, and probably cause the frames to collapse.

BUILDING STRENGTHENING

Upgrading Wing Buildings, A, B, C, D & E would not be economical if they were required to meet all current structural erequirements of Title 24. It would be difficult to add reinforcement to the columns and walls to correct the "Structural Deficiencies - Code Requirements" noted. In addition, the lateral force resisting system lacks the capacity required by Title 24, and new shearwalls with foundations would have to be added.

Wing Buildings A, B, C, D and E could be upgraded to a reasonable degree of seismic safety more easily if Title 24 structure requirements did not have to be fulfilled. New full-height shearwalls could be added to support transverse lateral loads. New footings, gunite and reinforcement could be added to stairway and elevator walls. Windows could be filled in to improve the shear resistance of exterior walls and/or trim bars and gunite could be added to reinforce the window openings.

SEISMIC PERFORMANCE

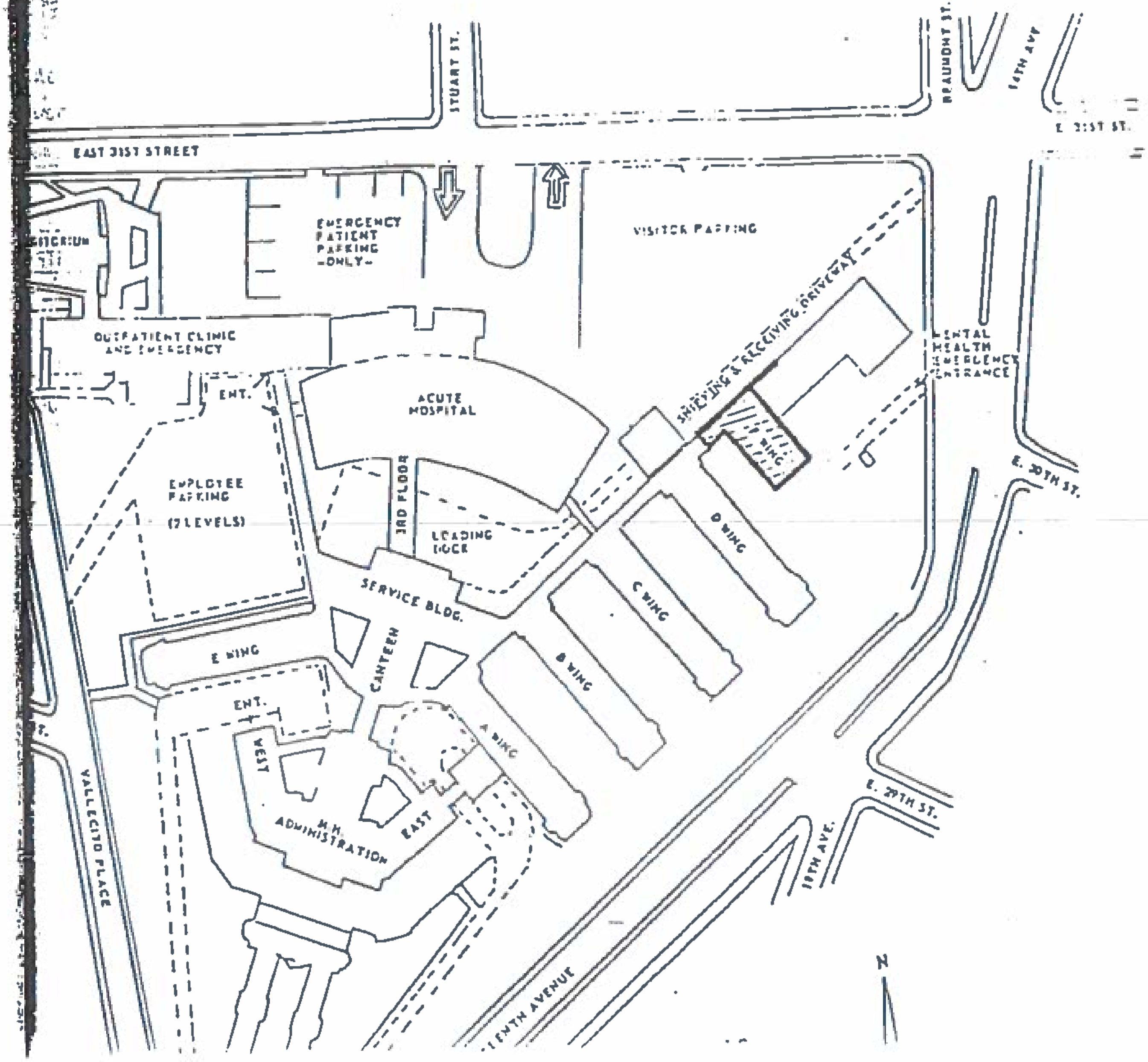
Older concrete frame structures have performed poorly during past strong earthquakes, sometimes exhibiting partial or total collapse. Lack of ductile reinforcing adds to the potential seismic hazard.

Wing Buildings A, B, C, D and E would be rated Poor to Very Poor according to the University of California Seismic Performance Rating System. (included later in this report). These buildings represent a high life safety hazard in their present condition.

WING F

Structural System

Wing F is a two story reinforced concrete building partially below grade. Structural drawings were not available for Wing F. It was assumed to be similar in construction to the other wing buildings. (See "Structural System" for Wings A, B, C, D, & E).



STRUCTURAL DEFICIENCIES - Code Requirements

Wing F is assumed to fail the same Title 24 code requirements as Wings A, B, C, D & E, with respect to minimum wall reinforcement, shearwall trim bars, and column tie size and spacing. (See "Structural Deficiencies - Code Requirements" for those buildings).

STRUCTURAL DEFICIENCIES AT V = 0.14W

At a lateral force level of V = 0.14W, no significant structural deficiencies were found.

STRUCTURAL DEFICIENCIES IN A MAJOR EARTHQUAKE

During a major earthquake, some shearwalls in Wing F could be overstressed, but the building would be reasonably safe from collapse.

Building Strengthening

Upgrading Wing F to conform to Title 24 would have the same problems as upgrading Wings A, B,C, D and E (see "Building Strengthening" for those buildings). No strengthening of Wing F is necessary to provide a reasonable degree of seismic safety.

Seismic Performance

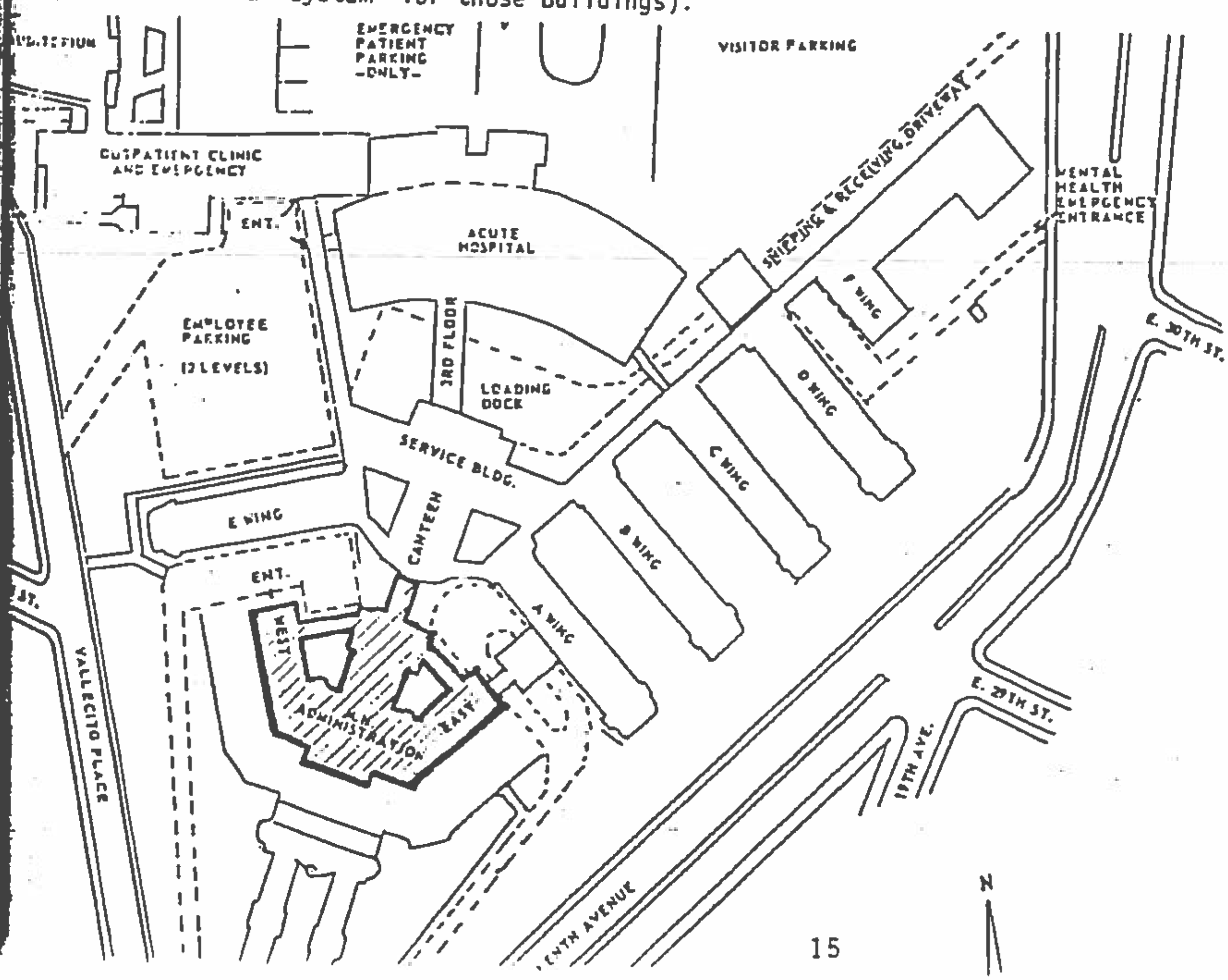
Wing F would be rated Fair to Good according to the University of California Seismic Performance Rating System. This building represents an insignificant life safety hazard.

Administration Building

Structural System

The Administration Building has three wings, A, B, and C, joined to a common front wall. The center wing (A) has a basement, three stories, and a roof with penthouse. The side wings (B and C) have a basement, two stories, and roofs with penthouses and bell towers. Corridors connect the basement and first stories at the rear of the wings (see plans).

Only partial structural drawings were available for the Administration Building. Other parts were assumed to be similar in construction to Wing Buildings A,B,C,D, and E. (see "Structural System" for those Buildings).



STRUCTURAL DEFICIENCIES - Code Requirements

The Administration Building is assumed to fail the same Title 24 code requirements as Wings A, B, C, D and E, with respect to minimum wall reinforcement, shearwall trim bears, and column tie size and spacing.

STRUCTURAL DEFICIENCIES AT V = 0.14W

At a lateral force level of V = 0.14W, no significant structural deficiencies in the Administration Building were found, using a conventional shearwall analysis (assigning shear to various walls in proportion to their relative rigidities). However, the irrgular shape of the building could result in appreciable torsional stresses , and its performance cannot be fully predicted on the basis of a conventional analysis.

STRUCTURAL DEFICIENCIES IN A MAJOR EARTHQUAKE

The second floor of the Administration Building is interrupted by a raised ceiling at the front (south) wall. During a major earthquake, torsional stresses could cause the second floor diaphragm to fail, leading to a partial collapse of the building.

Due to the highly irregular shape of the building, it is possible that other "weak spots" such as re-entrant corners, vertical and horizontal discontinuities, or interrupted footings and link beams at the back (north) wall of Wing A, could fail due to torsional stresses. The location of extent of problem areas cannot readily be determined

BUILDING STRENGTHENING

Upgrading the Administration Building to conform to Title 24 would have the same problems as Wings A, B, C, D and E. (See "Building Strengthening for those buildings.)

The Administration Buildingcould be strengthened, and weak areas (for example, the second floor diaphragm, of footings at the back (north) wall) improved, without fully meeting Title 24 structural requirements. New shearwalls could be added to support lateral loads. Footings could be added to stairway and exterior walls. Windows in exterior walls could be filled in and/or reinforced.

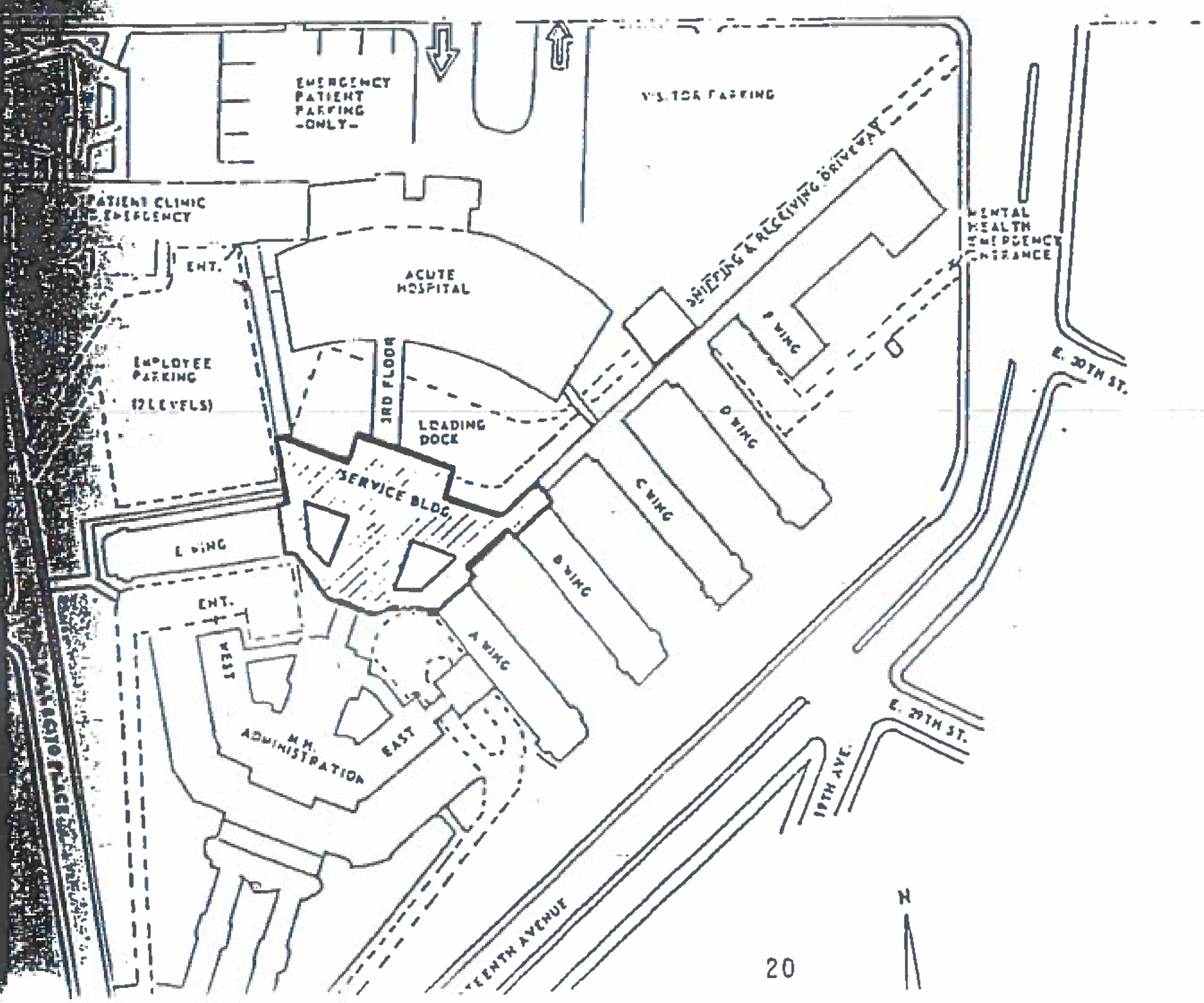
SEISMIC PERFORMANCE

The Administration Building would be rated Fair to Poor according to the University of California Performance Rating System. This building represents a possible life safety hazard in its present condition.

[illegible] SERVICE BUILDING

STRUCTURAL SYSTEM

The Service Building is irregularly shaped, with a partial basement, a [illegible] floor mostly at grade, two upper floors, and a roof with a penthouse [illegible] raised section. The Service Building was designed by architect [illegible] Meyers, and built about 1919. Reinforced concrete beams, columns, bearing walls, and concrete floor slabs support vertical loads. The main portion of the building is supported laterally by two massive diagonal concrete shear walls and the very rigid north wall.



STRUCTURAL DEFICIENCIES - Code Requirements

The Service Building fails to meet the same Tile 24 code requirements as Wings A, B, C, D and E, with respect to minimum wall reinforcement, shearwall trim bars, and column tie size and spacing. (See "Structural Deficiencies - Code Requirements" for those buildings).

STRUCTURAL DEFICIENCIES AT V = 0.14W

1. At a lateral force level of V = 0.14W, second floor piers between windows in the north wall of the Service Building are up to 71% overstressed in lateral force bending, using a conventional shearwall analysis.

2. The irregular shape of the Service Building could result in appreciable torsional stress, and its performance cannot be fully predicted on the basis of a conventional analysis. (Conventional analysis assigns shear to shearwalls on the basis of their relative rigidities.)

STRUCTURAL DEFICIENCIES IN A MAJOR EARTHQUAKE

Two large diagonal shearwalls provide a reasonable level of safety for the center section of the Service Building in a major earthquake. However, due to irregular vertical and plan layouts, the building may experience damage in local areas. The location and extent of damage cannot readily be determined.

Certain corridor areas were analyzed both as part of Wing Buildings and as part of the Service Building. Because of their dual assignment, the Service Building must share the possibility of major damage to these corridor areas. (See "Structural Deficiencies in a Major Earthquake" for Wings A, B, C, D and E.)

BUILDING STRENGTHENING

Upgrading the Service Building to meet Title 24 would have the same problems as Wings A, B, C, D & E. (See "Building Strengthening" for those buildings.)

The Service Building could be strengthened, without meeting Title 24 structural requirements, by filling in windows, guniting and reinforcing exterior walls, adding new footings to stairway shear walls, and adding new shearwalls and footings.

SEISMIC PERFORMANCE

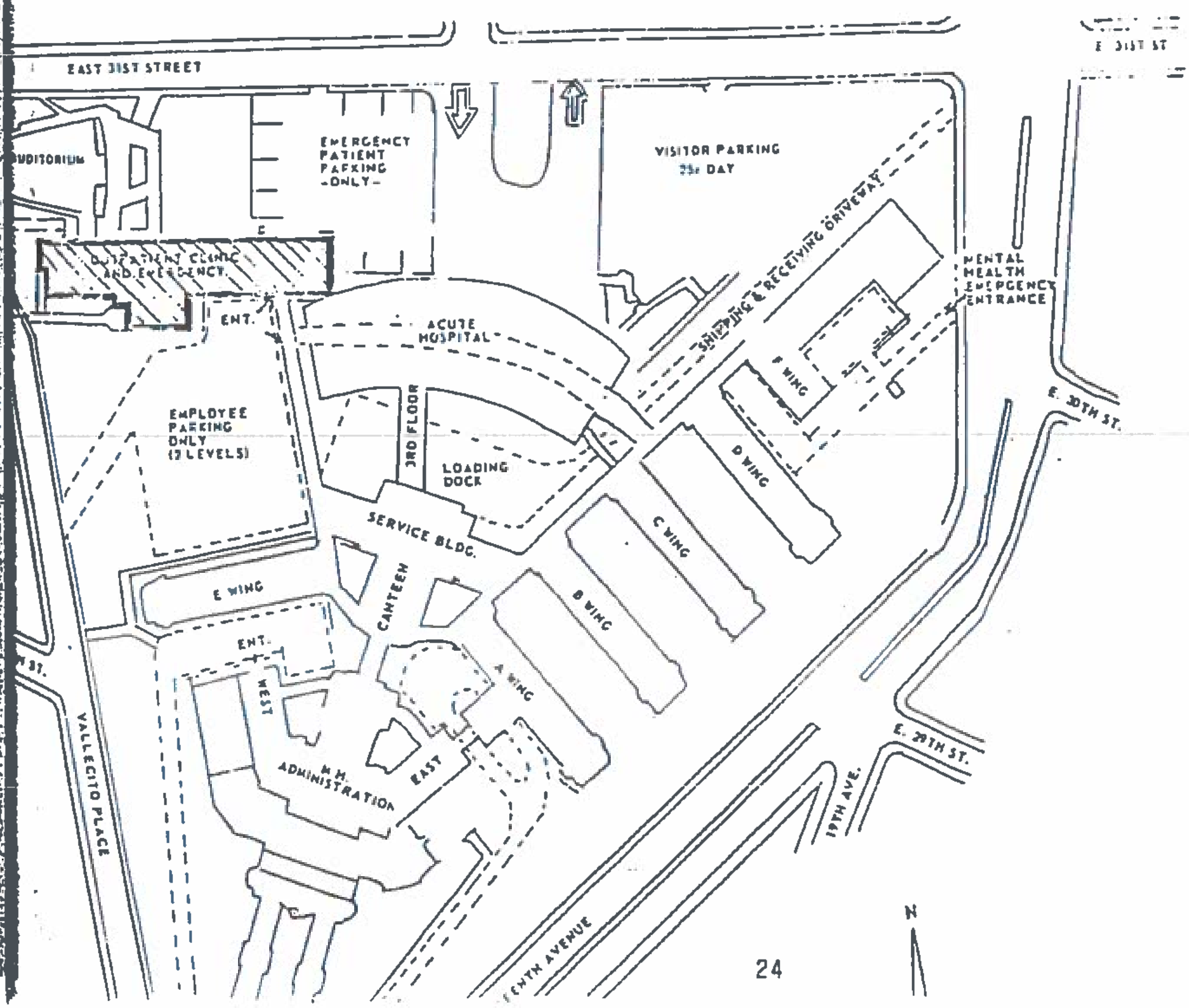
The Service Building would be rated Fair to Poor according to the University of California Seismic Performance Rating System. It represents an appreciable life safety hazard in certain areas, but an overall low hazard in the areas supported by massive shearwalls.

Clinic Building

Structural System

The Clinic has five stories and a roof. It was designed by Corlett and Anderson, architects and engineers, and built in 1955. The three lower floors are partially below grade on the uphill sides of the building.

Reinforced concrete columns, beams, bearing walls, joists, and slabs support vertical load. Reinforced concrete shearwalls support lateral loads. (see plan)



STRUCTURAL DEFICIENCIES - Code Requirements

The Clinic fails to meet the following current Title 24 structural requirements:

1. Spacing of column ties is too wide.

2. Some shearwalls, in general those not ending in pilasters, have in sufficient moment reinforcing steel to resist current code force levels.

STRUCTURAL DEFICIENCIES AT V = 0.14W

At a lateral force level of V = 0.14W, The Clinic Building has the following deficiencies:

1. The exterior wall of the stairway projecting from the west end of the building is overstressed more than 400% in lateral force bending. The footing below this wall is about 60% overstressed, with almost no dead load to prevent overtruning. This wall would be in danager of collapsing in even a moderate earthquake.

STRUCTURAL DEFICIENCIES IN A MAJOR EARTHQUAKE

1. During a major earthquake, the exterior wall of the west stairway would be in great danger of collapsing due to excessive overturning moment.

2. The exterior wall of the stairway projecting from the south wall would probably also be a hazard, although the mode of failure cannot be accuretely predicted.

3. There is a possibility of major damage at the south wall, fourth floor level.

BUILDING STRENGTHENING

Upgrading the Clinic to meet all current structural requirements of Title 24 would require:

1. Adding additional column ties where spacing is too wide.

2. Adding new shearwalls and reinforcing existing shearwalls, including adding foundations, to meet current lateral force requirements.

The seismic resistance of the Clinic could be improved, without meeting Title 24, by filling in some windows, especially at the fourth floor, and by adding reinforcing, gunite, and new footings to the walls of the two projecting stairways and to some interior shearwalls.

SEISMIC PERFORMANCE

Shearwall building have performed satisfactorily in past earthquakes; however, the Clinic was designed for a lateral force level well below current code requirements.

The Clinic would be rated Fair, according to the University of California Seismic Performance Rating System. The building represents a low overall life safety hazard; hwoever, there is possibility of major structural damage and some life safety hazard in local areas of the building, such as the projecting stairwells.

Site Data:

1) Geologic formation: at least 100' depth of well consolidated clays, sands, and silts over unknown base rock

2) Elevation: 135 - 175 MSL (site slopes up to the northeast)

3) Water table: varies across site, and varies with rainfall. Basements of old buildings flood during rainfall and irrigation (Subdrainage system is nonfunctioning or nonexistent)

4) Faults: 2 miles west of Hayward Fault, 15 miles east of San Andreas Fault

5) Soil Bearing Capacity:

A) Dames and Moore, 1954 report

caisson value @ 20'	4000/	6000	/8000 psf
	D.L.	D.L. + L.L	D.L. +L.L, +S.L.
lateral load	4500 plf on 3' deep footings		
	8500 plf on 5' deep footings		

B) Woodward-Clyde-Sherard, 1965 Report

footing value @ 4'	8000/	10000	/ 12000 psf
	D.L.	D.L.+L.L.	D.L. + L.L. + S.L.
footing value @ 2-1/2'	5000/	6000	/7000
	D.L.	D.L. +L.L.	D.L.+L.L. + S.L.

Area Seismicity

Highland Hospital is about 2 miles west of the Hayward Fault. Major earthquake occurred on this fault in 1836 and 1868. These earthquakes measured X on the Modified Mercalli Scale. The 1906 San Francisco earthquake measured VIII to IX in Oakland.

It is possible that Highland Hospital will experience a major earthquake during its remaining life.

Seismic Performance Ratings

University Policy-Seismic Safety
University of California   20 January 1975

GOOD seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance* is anticipated to result in some structural and/or nonstructural damage and/or falling hazards** that would not significantly jeopardize life. Buildings and other structures with a GOOD rating would have a level of seismic resistance such that funds need not be spent to improve their seismic resistance to gain greater life safety and would represent an acceptable level of earthquake safety.

FAIR seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance* is anticipated to result in structural and nonstructural damage and/or falling hazards** that would represent low life hazards. Buildings and other structures with a FAIR seismic performance rating would be given a low priority for expenditures to improve their seismic resistance and/or to reduce falling hazards so that the building could be reclassified GOOD.

POOR seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance* is anticipated to result in significant structural and nonstructural damage and/or falling hazards** that would represent appreciable life hazards. Such buildings or structures either would be given a high priority for expenditures to improve their seismic resistance and/or to reduce falling hazards** so that the building could be reclassified GOOD, or would be considered for other abatement programs, such as reduction of occupancy.

VERY POOR seismic performance rating would apply to buildings and other structures whose performance during a major seismic disturbance* is anticipated to result in extensive structural and nonstructural damage, potential structural collapse, and/or falling hazards** that would represent high life hazards. Such buildings or structures either would be given the highest priority for expenditures to improve their seismic resisetance and/or to reduce falling hazards** so that the building could be reclassified GOOD, or would be considered for other abatement programs, such as reduction of occupancy.

*Major seismic disturbance is defined in the next section

**Falling hazards are defined for the purposes of these Seismic Performance Ratings as potential falling or sliding hazards such interior and exterior building elements including parapets, ornamentation, chimneys, walls and partitions, but excluding equipment, fixtures, ceilings, furniture, furnishings, and other contents. The falling hazards in the excluded list above should not be used in the determination of the Seismic Performance Rating of a building or structure but should be abated.

Modified Mercalli Scale

Major seismic disturbance is defined for the purposes of the Seismic Performance Ratings as an earthquake at the site which would be given a Modified Mercalli Intensity Scale (as modified by Charles F. Richter in 1958) rating of at least IX based on the description of the structural effects. It is assumed that the intensity of ground shaking is not appreciably greater in areas rated MM X, MM XI, and MM XII. The damage descriptions in MMX, MMXI, and MMXII relate more to geologic features and nonbuilding structures.

NOTE: The Richter scale is not used in this report. Richter magnitude is based on ground motion amplitude measured by a seismometer. Magnitude does not necessarily represent the damaging effect of an earthquake at a given location. The Richter magnitude and Modified Mercalli intensity have been correlated for ordinary ground conditions in California. These correlations are very approximate and apply only at the epicenter. The smallest shocks reported felt by persons are near magnitude 2; those causing damage to weak structures (intensity VII) are usually of magnitude 5 or over; destructive earthquakes generally exceed magnitude 6. For ordinary ground conditions in metropolitan centers in California, the following figures are representative:

Richter Magnitude	2	3	4	5	6	7	8
M.M. Maximum Intensity	I-II	III	V	VI-VII	VII-VIII	IX-X	XI
Radius Km perceptibility to persons	0	15	80	150	[illegible]	[illegible]	[illegible]

The radius given here is the mean epicentral distance of the limit of perceptibility to persons. This is extremely rough, since the isoseismals are usually elongated and show additional irregularities; it neglects the effects of increased intensity on unconsolidated ground and of lowered intensity on firm rock. Great caution should be used in applying even this rough tabulation elsewhere than in California.

MODIFIED MERCALLI INTENSITY SCALE

(1956 Version-C.F. Richter P.137)

I. Not felt. Marginal and low-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, door rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures moves. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc. off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D. cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).

General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundatons. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud rejected, earthquake fountains, sand craters.

Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, in masonry C. Waves on ponds; water turbid with mud. Small slides and caving along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chmineys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in floor or temperature of springs and wells. Cracks in wet ground and on steep slopes.

Definition of Masonry A, B, C, D:

Masonry A: Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.: designed to to resist lateral forces.

Masonry B: Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.

Masonry C: Ordinary workmanship and mortar; no extreme weaknesses like failing to tie at corners, but neither reinforced nor designed against horizontal forces.

Masonry D: Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

Occupancy Potential

ATC 3-06, Chapter 13, "Systematic Abatement of Seismic Hazards in Buildings" considers occupancy potential (Building area divided by maximum occupancy) in evaluation of buildings. Non-essential building with an occupancy potential of 100 or less are exempt from evaluation (not a significant safety risk).

A typical wing building has 4 x 192' x 40' or 30,720 sq. ft. ATC's criteria are 300 sq. ft. per occupant for dwellings, 50 for libraries, and 100 for office and other uses;

According to these standards, for example, 10,000 sq.ft. of a wing building could be used safely for offices if the remainder were unoccupied. The concept of occupancy potential could be used in planning building uses for Highland Hospital.