SECTION 1604.3.7

SECTION 1604 – GENERAL DESIGN REQUIREMENTS

1604.3.7. Add the following section:

Section 1604.3.7 Building separations. All structures shall be separated from adjoining structures. Separations shall allow for the total deflection δ_X. Adjacent buildings on the same property shall be separated by at least δ_{XT} where

$$\delta_{XT} = \sqrt{(\delta_{X1})^2 + (\delta_{X2})^2} \qquad \textbf{(Equation 16-0)}$$

and δ_{X1} and δ_{X2} are the total deflections of the adjacent buildings as determined by ASCE7-05 Section 12.8.6.

When a structure adjoins a property line not common to a public way, that structure shall also be set back from the property line by at least the total deflection δ_X of that structure.

EXCEPTION: Smaller separations or property line setbacks may be permitted when justified by rational analyses based on maximum expected ground motions.

NOTE : THE ABOVE ITEM IS REPLACED BY THE FOLLOWING ITEM :

COMMENT 1:

Name: David Leung-DBI
Date: March 9, 2010

Comments/Findings:

SECTION 1613 – EARTHQUAKE LOADS

1613.8. Add the following section:

Section 1613.8 Building separations. Provisions of Section 1613.6.7 shall apply.

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 2:
Name: CAC Structural Subcommittee Date: March 9, 2010
Comments/Findings: Approved and forwarded to full CAC committee.

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 3:
Name: Code Advisory Committee Date:
Comments/Findings:

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

SECTION 1604— GENERAL DESIGN REQUIREMENTS

1604.11. Add the following section:

1604.11 Minimum Lateral Force for Existing Buildings.

1604.11.1 General. This section is applicable to existing buildings when invoked by Section 3403.5 . This section may be used as a standard for voluntary upgrades.

An existing building or structure which has been brought into compliance with the lateral force resistance requirements of the San Francisco Building Code in effect on or after May 21, 1973, shall be deemed to comply with this section except when a vertical extension or other alterations are to be made which would increase the mass or reduce the seismic resistance capacity of the building or structure.

1604.11.2 Wind forces. Buildings and structures shall be capable of resisting wind forces as prescribed in Section 1609.

1604.11.3 Seismic forces. Buildings and structures shall comply with the applicable provisions of Sections 1613, except that, when compliance with this section is required by Section 3403.5 , then structures and elements may be designed for seismic forces of not less than 75 percent of those given in Section 1613, and the building separation limitations of Section 1604.3.7 do not apply.

When upper floors are exempted from compliance by Section 3405 , the lateral forces generated by their masses shall be included in the analysis and design of the lateral force resisting systems for the strengthened floor. Such forces may be applied to the floor level immediately above the topmost strengthened floor and distributed in that floor in a manner consistent with the construction and layout of the exempted floor.

In lieu of meeting the specific requirements of this section, an alternative lateral analysis procedure incorporating inelastic behavior may be submitted and approved in accordance with rules and regulations adopted by the Building Official pursuant to Section 104A.2.1.

1604.11.4 Design values for existing materials. The incorporation of existing materials, construction and detailing into the designed lateral force system shall be permitted when approved by the Building Official. Minimum quality levels and maximum load and stress values shall comply with Table 16C-D of this code, Tables 8-8-A and 8-8-B of the State Historical Building Code, or with other rules, regulations and standards adopted by the Building Official pursuant to Section 104A.2.1.

NOTE : THE ABOVE ITEM IS REVISED AS FOLLOWS:

COMMENT 1:

Name: David Leung-DBI
Date: March 9, 2010

Comments/Findings:

1604.11. Add the following section:

1604.11 Minimum Lateral Force for Existing Buildings.

1604.11.1 General. This section is applicable to existing buildings when invoked by Section 3403.5 3401.7. This section may be used as a standard for voluntary upgrades.

An existing building or structure which has been brought into compliance with the lateral force resistance requirements of the San Francisco Building Code in effect on or after May 21, 1973, shall be deemed to comply with this section except when a vertical extension or other alterations are to be made which would increase the mass or reduce the seismic resistance capacity of the building or structure.

1604.11.2 Wind forces. Buildings and structures shall be capable of resisting wind forces as prescribed in Section 1609.

1604.11.3 Seismic forces. Buildings and structures shall comply with the applicable provisions of Sections 1613, except that, when compliance with this section is required by Section 3403.5 3401.7, then structures and elements may be designed for seismic forces of not less than 75 percent of those given in Section 1613, and the building separation limitations of Section 1604.3.7 1613.8 do not apply.

When upper floors are exempted from compliance by Section 3405 3401.7, the lateral forces generated by their masses shall be included in the analysis and design of the lateral force resisting systems for the strengthened floor. Such forces may be applied to the floor level immediately above the topmost strengthened floor and distributed in that floor in a manner consistent with the construction and layout of the exempted floor.

In lieu of meeting the specific requirements of this section, an alternative lateral analysis procedure incorporating inelastic behavior may be submitted and approved in accordance with rules and regulations adopted by the Building Official pursuant to Section 104A.2.1.

1604.11.4 Design values for existing materials. The incorporation of existing materials, construction and detailing into the designed lateral force system shall be permitted when approved by the Building Official. Minimum quality levels and maximum load and stress values shall comply with Table 16C-D of this code, Tables 8-8-A and 8-8-B of the State Historical Building Code, or with other rules, regulations and standards adopted by the Building Official pursuant to Section 104A.2.1.

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

COMMENT 2:				
Name: CAC Structural Subcommittee **Date: March 9, 2010**				
Comments/Findings: Approved and forwarded to full CAC committee.				
Place an X in one of the following:	**Retain as is:**	**Update as noted:**	**Revise:**	**Delete:**
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

COMMENT 3:				
Name: Code Advisory Committee **Date:**				
Comments/Findings:				
Place an X in one of the following:	**Retain as is:**	**Update as noted:**	**Revise:**	**Delete:**
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

SECTION 1604— GENERAL DESIGN REQUIREMENTS

COMMENT 1:

Name: David Leung-DBI
Date: March 9, 2010

Comments/Findings:

1604.12. Add the following section:

1604.12 Earthquake Recording Instrumentation. This section is adopted by the City and County of San Francisco for the purpose of evaluating the performance of instrumented building in earthquakes.

1604.12.1 — General. Every building over six stories in height with an aggregate floor area of 60,000 square feet (5574 m^2) or more, and every building over 10 stories in height regardless of floor area, shall be provided with not less than three approved recording accelerographs. The accelerographs shall be interconnected for common start and common timing.

1604.12.2 — Location. The instruments shall be located in the basement, midportion, and near the top of the building. Each instrument shall be located so that access is maintained at all times and is unobstructed by room contents. A sign stating MAINTAIN CLEAR ACCESS TO THIS INSTRUMENT shall be posted in a conspicuous location.

1604.12.3 — Maintenance. Maintenance and service of the instruments shall be provided by the owner of the building, subject to the approval of the Building Official. Data produced by the instruments shall be made available to the Building Official on request.

1604.12.4 — Instrumentation of Existing Buildings. With the agreement of the owners of existing structures selected by the Building Official, such structures shall have provided accessible space for the installation of appropriate earthquake recording instruments. Location of said instruments shall be determined by the Building Official. The Building Official shall make arrangements to provide, maintain, and service the instruments. Data shall be the property of the jurisdiction, but copies of individual records shall be made available to the public on request and the payment of an appropriate fee.

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

COMMENT 2:

Name: CAC Structural Subcommittee

Date: March 9, 2010				
Comments/Findings: Approved and forwarded to full CAC committee.				
Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:	
			X	

COMMENT 3:				
Name: Code Advisory Committee Date:				
Comments/Findings:				
Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:	
			X	

TABLE 1607.1 — MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS AND CONCENTRATED LIVE LOADS

SECTION 1607 — LIVE LOADS

TABLE 1607.1 — MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS AND CONCENTRATED LIVE LOADS

Table 1607.1 Add the following footnote n to Occupancy or Use 33, Sidewalks and Driveways

[n] Driveways subject to vehicle loading shall be designed in accordance with the American Association of State Highway and Transportation Officials (AASHTO) HS-20 Standard Specification for Highways and Bridges. Sidewalks subject to vehicle loading shall be designed for a concentrated load of 10,000 pounds placed upon any space 2½ feet (762 mm) square, wherever this load upon an otherwise unloaded sidewalk would produce stresses greater than those caused by the uniform load of 250 psf required therefor.

NOTE : THE ABOVE ITEM IS REVISED AS FOLLOWS:

COMMENT 1:

Name: David Leung-DBI
Date: March 9, 2010

Comments/Findings:

SECTION 1607 — LIVE LOADS

TABLE 1607.1 — MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS AND CONCENTRATED LIVE LOADS

Table 1607.1 Add the following footnote n to Occupancy or Use 32 33, Sidewalks and Driveways

[n] Driveways subject to vehicle loading shall be designed in accordance with the American Association of State Highway and Transportation Officials (AASHTO) HS-20 Standard Specification for Highways and Bridges. Sidewalks subject to vehicle loading shall be designed for a concentrated load of 10,000 pounds placed upon any space 2½ feet (762 mm) square, wherever this load upon an otherwise unloaded sidewalk would produce stresses greater than those caused by the uniform load of 250 psf required therefor.

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 2:
Name: CAC Structural Subcommittee Date: March 9, 2010
Comments/Findings: Approved and forwarded to full CAC committee.

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 3:
Name: Code Advisory Committee Date:
Comments/Findings:

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

SECTION 1601B thru 1607B

Chapter 16B
EARTHQUAKE HAZARD REDUCTION IN UNREINFORCED MASONRY BEARING WALL BUILDINGS

COMMENT 1:

Name: David Leung-DBI
Date: March 9, 2010

Comments/Findings:

Add the following chapter:

Chapter 16B
EARTHQUAKE HAZARD REDUCTION IN UNREINFORCED MASONRY BEARING WALL BUILDINGS

(NOTE: The time limits for compliance with the provisions of Chapters 16B and 16C had passed, but the ordinance and the time limits therein are still in effect.)

SECTION 1601B — PURPOSE

The purpose of this chapter is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of an earthquake on existing unreinforced masonry bearing wall buildings.

The provisions of this chapter are intended as minimum standards for structural seismic resistance for earthquake ground shaking and are established primarily to reduce the risk of life loss or injury. Compliance with these provisions will not necessarily prevent loss of life or injury, or prevent earthquake damage to rehabilitated structures, or protect against the release of hazardous materials, or protect the function of essential facilities. These provisions are not intended to mitigate ground failure hazards such as liquefaction. The Community Safety Element of the General Plan of the City and County of San Francisco should be consulted for areas most susceptible to ground failure.

Time limits are given for owners of unreinforced masonry bearing wall buildings to submit an inventory of each building and an evaluation of the degree of risk presented by the building. Priorities and time limits are established for work to be completed.

Requirements for seismic strengthening of unreinforced buildings are contained in Chapter 16C.

SECTION 1602B — SCOPE

The provisions of this chapter shall apply to all existing buildings having one or more bearing walls of unreinforced masonry as defined in Chapter 16C.

EXCEPTIONS:

1. Buildings housing Group R Occupancies containing less than five dwelling units or guest rooms and used solely for residential purposes.

2. Buildings accessory to and on the same lot as those described in Exception 1.

3. Buildings which have been brought into full compliance with the requirements of Section ~~3403.5~~ 3401.7 in effect on or after May 21, 1973.

Compliance with the provisions of Chapters 16B and 16C does not supersede the requirement for compliance with Section ~~3403.5~~ 3401.7 when otherwise required under Chapter 34 of this code.

A permit issued solely for compliance with any of the procedures of Chapters 16B and 16C of this code shall not be considered "substantial change" or "structural work" as defined in ~~Section 3403~~ Chapter 34 and compliance with Section ~~3403.5~~ 3401.7 will not be required.

SECTION 1603B — DEFINITIONS

For the purpose of Chapters 16B and 16C, certain terms are defined as follows:

BOLTS-PLUS is the installation of shear and tension anchors at the roof and floors and, when required, the bracing of the unreinforced masonry bearing walls upon evaluation of the height-to- thickness ratio of these walls.

POOR SOIL is all soil lying bayward of the line indicating the landward limit of Bay Mud deposits as shown on the U.S. Geological Survey Map MF-1376, title "Map Showing the 200-feet thickness contour of surficial deposits and the landward limit of Bay Mud deposits of San Francisco, California," by William B. Joyner, 1982.

EXCEPTION: A building need not be considered as being located on poor soil when a subsurface exploration demonstrates that the soil is not underlain by Bay Mud.

UNREINFORCED MASONRY BEARING WALL BUILDING is a building or structure having at least one unreinforced masonry bearing wall.

SECTION 1604B — COMPLIANCE REQUIREMENTS

1604B.1 General. The owner of each unreinforced masonry bearing wall building within the scope of this chapter and Chapter 16C shall cause a structural analysis to be made of the building by a registered civil or structural engineer or licensed architect, and, if the building does not meet the minimum standards specified in this code except as provided for in Chapters 16B and 16C, the owner shall cause the building to be structurally altered to conform to such standards or cause the building to be demolished pursuant to the program implementation schedule set forth.

1604B.2 Program Implementation. The requirements stated in Section 1604B.1 above shall be accomplished by submitting to the Building Official the following:

1604B.2.1 Inventory form. The owner is required to submit to the Department, within the time limits set forth in Table 16B-A, a properly completed inventory form, signed and sealed by the owner's civil or structural engineer or architect. See Section 110A, Table 1A-S for the applicable fee for the review of the inventory form. A failure to respond within the time limits set forth in Table 16B-A is a violation of this code.

1604B.2.2 Risk assessment.

1604B.2.2.1 General. When filling out the required information on the inventory form, the owner's architect or civil or structural engineer shall assign to the building a relative level of risk depending upon the occupancy, soil conditions at the site and the density of the population exposed.

1604B.2.2.2 Level of risk assigned.

1. Level 1 buildings are buildings containing Groups A Occupancies with an occupant load of 300 or more; or Group E Occupancies, and those buildings greater than three stories in height which are located on poor soil.

2. Level 2 buildings are all non-Level 1 buildings which are located on poor soil in the Downtown, North of Market/Civic Center, South of Market, South of Market Residential and Chinatown Unreinforced Masonry Building Study Areas as delineated on Figure 16B-1.

3. Level 3 buildings are buildings in the above areas which are not located on poor soil and buildings located on poor soil outside the above areas.

4. Level 4 buildings are all other unreinforced masonry bearing wall buildings.

1604B.2.3 Engineering reports. The owner shall engage a registered civil or structural engineer or licensed architect to prepare an engineering report on the building when: [Amended 10-7-2003 by Ord. No. 245-03]

1. An owner desires to demolish a qualified historical building or any building containing a nonexempt Group R Occupancy rather than retrofit the building, and a report is requested by the Building Official or the Building Official of the Planning Department; or

2. The Bolts-plus level of strengthening is proposed; or

3. Strengthening to comply with the State Historical Building Code is proposed; or

4. The owner believes the building complies with Chapters 16B and 16C without any further alteration.

The engineering report shall detail applicable retrofit requirements of the least restrictive retrofit procedure for which the building qualifies. The required retrofit measures shall be developed schematically, and a conceptual construction cost estimate shall be included. If the Bolts-plus level of strengthening defined above and described in Exception 1 to Section 1609C.2 is proposed, the necessary measures for compliance with the Special Procedure of Section 1611C shall also be designated, and a second cost estimate for this option shall also be included in the report. If the engineering report demonstrates that no deficiencies exist, and the report is approved by the Department, the structure will be considered to conform to the requirements of this chapter. Except as noted in 1. above, the report shall be submitted not later than the date when the application for the building permit to either strengthen or demolish the building would otherwise be required. The format and content of the engineering report shall comply with the provisions of rules and regulations to be issued by the Building Official pursuant to Section 104A.2.1 after consultation with the Seismic Safety Retrofit Bond Program Board. See Section 110A, Table 1A-S for the applicable fee for the review of the engineering report.

1604B.2.4 Application for building permit. The owner shall submit to the Department an application for a structural alteration permit accompanied by structural plans, specifications and calculations for the proposed mitigation solution or a permit application to demolish the building. Time limits for submission of the application and for permit processing and approval are established in Table 16B-A.

1604B.2.5 Commencement and completion of construction. Construction work shall commence and a Certificate of Final Completion and Occupancy or final inspection of work under a demolition permit shall be obtained within the time limits set forth in Table 16B-A.

1604B.2.6 Transfer of title. No transfer of title shall alter the time limits for compliance set forth in Table 16B-A.

SECTION 1605B — ADMINISTRATION

1605B.1 Service of Notice. The Building Official shall, not later than February 15, 1993, issue a notice to comply with Section 1604B.1 to the owner of each building known by the Department to be within the scope of this chapter. The notice shall be accompanied by an informational letter or brochure and a sample inventory form. If, on or before February 15, 1993, an owner of an unreinforced masonry bearing wall building has knowledge that he or she owns such a building, then failure of the Building Official to issue a notice or failure of the owner to receive such a notice shall not relieve the owner of the obligation to comply with the provisions of Chapters 16B and 16C within the time limits set forth in Table 16B-A. An owner is presumed to have knowledge that he or she owns an unreinforced masonry bearing wall building if the building is on the inventory list of potential hazardous unreinforced masonry bearing wall buildings required by Section 8877(a) of the California Government Code.

For buildings not known to the Department to be unreinforced masonry bearing wall buildings and whose owners have no knowledge that the buildings are unreinforced masonry bearing wall buildings, the time limits set forth in Table 16B-A shall commence upon the owners having actual or constructive knowledge that their buildings are unreinforced masonry bearing wall buildings.

1605B.2 Appeal from Notice. The owner or the owner's agent may appeal the Building Official's notice to the Unreinforced Masonry Building Appeals Board in accordance with Section 105A.7.

1605B.3 Processing and Recordation. Within 30 days of receipt of the inventory form, the Building Official shall review it and either approve it as submitted or reject it and return it for correction. Inventory forms returned for correction shall be revised by the owner's architect or engineer and returned to the Department within 30 days of the date of the Department's initial rejection. The Building Official shall cause to be recorded with the Assessor-Recorder's Office a notice of the requirement for structural alteration or demolition and the inventory form. The Building Official may cause such a notice to be recorded upon expiration of the time limits for submittal of the inventory form as stated in Table 16B-A. [Amended 10-7-2003 by Ord. No. 245-03]

1605B.4 Enforcement. Whenever an inventory form has not been submitted or a notice issued by the Building Official to structurally alter or demolish an unreinforced masonry bearing wall building has not been complied with within the time limits set forth in Table 16B-A, the Building Official shall have the power to abate the building in accordance with Section 102A.

1605B.5 Removal from Inventory. After all of the retrofit work required by this chapter and Chapter 16C has been completed in any building to the satisfaction of the Building Official and a Certificate of Final Completion and Occupancy has been issued in accordance with Section 109, or after a final inspection of building demolition work has been made, or if the Building Official finds that no retrofit work is required, the Building Official shall remove that building from the inventory list of potentially hazardous unreinforced masonry bearing wall buildings required by Section 8877(a) of the California Government Code. The Building Official shall thereupon cause to be filed with the Assessor-Recorder's Office a release of any notice or Abatement Order recorded under Section 1605B.3 or 1605B.4. Additionally, the Department shall furnish to each owner upon satisfactory completion of a retrofit a sign, on a standard Department form, of the same size as that required by California Government Code Section 8875.8, stating "This building has been seismically retrofitted to reduce the risk of death or injury in the event of a major earthquake pursuant to Chapters 16B and 16C of the San Francisco Building Code." The sign shall also indicate the retrofit procedure used and shall bear the signature of the Building Official. The posting of the sign shall be at the option of the owner.

1605B.6 Voluntary Seismic Strengthening. The owner of a building that is exempt from compliance with this chapter may voluntarily retrofit the building using the procedures for seismic strengthening set forth in Chapter 16C.

1605B.7 Application of Future Retrofitting Legislation. It is the present intent of the Board of Supervisors that, absent a compelling public safety necessity, buildings strengthened pursuant to Chapter 16C will not be subject to future mandatory seismic retrofitting legislation adopted by the Board.

1605B.8 Phased Strengthening. Other provisions of this code notwithstanding, an unreinforced masonry bearing wall building may be strengthened in phases under multiple alteration permits, provided: [Amended 10-7-2003 by Ord. No. 245-03]

1. A complete structural analysis accompanied by plans, specifications and calculations for the proposed mitigation solution is submitted to the Department with the first alteration permit application; and

2. A phasing program is submitted to and approved by the Department as part of the review of the first alteration permit application; and

3. Each subsequent alteration permit application clearly indicates the further work proposed and the work completed to date; and

4. The engineer or architect responsible for the structural design for the strengthening program provides structural requirements observation in accordance with Section ~~1709~~ 1710; and

5. All of the required strengthening work is completed within the time limits set forth in Table 16B-A.

SECTION 1606B — EXISTING UTILITY, FIRE PROTECTION, LIFE-SAFETY SYSTEMS, HOMELESS SHELTERS AND DISABLED ACCESS REQUIREMENTS

[Amended 10-7-2003 by Ord. No. 245-03]

This chapter does not require alteration of existing electrical, plumbing, mechanical, fire protection or life-safety systems which are in compliance with the code in effect at the time of their construction or installation. The application of Section ~~3403.6~~ 3401.8 relating to homeless shelters does not waive the requirement for compliance with the provisions of this chapter and Chapter 16C within the time limits set forth in Table 16B-A. This section does not exempt any building from compliance with the requirements of State or Federal disability access regulations.

SECTION 1607B — ENERGY CONSERVATION

The provisions of California Code of Regulations; Title 24, Part 6, the California Energy Code, San Francisco Housing Code, Chapter 12 (the Residential Energy Conservation Ordinance) are not applicable to buildings altered as required by this chapter, unless the alteration work also constitutes a change in use as defined in Section ~~3406~~ 3408, or increases the conditioned space or alters the lighting or mechanical systems.

FIGURE 16B-1 — UNREINFORCED MASONRY BUILDING STUDY AREAS

[Amended 10-7-2003 by Ord. No. 245-03]

1 Downtown

2 South of Market

3 South of Market/Residential

4 North of Market/Civic Center

5 Bush Street Corridor

6 Van Ness/Polk

7 Chinatown

8 North Beach

9 Waterfront

10 Mission/Upper Market

11 Outlying

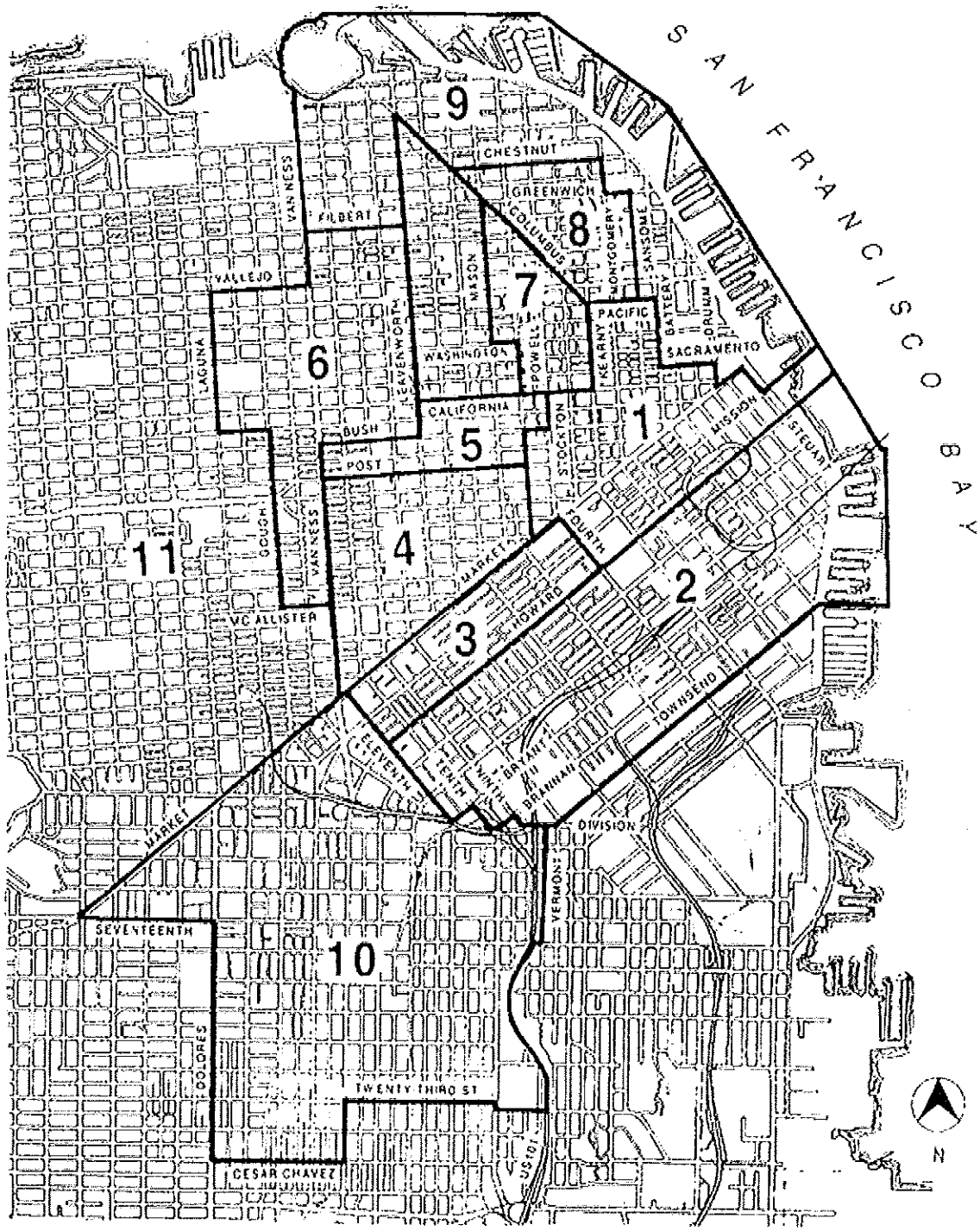

SAN FRANCISCO BAY
9
8
7
6
5
4
3
2
1
10
11
CHESTNUT
GREENWICH
FILBERT
VALLEJO
LOMBARD
WASHINGTON
CALIFORNIA
BUSH
POST
MARKET
HOWARD
FOLSOM
HARRISON
BRYANT
BRANNAN
TOWNSEND
DIVISION
VANNESS
VAN NESS
GOUGH
LAGUNA
OCTAVIA
MASON
COLUMBUS
POWELL
STOCKTON
GRANT
KEARNY
MONTGOMERY
SANSOME
BATTERY
DRUMM
PACIFIC
SACRAMENTO
MISSION
STEUART
FOURTH
VERMONT
VC ALLISTER
SEVENTEENTH
TWENTY THIRD ST
CESAR CHAVEZ
DOLORES
N

TABLE 16B-A — PROGRAM IMPLEMENTATION SCHEDULE [1, 2]

I	II	III	IV	V
Risk Level of Building	Submission of Inventory Form to DBI	Application of Building Permit with Plans or Application for Demolition[4]	Permit Processing and Approval[4]	Structural Alterations Completion[3,4]
1	1.0	2.0	2.5	3.5
2	1.0	2.5	3.0	5.0
3	1.0	8.0	9.0	11.0
4	1.0	10.0	11.0	13.0

[1] All time periods are in years measured from February 15, 1993.

[2] When compliance with this table is required, the time limits and extensions of Chapter 1A are not applicable.

[3] One or more extensions of time totaling not more than two years may be approved by the Building Official for a building with preexisting lease(s) due to expire, for tenant relocation conditions, for delays in obtaining financing under the City bond fund loan program and for other conditions causing delay. Such extension requests must be submitted to the Chief Building Inspector in writing prior to the expiration of the permit with payment of a fee. Any construction inspection granted under this footnote during the period of extension will require payment of an inspection fee in addition to the basic extension fee. These extensions are not cumulative with the extensions allowed by Footnote 4.

[4] For structures containing Occupancy Group A or E and owned by organizations exempt from taxation under the Internal Revenue laws of the United States and the Revenue and Taxation Code of the State of California as bona fide fraternal, charitable, benevolent, religious or other nonprofit organizations, extensions of time in increments of not more than three years up to the maximum time limit set forth in Column V of this table may be approved by the Building Official, provided all of the following conditions are met:

1. The owner demonstrates that an application has been made for funding available under the general obligation bond or the owner is actively seeking other sources of funds; and

2. The building is vacated and secured to the Building Official's satisfaction. For Occupancy Group A buildings only, in lieu of vacation, an owner may agree in writing to limit occupancy of the building for use as an assembly building with an actual occupant load greater than 299 persons to not more than 12 hours per week or four hours in any one day. The signs required by California Government Code Section 8875.8 shall also be posted at each entrance to the building; and

3. When deemed necessary by the Building Official, pedestrian protection canopies complying with Chapter 33 of this code and Department of Public Works Order No. 157,501 are erected and maintained along sidewalks adjacent to the building; and

4. The Building Official finds that there is no hazard to any adjacent building or that hazard is satisfactorily mitigated; and

5. The owner, for the period of time in which the extension is in effect, agrees not to file an application for a demolition permit.

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

COMMENT 2:

Name: CAC Structural Subcommittee
Date: March 9, 2010

Comments/Findings:
Approved and forwarded to full CAC committee.

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

COMMENT 3:

Name: Code Advisory Committee
Date:

Comments/Findings:

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**	
			X	

SECTION 1601C thru 1616C
Chapter 16C SEISMIC STRENGTHENING PROVISIONS FOR UNREINFORCED MASONRY BEARING WALL BUILDINGS
COMMENT 1:
Name: David Leung-DBI Date: March 9, 2010

Comments/Findings:

Add the following chapter:

Chapter 16C

SEISMIC STRENGTHENING PROVISIONS FOR UNREINFORCED

MASONRY BEARING WALL BUILDINGS

(NOTE: The time limits for compliance with the provisions of Chapters 16B and 16C had passed, but the ordinance and the time limits therein are still in effect.)

SECTION 1601C — PURPOSE

The purpose of this chapter is that stated in Section 1601B.

SECTION 1602C — SCOPE

1602C.1 General. The seismic strengthening of unreinforced masonry bearing wall buildings shall comply with the provisions of this chapter when strengthening either is mandated by Chapter 16B or is done voluntarily under Section 1605B.6. The elements regulated by this chapter shall be determined in accordance with Table 16C-A. Except as provided herein, other structural provisions of this code shall apply.

1602C.2 Essential and Hazardous Facilities. The provisions of this chapter are not intended to apply to the strengthening of buildings or structures in Occupancy Categories III and IV of ASCE 7-05 Table 1-1 . Such buildings or structures shall be strengthened to meet the requirements of this code for new buildings of the same occupancy category or to such other criteria as has been established by the Building Official.

1602C.3 Unreinforced Masonry Private School Buildings. The strengthening of unreinforced masonry private school buildings shall comply with Sections 39160-39176 of the California Education Code.

1602C.4 Qualified Historical Buildings. Qualified historical buildings shall be strengthened to comply with this chapter or the alternative provisions contained in Title 24, California Code of Regulations, Part 8, the State Historical Building Code.

1602C.5 Party Wall Buildings. In buildings separated by party walls, all segments sharing the party walls shall be strengthened at the same time whenever feasible. When such action is not feasible, a party wall in any segment undergoing strengthening shall be provided with the capacity to resist a reasonable estimate of the shear forces generated by the adjacent unstrengthened segments.

1602C.6 Buildings of Mixed Construction. When buildings having at least one bearing wall of unreinforced masonry also utilize other structural systems, the following requirements shall apply:

1602C.6.1 Masonry-wood or steel mix. When the lower stories of the building are of unreinforced masonry bearing wall construction and the upper stories are of wood frame or steel stud construction, the unreinforced masonry stories shall be strengthened to meet the requirements of the general procedure of this chapter and the other stories need not be strengthened. [Amended 10-7-2003 by Ord. No. 245-03]

1602C.6.2 Masonry-concrete mix. When a building is of mixed unreinforced masonry bearing wall construction and reinforced concrete or masonry construction, the entire building shall be strengthened in accordance with a program developed by the owner's architect or engineer and approved by the Building Official. [Amended 10-7-2003 by Ord. No. 245-03]

SECTION 1603C — DEFINITIONS

For the purpose of this chapter, the applicable definitions in this code shall also apply.

COLLAR JOINT is the vertical space between adjacent wythes and may contain mortar.

CROSSWALL is a new or existing wall that meets the requirements of Section 1611C.3. A crosswall is not a shear wall.

CROSSWALL SHEAR CAPACITY is the allowable shear value times the length of the crosswall, $v_c L_o$.

DIAPHRAGM EDGE is the intersection of the horizontal diaphragm and a shear wall.

DIAPHRAGM SHEAR CAPACITY is the allowable shear value times the depth of the diaphragm, $v_u D$.

ESSENTIAL FACILITY is any building or structure classified in Occupancy Category IV of ASCE 7-05 Table 1-1.

HAZARDOUS FACILITY is any building or structure classified in Occupancy Category III of ASCE 7-05 Table 1-1.

NORMAL WALL is a wall perpendicular to the direction of seismic forces.

OPEN FRONT is an exterior building wall line, without vertical elements of the lateral force resisting system in one or more stories.

PARTY WALL is a wall common to two or more buildings located on separate parcels of land.

POINTING is the partial reconstruction of the bed joints of an unreinforced masonry wall as defined in Section 1616C.

QUALIFIED HISTORICAL BUILDING is a building or structure as defined in the June 1, 1990, Edition of Title 24, California Code of Regulations, Part 8, Section 8-302.

UNREINFORCED MASONRY includes burned clay, concrete or sand-lime brick, hollow clay or concrete block, plain concrete and hollow clay tile. These materials shall comply with the requirements of Section 1606C.

UNREINFORCED MASONRY WALL is a masonry wall in which the area of reinforcing steel is less than 25 percent of the minimum steel ratios required by this code for reinforced masonry. To qualify, reinforcing steel must have been installed in grouted cells within the masonry.

UNREINFORCED MASONRY BEARING WALL is an unreinforced masonry wall which provides the vertical support for a floor or roof for which the total superimposed load exceeds 200 pounds per linear foot (298 kg/m) of wall.

YIELD STORY DRIFT is the lateral displacement of one level relative to the level above or below at which yield stress is first developed in a frame member.

SECTION 1604C — SYMBOLS AND NOTATIONS

[Amended 10-7-2003 by Ord. No. 245-03]

1604C.1 For the purpose of this chapter, the applicable symbols and notations in this code shall apply.

A = cross sectional area of unreinforced masonry pier or wall, square inches.

A_b = total area of the bed joints above and below the test specimen for each in-place shear test.

C_p = numerical coefficient as specified in Table 16C-C for Special Procedure diaphragm shear transfer.

D = in-plane width dimension of pier, inches, or depth of diaphragm, feet.

DCR = demand-capacity ratio specified in Section 1611C.4.2.

F_{wx} = force applied to a wall at level x, pounds.

H = least clear height of opening on either side of a pier, inches.

h/t = height-to-thickness ratio of an unreinforced masonry wall. Height, h, is measured between wall anchorage levels and/or slab-on-grade.

L = span of diaphragm between shear walls, or span between shear wall and open front, feet.

L_o = length of crosswall, feet.

L_i = effective span for an open front building specified in Section 1611C.8, feet.

P_D = superimposed dead load at the location under consideration, pounds. For determination of the rocking shear capacity, dead load at the top of the pier under consideration shall be used.

p_{D+L} = stress resulting from the dead plus actual live load in place at the time of testing, pounds per square inch (psi).

P_w = weight of wall, pounds.

V_a = vaA, the allowable shear in any unreinforced masonry pier, pounds.

V_{ca} = total shear capacity of crosswalls in the direction of analysis immediately above the diaphragm level being investigated, $åv_cL_o$, pounds.

V_{cb} = total shear capacity of crosswalls in the direction of analysis immediately below the diaphragm level being investigated, $åv_cL_o$, pounds.

V_p = shear force assigned to a pier on the basis of its relative shear rigidity, pounds.

V_r = pier rocking shear capacity of any unreinforced masonry wall or wall pier, pounds.

V_{test} = load at incipient cracking for each in-place shear test per Section 1614C, pounds.

V_{wx} = total shear force resisted by a shear wall at the level under consideration, pounds.

v_a = allowable shear stress for unreinforced masonry, pounds per square inch (psi).

v_c = allowable shear value for a crosswall sheathed with any of the materials given in

Table 16C- D or 16C-E, pounds per foot.

v_t = mortar shear strength as specified in Section 1606C.3.3.4, pounds per square inch (psi).

v_{to} = mortar shear test values as specified in Section 1606C.3.3.4, pounds per square inch (psi).

v_u = allowable shear value for a diaphragm sheathed with any of the materials given in Table 16C-D or 16C-E, pounds per foot.

$\sum v_u D$ = sum of diaphragm shear capacities of both ends of the diaphragm, pounds.

$\sum\sum v_u D$ = for diaphragms coupled with crosswalls, $\sum\sum v_u D$ includes the sum of shear capacities of both ends of diaphragms coupled at and above the level under consideration.

W = total seismic dead load as defined in Chapter 16, pounds.

W_d = total dead load tributary to a diaphragm, pounds.

$\sum w_d$ = total dead load to all the diaphragms at and above the level under consideration, pounds.

W_w = total dead load to an unreinforced masonry wall above the level under consideration or above an open front building, pounds.

W_{wx} = dead load of a unreinforced masonry wall assigned to Level x halfway above and below the level under consideration, pounds.

SECTION 1605C — GENERAL REQUIREMENTS

1605C.1 General. All buildings shall have a seismic resisting system conforming with ASCE 7-05 Section 12.2, except as modified by this chapter.

1605C.2 Alterations and Repairs. Alterations and repairs required to meet the provisions of this chapter shall comply with all other applicable structural requirements of this code unless specifically provided for in this chapter.

1605C.3 Requirements for Plans. In addition to the requirements of Section 106A.3.3 of this code, the following construction information shall be included in the plans required by this chapter:

1. Dimensioned floor and roof plans showing existing walls and the size and spacing of floor and roof framing members and sheathing materials. The plans shall indicate all existing and new crosswalls and shear walls and their materials of construction. The location of these walls and their openings shall be fully dimensioned and drawn to scale on the plans.

2. Dimensioned wall elevations showing openings, piers, wall classes as defined in Section 1606C.3.3.6, thickness, heights, wall shear test locations, and cracks or damaged portions requiring repairs. Where the exterior face is veneer, the type of veneer, its thickness and its bonding and/or ties to the structural wall masonry shall also be noted.

3. The type of interior wall and ceiling materials and framing.

4. The extent and type of existing wall anchorage to floors and roof when used in the design.

5. The extent and type of parapet and appendage corrections which were previously performed, if any.

6. Repair details, if any, of cracked or damaged unreinforced masonry wall walls required to resist forces specified in this chapter.

7. All other plans, sections and details necessary to delineate required retrofit construction.

8. The design procedure used shall be stated on both the plans and the permit application.

9. Details of the anchor prequalification program required by Section 1615C, if utilized, including location and results of all tests.

10. In buildings with party walls, the details of construction on both sides of each party wall shall be shown. Where required by Section 1611C.1, Item 5 the owners' consent statements shall be included with the plans.

SECTION 1606C — MATERIALS REQUIREMENTS

1606C.1 General. All materials permitted by this chapter, including their appropriate allowable design values and those existing configurations of materials specified herein, may be utilized to meet the requirements of this chapter.

1606C.2 Existing Materials. All existing materials utilized as part of the required vertical load- carrying or lateral force-resisting system shall be in sound condition or shall be repaired or removed and replaced with new materials. All unreinforced masonry materials shall comply with the following requirements:

1. The construction (lay-up) of the masonry units complies with Section 1606C.3.2 and the quality of bond between the units has been verified to the satisfaction of the Building Official.

2. Concrete masonry units are verified to be load-bearing units complying with ASTM Standard Specification C 90 or such other standard as is acceptable to the Building Official.

3. Hollow clay tile units are verified to be structural load-bearing units complying with ASTM Standard Specification C 34 or such other standard as is acceptable to the Building Official.

4. The compressive strength of plain concrete walls shall be determined based

on cores taken from each class of concrete wall. The location and number of tests shall be the same as prescribed for strength tests in Sections 1606C.3.3.2 and 1606C.3.3.3.

1606C.3 Existing Unreinforced Masonry Walls.

1606C.3.1 General. All unreinforced masonry walls utilized to carry vertical loads or seismic forces parallel and perpendicular to the wall plane shall be tested as specified in this section. All masonry that does not meet the minimum standards established by this chapter shall be removed and replaced with new materials, repaired or alternatively shall have its structural functions replaced with new materials and shall be anchored to supporting elements.

1606C.3.2 Construction (lay-up) of walls.

1606C.3.2.1 Multi-wythe solid brick. The facing and backing shall be bonded so that not less than 10 percent of the exposed face area is composed of solid headers extending not less than 4 inches (101.6 mm) into the backing. The clear distance between adjacent full-length headers shall not exceed 24 inches (609.6 mm) vertically or horizontally. Where the backing consists of two or more wythes, the headers shall extend not less than 4 inches (101.6 mm) into the most distant wythe or the backing wythes shall be bonded together with separate headers whose area and spacing conform to the foregoing. Wythes of walls not bonded as described above shall be considered as veneer. Veneer wythes shall not be included in the effective thickness used in calculating the height to thickness and the shear capacity of the wall.

1606C.3.2.2 Grouted or ungrouted hollow concrete or clay block and structural hollow clay tile. These materials shall be laid in a running bond pattern.

Other lay-up patterns may be acceptable if their performance can be justified as being at least equal to those specified above.

1606C.3.3 Mortar.

1606C.3.3.1 Tests. The quality of mortar in all masonry walls shall be determined by performing in-place shear tests in accordance with Section 1614C. Alternative methods of testing may be approved by the Building Official for masonry walls other than brick.

1606C.3.3.2 Location of tests. The shear tests shall be taken at locations representative of the mortar conditions throughout the entire building, taking into account variations in workmanship at different building height levels, variations in weathering of the exterior surfaces, and variations in the condition of the interior surfaces due to deterioration caused by leaks and condensation of water and/or by the deleterious effects of other substances contained within the building. The exact test locations shall be determined at the building site by the engineer or architect in responsible charge of the structural design work. An accurate record of all such tests and their location in the building shall be recorded, and these results shall be submitted to the Department for approval as part of the structural analysis.

1606C.3.3.3 Number of tests. The minimum number of tests per class shall be as follows:

1. At each of both the first and top stories, not less than two tests per wall or line of wall elements providing a common line of resistance to lateral forces.

2. At each of all other stories, not less than one test per wall or line of wall elements providing a common line of resistance to lateral forces.

3. In any case, not less than one test per 1,500 square feet (139.355 m^2) of wall surface nor less than a total of eight tests.

1606C.3.3.4 Minimum quality of mortar.

1. Mortar shear test values, v_{to}, in psi shall be obtained for each in-place shear test in accordance with the following equation:

$$v_{to} = (V_{test}/A_b) - p_{D+L} \quad (16C\text{-}1)$$

2. The mortar shear strength, v_t, is the value in psi that, after discarding the lowest 20 percent of the mortar shear test values, v_{to}, is the lowest of the remaining 80 percent of the mortar shear test values.

3. Any unreinforced masonry bearing wall with v_{to}, or with mortar shear strength, v_t, less than 30 psi (206.84 kPa) shall be either removed, entirely pointed and retested or have its structural function replaced and shall be anchored to supporting elements in accordance with Section 1606C.3.1 and Section 1613C.8. When existing mortar in any wythe is pointed to increase its shear strength and retested, the condition of the mortar in the adjacent bed joints of the inner wythe or wythes and the opposite outer wythe shall be examined for extent of deterioration. The shear strength of any wall class shall be no greater than that of the weakest wythe of that class.

1606C.3.3.5 Collar joints. The collar joints shall be inspected at the test locations during each in- place shear test, and estimates of the percentage of the surfaces of adjacent wythes which are covered with mortar shall be reported along with the results of the in-place shear tests.

1606C.3.3.6 Unreinforced masonry classes. All existing unreinforced masonry shall be categorized into one or more classes based on quality of construction, state of repair, deterioration and weathering. A class shall be characterized by the allowable masonry shear stress determined in accordance with Section 1608C.2. Classes shall be defined for whole walls, not for small areas of masonry within a wall.

1606C.3.3.7 Pointing. All deteriorated mortar joints in unreinforced masonry bearing walls shall be pointed according to Section 1616C. Nothing shall prevent pointing of any deteriorated masonry wall joints before the tests are made, except as required in

Section 1607C.1.

SECTION 1607C — QUALITY CONTROL

1607C.1 Pointing. All preparation and mortar pointing shall be performed with special inspection.

EXCEPTION: At the discretion of the Building Official, incidental pointing may be performed without special inspection.

1607C.2 Masonry Shear Tests. In-place shear tests shall comply with Section 1614C.

1607C.3 Existing Wall Anchors. Existing wall anchors utilized as all or part of the required tension anchors shall be tested in pullout according to Section 1615C. The minimum number of anchors tested shall be four per floor, with two tests at walls with joists framing into the wall and two tests at walls with joists parallel to the wall, but not less than 10 percent of the total number of existing tension anchors at each level.

1607C.4 New Bolts. Twenty-five percent of all new embedded bolts resisting only shear forces in unreinforced masonry walls shall be tested using a calibrated torque wrench in accordance with Section 1615C.

EXCEPTION: The number of bolts tested may be reduced to 10 percent when special inspection in accordance with Section 1704 is provided during installation but in no case shall less than two bolts per 500 square feet (46.45 m^2) of wall or four bolts per wall be tested.

All new embedded bolts resisting tension forces or a combination of tension and shear forces shall be subject to periodic special inspection in accordance with Section 1704 prior to placement of the bolt and grout or adhesive in the drilled hole. Five percent of all embedded bolts resisting tension forces, but not less than two bolts, shall be subject to a direct tension test and an additional 20 percent, but not less than three bolts, shall be tested using a torque calibrated wrench. Testing shall be performed in accordance with Section 1615C.

New through bolts and existing bolts installed under the Parapet Safety Program need not be tested.

SECTION 1608C — ALLOWABLE DESIGN VALUES

1608C.1 Allowable Values.

1608C.1.1 Existing materials. Allowable values for existing materials are given in Table 16C-D, and for new materials in Table 16C-E.

1608C.1.2 Values not specified. Allowable values not specified in this chapter shall be as specified elsewhere in this code.

1608C.2 Masonry shear. The allowable unreinforced masonry shear stress, v_a shall be determined for each masonry class from the following equation:

$$v_a = 0.1v_t + 0.15P_D/A \quad (16C\text{-}2)$$

The mortar shear test value, v_t, shall be determined in accordance with Section 1606C.3.3, and shall not exceed 100 psi (689.476 kPa) for the determination of v_a.

The one-third increase in allowable values of this code for short-term loading is not allowed for v_a.

1608C.3 Masonry Compression. Where any increase in dead plus live compression stress occurs, the allowable compression stress in unreinforced masonry shall not exceed 100 psi (689.476 kPa). The one-third increase in allowable stress of this code is allowed.

1608C.4 Masonry Tension. Unreinforced masonry shall be assumed as having no tensile capacity.

1608C.5 Unreinforced Masonry Materials Other Than Solid Brick. The provisions of this chapter are primarily intended for brick construction but are also applicable to other unreinforced masonry materials when the following conditions are satisfied: [Amended 10-7-2003 by Ord. No. 245-03]

1. The building does not exceed two stories in height.

2. In the case of hollow concrete and clay block, the shear stress is limited to that permitted by Equations 16C-1 and 16C-2 based on the net area in contact through the bed joints but not more than that calculated using a mortar shear strength, v_t, of 100 psi (689.476 kPa).

3. In the case of plain concrete, the compressive strength (f'_c) shall be not less than 900 psi (6,205.28 kPa) and the allowable shear strength is limited to not more than $0.02f'_c$.

4. In the case of all other unreinforced masonry materials, the shear stress is limited to 3 psi (20.684 kPa) based on the net area in contact through the bed joint.

Unreinforced masonry not meeting the above criteria shall have its structural function replaced and shall be resupported, if required, in accordance with Section 1613C.8.

1608C.6 Existing Tension Anchors. The allowable resistance values of the existing anchors shall be 40 percent of the average of the tension tests of existing anchors having the same wall thickness and joist orientation. The one-third increase in allowable value of this code is not allowed for existing tension anchors.

1608C.7 Foundations. For existing foundations, new total dead loads may be increased over existing dead load by 25 percent. New total dead load plus live load plus seismic forces may be increased over existing dead load plus live load by 50 percent.

EXCEPTION: In buildings located in poor soil areas as defined in Chapter 16B, any increase in dead load shall require an evaluation of the existing foundation system.

Higher values may be justified only in conjunction with a geotechnical investigation. A foundation investigation shall be also submitted with the building permit application when:

1. A building has an existing full or partial pile supported, or similar foundation system or whenever the installation of such a system is proposed as part of the strengthening.

2. Whenever there is evidence of significant distress attributable to foundation or geotechnical conditions.

3. An investigation is required by Section 1802 or 1804.

4. It is desired to prove that the building is not on poor soil as permitted by the exception to Section 1603B.

SECTION 1609C — SELECTION OF PROCEDURE

1609C.1 General. Except as modified herein, the analysis and design relating to the structural alteration of existing buildings shall be in accordance with this code.

1609C.2 Selection of Procedure. All buildings shall be analyzed by either the General Procedure of Section 1610C or, when applicable, buildings may be analyzed by the Special Procedure of Section 1611C.

EXCEPTIONS:

1. A building may be strengthened to the Bolts-plus level by complying only with the requirements for wall anchorage (tension bolts), diaphragm shear transfer (shear bolts) and out-of-plane wall and parapet and appendage bracing, provided the entire building complies with all of the following requirements:

(1) The building does not have any vertical irregularities of Types 1a or 1b (Soft Story), 4 (In-Plane Discontinuity) or 5a or 5b (Weak Story) as defined in ASCE 7-05 Table 12.3-2 or horizontal irregularities of Types 3 (Diaphragm Discontinuity) or 4 (Out-of-Plane Offset) as defined in ASCE 7-05 Table 12.3-1 or those irregularities are corrected.

(2) The building does not contain any Group A Occupancies with an occupant load of 300 or more, or Group E, Group I or Group H-1, H-2 or H-4 Occupancies.

(3) The building has a mortar shear strength, v_t, as determined by Section

1606C.3.3, of 30 psi (206.843 kPa) or more for all masonry classes.

(4) The building has wood or plywood diaphragms at all levels above the base of building.

(5) The building contains a maximum of six stories above the base of the building. The base shall be the ground level and basement or basements shall be excluded from the story count.

EXCEPTION: In an otherwise qualifying building of greater than six stories, a maximum of six of the uppermost contiguous stories may be retrofitted using the Bolts-Plus Procedure, providing the building is not located on poor soil as defined in Section 1603B. The masonry walls required by Item 7 below shall occupy not less than 50 percent of the wall length in the lowest two of the uppermost six stories. Nonqualifying stories and stories below the uppermost six shall be retrofitted to any other procedure for which they qualify.

(6) The building has or will be provided with crosswalls as defined in Section 1611C.3 at a spacing that does not exceed 40 feet (12.192 m) on center. Any story which does not have or is not provided with complying crosswalls and all stories below that story shall be analyzed using the General Procedure of Section 1610C or, where applicable, the Special Procedure of Section 1611C. The floor structure that separates the Bolts-Plus and General or Special Procedure stories shall be investigated for its adequacy to act as a diaphragm in accordance with Section 1610C.1 or, where the Special Procedure is applicable, Section 1611C.4.

(7) The building has or will be provided with a minimum of two lines of vertical elements of the lateral force resisting system parallel to each axis. Masonry walls shall have wall piers with a height-to-width ratio that does not exceed 2 to 1 and shall occupy not less than 40 percent of the wall's length in order to be considered as providing a line of resistance. Existing moment frames and other lines of resistance added or altered to comply with this requirement shall fully comply with Section 1612C. At least one line in each direction shall be a masonry or concrete shear wall.

(8) In buildings containing one or more party walls, the Bolts-Plus Procedure shall not be used unless each building sharing a party wall individually complies with all of the limitations set forth above and the owner of each such building consents to the use of the procedure in writing.

When the Bolts-Plus Procedure is applicable, the forces to be used for diaphragm shear transfer and irregularity correction shall be those specified in Sections 1611C.5 and 1611C.6 and h/t ratios shall be evaluated in accordance with Section 1611C.7. When the intersection of the diaphragm span and demand capacity ratio falls outside the three regions of Figure 16C-1, the h/t ratios for "all other buildings" in Table 16C-B shall be used. The measures used to comply shall be part of, and be coordinated with, the complete strengthening scheme described in the engineering report required by Section 1604B.2.3.

2. Buildings which are strengthened to conform to the requirements of Section ~~3403.5~~ 3401.7 in effect on or after May 21, 1973, are exempt from compliance with the provisions of this chapter.

SECTION 1610C — GENERAL PROCEDURE

1610C.1 Minimum Design Lateral Forces. Buildings shall be analyzed to resist minimum lateral forces assumed to act nonconcurrently in the direction of each of the main axes of the structure in accordance with the following:

$V = 0.10\ W$ (16C-3)

EXCEPTION: The lateral forces need not exceed those prescribed by Section 1613.

For buildings more than one story in height, the total force shall be distributed over the height of the building in accordance with the procedures of Chapter 16.

For the purpose of this chapter, a dynamic analysis need not be performed for those buildings with irregularities, as defined in ASCE 7-05 Table 12.3-2 and ASCE 7-05 Table 12.3-1 which would otherwise require such analysis. All other design and analysis requirements of those tables shall apply.

1610C.2 Lateral Forces on Elements of Structures. Parts of structures shall be analyzed and designed as required in Chapter 16.

EXCEPTIONS:

1. Unreinforced masonry walls for which height-to-thickness ratios do not exceed ratios set forth in Table 16C-B need not be analyzed for out-of-plane loading. Unreinforced masonry walls which exceed the allowable h/t ratios of Table 16C-B shall be braced according to Section 1613C.5.

2. Parapets complying with Section 1613C.6 need not be analyzed for out-of-plane loading.

3. Out-of-plane anchorage of the walls shall be designed to 0.3 times the mass of the wall.

1610C.3 Shear Walls (In-Plane Loading). Shear walls shall comply with Section 1612C.

1610C.4 Chords. When required by the structural analysis, chord forces of horizontal diaphragms shall be developed in existing materials or by the addition of new materials.

SECTION 1611C — SPECIAL PROCEDURE

1611C.1 Limits for Application. The Special Procedure of this section may only be applied to buildings with the following characteristics:

1. The building is not an essential or hazardous facility.

2. Wood or plywood diaphragms at all levels above the base of structure.

3. A maximum of six stories above the base of the building. The base shall be the ground level, and basement or basements shall be excluded from the story count.

EXCEPTION: An otherwise qualifying building of greater than six stories may also be retrofitted using the Special Procedure, provided the building is not located on poor soil as defined in Section 1603B or does not contain any Group A Occupancies with an occupant load of 300 or more, or Group E, or Group I Occupancies.

4. Except for single-story buildings with an open front on one side only, a minimum of two lines of vertical elements of the lateral force resisting system complying with Section 1612C parallel to each axis. At least one line in each direction shall be a masonry or concrete shear wall. Requirements for open front buildings are contained in Section 1611C.8.

5. In buildings containing one or more party walls, the Special Procedure shall not be used unless each building sharing a party wall individually complies with all of the limitations set forth above, and the owner of each such building consents to the use of the procedure in writing.

1611C.2 Lateral Forces on Elements of Structures. With the exception of the diaphragm provisions in Section 1611C.4, elements of structures shall comply with Section 1610C.2.

1611C.3 Crosswalls. Crosswalls when used shall meet the requirements of this section.

1611C.3.1 Crosswall definition. A "crosswall is a wood-framed wall sheathed with any of the materials described in Table 16C-D or 16C-E or other system as defined in Section 1611C.3.5. Spacing of crosswalls shall not exceed 40 feet (12.19 m) on center measured perpendicular to the direction of consideration and shall be placed in each story of the building. Crosswalls shall extend the full story height between diaphragms. [Amended 10-7-2003 by Ord. No. 245-03]

EXCEPTIONS:

1. Crosswalls need not be provided at all levels in accordance with Section 1611C.4.2(4).

2. Existing crosswalls need not be continuous below a wood diaphragm at or within 4 feet (1.219 m) of grade, provided:

(1) Shear connections and anchorage requirements, Section 1611C.5 are satisfied at all edges of the diaphragm.

(2) Crosswalls with total shear capacity of $0.08 \text{å} W_d$ interconnect the diaphragm to the foundation.

(3) The demand-capacity ratio of the diaphragm between the crosswalls that are continuous to their foundations shall be calculated as:

$$DCR = (0.332W_d + V_{ca})/2v_uD \qquad (16C\text{-}4)$$

and DCR shall not exceed 2.5.

1611C.3.2 Crosswall shear capacity. Within any 40 feet (12.19 m) measured along the span of the diaphragm, the sum of the crosswall shear capacities shall be at least 30 percent of the diaphragm shear capacity of the strongest diaphragm at or above the level under consideration.

1611C.3.3 Existing crosswalls. Existing crosswalls shall have a maximum height-to-length ratio between openings of 1.5 to 1. Existing crosswall connections to diaphragms need not be investigated as long as the crosswall extends to the framing of the diaphragm above and below.

1611C.3.4 New crosswalls. New crosswall connections to the diaphragm shall develop the crosswall shear capacity. New crosswalls shall have the capacity to resist an overturning moment equal to the crosswall shear capacity times the story height. Crosswall overturning moments need not be cumulative over more than two stories.

1611C.3.5 Other crosswall systems. Other systems, such as moment resisting frames, may be used as crosswalls, provided that the yield story drift does not exceed 1 inch (25.4 mm) in any story.

1611C.4 Wood Diaphragms.

1611C.4.1 Acceptable diaphragm span. A diaphragm is acceptable if the point (L,DCR) on Figure 16C- 1 falls within Regions 1, 2 or 3.

1611C.4.2 Demand-capacity ratios. Demand-capacity ratios shall be calculated for the diaphragm at any level according to the following formulas: [Amended 10-7-2003 by Ord. No. 245-03]

1. For a diaphragm without qualifying crosswalls at levels immediately above or below:

$$DCR = 0.332W_d/\sum v_uD \qquad (16C\text{-}5)$$

2. For a diaphragm in a single-story building with qualifying crosswalls:

$$DCR = 0.332W_d/(\sum v_u D + V_{cb}) \qquad (16C\text{-}6)$$

3. For diaphragms in a multi-story building with qualifying crosswalls in all levels:

$$DCR = 0.332\sum W_d/(\sum\sum v_u D + V_{cb}) \qquad (16C\text{-}7)$$

DCR shall be calculated at each level for the set of diaphragms at and above the level under consideration. In addition, the roof diaphragm shall also meet the requirements of Formula (16C-6).

4. For a roof diaphragm and the diaphragm directly below if coupled by crosswalls:

$$DCR = 0.332\sum W_d/\sum\sum v_u D \qquad (16C\text{-}8)$$

1611C.4.3 Chords. An analysis for diaphragm flexure need not be made and chords need not be provided.

1611C.4.4 Collectors. An analysis of diaphragm collector forces shall be made for the transfer of diaphragm edge shears into vertical elements of the lateral force resisting system. Collector forces may be resisted by new or existing elements.

1611C.4.5 Diaphragm openings.

1611C.4.5.1 Forces. Diaphragm forces at corners of openings shall be investigated and shall be developed into the diaphragm by new or existing materials.

1611C.4.5.2 Demand-capacity ratio. In addition to the demand-capacity ratios of Section 1611C.4.2, the demand-capacity ratio of the portion of the diaphragm adjacent to an opening shall be calculated using the opening dimension as the span.

1611C.4.5.3 End quarter of diaphragm. Where an opening occurs in the end quarter of the diaphragm span, v_uD for the demand-capacity ratio calculation shall be based on the net depth of the diaphragm.

1611C.5 Diaphragm Shear Transfer. Diaphragms shall be connected to shear walls with connections capable of developing a minimum force given by the lesser of the following formulas:

$$V = 0.2C_pW_d \qquad (16C\text{-}9)$$

using the C_p values in Table 16C-C, or

$$V = v_uD \qquad (16C\text{-}10)$$

1611C.6 Shear Walls (In-Plane Loading).

1611C.6.1 Wall story force. The wall story force distributed to a shear wall at any diaphragm level shall be the lesser value calculated as: [Amended 10-7-2003 by Ord. No. 245-03]

1. For buildings without crosswalls:

$F_{wx} = 0.132 (W_{wx} + W_d /2)$ (16C-11)

but need not exceed

$F_{wx} = 0.132W_{wx} + v_uD$ (16C-12)

2. For buildings with crosswalls in all levels:

$F_{wx} = 0.1 (W_{wx} + W_d /2)$ (16C-13)

but need not exceed

$F_{wx} = 0.1 [W_{wx} + \sum W_d (v_uD/\sum\sum v_uD)]$ (16C-14)

and need not exceed

$F_{wx} = 0.1W_{wx} + v_uD$ (16C-15)

1611C.6.2 Wall story shear. The wall story shear shall be the sum of the wall story forces at and above the level of consideration. [Amended 10-7-2003 by Ord. No. 245-03]

$V_{wx} = \sum F_{wx}$ (16C-16)

1611C.6.3 Shear wall analysis. Shear walls shall comply with Section 1612C.

1611C.6.4 Moment frames. Moment frames used in place of shear walls shall be designed as required in Chapter 16 except that the forces shall be as specified in Section 1611C.6.1 and the story drift ratio shall be limited to 0.005, except as further limited by Section 1612C.4.2.

1611C.7 Out-of-Plane Forces - Unreinforced Masonry Walls.

1611C.7.1 Allowable unreinforced masonry wall height-to-thickness ratios. The provisions of Section 1610C.2 are applicable except the allowable height-to-thickness ratios given in Table 16C-B shall be determined from Figure 16C-1 as follows:

1. In Region 1, height-to-thickness ratios for buildings with crosswalls may be used if qualifying crosswalls are present in all stories.

2. In Region 2, height-to-thickness ratios for buildings with crosswalls may be used whether or not qualifying crosswalls are present.

3. In Region 3, height-to-thickness ratios for "all other buildings" shall be used whether or not qualifying crosswalls are present.

1611C.7.2 Walls with diaphragms in different regions. When diaphragms above and below the wall under consideration have demand-capacity ratios in different regions of Figure 16C-1, the lesser height-to-thickness ratio shall be used.

1611C.8 Open Front Design Procedure. A single-story building with an open front on one side and crosswalls parallel to the open front may be designed by the following procedure:

1. Effective diaphragm span, L_i, for use in Figure 16C-1 shall be determined in accordance with the following formula:

$$L_i = 2\,[(W_w / W_d)L + L]x \quad (16C\text{-}17)$$

2. Diaphragm demand-capacity ratio shall be calculated as:

$$DCR = 0.332\,(W_d + W_w) / [(v_u D) + V_{cb}] \quad (16C\text{-}18)$$

SECTION 1612C — ANALYSIS AND DESIGN

1612C.1 Analysis of Vertical Elements of the Lateral Force-Resisting System. General. The following requirements are applicable to both the General Procedure and Special Procedure.

1612C.2 Existing Unreinforced Masonry Walls.

1612C.2.1 Flexural rigidity. Flexural components of deflection may be neglected in determining the rigidity of an unreinforced masonry wall.

1612C.2.2 Shear walls with openings. Wall piers shall be analyzed according to the following procedure which is diagrammed in Figure 16C-2:

1612C.2.2.1 For any pier:

1. The pier shear capacity shall be calculated as:

$$V_a = v_a A x \quad (16C\text{-}19)$$

2. The pier rocking shear capacity shall be calculated as:

$$V_r = 0.5 P_D D/H \quad (16C\text{-}20)$$

1612C.2.2.2 Pier behavior. The wall piers at any level are acceptable if they comply with one of the following modes of behavior: [Amended 10-7-2003 by Ord. No. 245-03]

1. Rocking controlled mode. When the pier rocking shear capacity is less than the pier shear capacity, i.e., $V_r < V_a$ for each pier in a level, forces in the wall at that level, V_{wx}, shall be distributed to each pier in proportion to PDD/H.

For the wall at that level:

$V_{wx} < \sum \text{å} V_r$ (16C-21)

2. Shear controlled mode. Where the pier shear capacity is less than the pier rocking capacity, i.e., $V_r < V_a$ in at least one pier in a level, forces in the wall at the level, V_{wx}, shall be distributed to each pier in proportion to D/H.

For each pier at that level:

$V_p < V_a$ (16C-22)

and

$V_p < V_r$ (16C-23)

If $V_p < V_a$ for each pier and $V_p > V_r$ for one or more piers, such piers shall be omitted from the analysis, and the procedure shall be repeated for the remaining piers, unless the wall is strengthened and reanalyzed.

1612C.2.2.3 Masonry pier tension stress. Unreinforced masonry wall piers need not be analyzed for tension stress.

1612C.2.3 Shear walls without openings. Shear walls without openings shall be analyzed as for walls with openings except that V_r shall be calculated as follows:

$V_r = (0.50P_D + 0.25P_w)\ D/H$ (16C-24)

1612C.3 Plywood Sheathed Shear Walls. Plywood sheathed shear walls may be used to resist lateral forces for buildings with wood diaphragms analyzed according to provisions of Section 1610C. Plywood sheathed shear walls may not be used to share lateral forces with other materials along the same line of resistance.

1612C.4 Combinations of Vertical Elements.

1612C.4.1 Lateral force distribution. Lateral forces shall be distributed among the designated vertical resisting elements in a line in proportion to their relative rigidities

except that moment frames shall comply with Section 1612C.4.2.

1612C.4.2 Moment-resisting frames. A moment frame shall not be used with an unreinforced masonry wall in a single line of resistance unless the wall has piers that are capable of sustaining rocking in accordance with Section 1612C.2.2 and the frames are designed to carry 100 percent of the lateral forces, and the story drift ratio shall be limited to 0.0025.

1612C.5 Shear Force. The shear force used in the design of any party wall shall be the sum of the shear forces contributed by each building sharing that wall.

SECTION 1613C — DETAILED SYSTEM DESIGN REQUIREMENTS

1613C.1 Wall Anchorage.

1613C.1.1 Anchor locations. All unreinforced masonry walls shall be anchored at the roof and floor levels as required in Section 1610C.2. Ceilings of plaster, gypsum board or similar heavier materials, when not attached directly to roof or floor framing, and abutting masonry walls, shall be either anchored to the walls at a maximum spacing of 6 feet (1.829 m) or removed.

1613C.1.2 Anchor requirements. Anchors shall consist of bolts installed through the wall as specified in Table 16C-E, or by an approved equivalent at a maximum anchor spacing of 6 feet (1.829 m). All existing wall anchors shall be secured to the joists to develop the required forces.

1613C.1.3 Minimum wall anchorage. Anchorage of masonry walls to each floor or roof shall resist a minimum force determined in accordance with Chapter 16 or 200 pounds per linear foot (298 kg/m), whichever is greater, acting normal to the wall at the level of the floor or roof. Anchor spacing shall not exceed 6 feet (1.829 m) on center. Existing through-the-wall anchors, if used, must meet the requirements of this chapter or must be upgraded.

1613C.1.4 Anchors at corners. At the roof and floor levels, both shear and tension anchors shall be provided within 2 feet (0.609 m) horizontally from the inside of the corners of the walls.

1613C.1.5 Anchors with limited access. When access to the exterior face of the masonry wall is prevented, wall anchors conforming to Item 4.b. in Table 16C-E may be used.

1613C.1.6 Anchors at interior and party walls. When floor or roof framing aligns vertically at party and interior masonry walls, continuous anchors shall be utilized to directly connect the floor or roof framing on either side of the wall. Where the roof or floor framing is offset more than the least depth of any adjacent framing, the intervening wall section shall be investigated for cross wythe shear assuming that the diaphragm to wall tensions on either side of the wall are acting in opposite directions.

1613C.2 Diaphragm Shear Transfer. Bolts transmitting shear forces shall have a maximum bolt spacing of 6 feet (1.829 m) and shall have nuts installed over malleable iron or plate washers when bearing on wood and heavy cut washers when bearing on steel.

1613C.3 Collectors. Collector elements shall be provided which are capable of transferring the seismic forces originating in other portions of the building to the element providing the resistance to those forces.

1613C.4 Ties and Continuity. Ties and continuity shall conform to Section 1604.11.

1613C.5 Wall Bracing.

1613C.5.1 General. Where a wall height-to-thickness ratio exceeds the specified limits, the wall may be laterally supported by vertical bracing members per Section 1613C.5.2 or by reducing the wall height by bracing per Section 1613C.5.3.

1613C.5.2 Vertical bracing members. Vertical bracing members shall be attached to floor and roof construction for their design loads independently of required wall anchors. Horizontal spacing of vertical bracing members shall not exceed one-half the unsupported height of the wall nor 10 feet (3.048 m). Deflection of such bracing members at design loads shall not exceed one-tenth of the wall thickness.

1613C.5.3 Intermediate wall bracing. The wall height may be reduced by bracing elements connected to the floor or roof. Horizontal spacing of the bracing elements and wall anchors shall be as required by design but shall not exceed 6 feet (1.829 m) on center. Bracing elements shall be detailed to minimize the horizontal displacement of the wall by the vertical displacement of the floor or roof.

1613C.6 Parapets. Parapets and appendages not conforming to this chapter shall be removed, or stabilized or braced to ensure that the parapets and appendages remain in their original position.

EXCEPTIONS:

1. Parapets, appendages and roof-to wall-tension anchors which have already been removed, stabilized or braced to comply with Chapter 16D of this code or previous codes pursuant to an application filed before the effective date of this ordinance need not be reanalyzed or restrengthened.

2. Parapets whose heights do not exceed 3 times their thicknesses need not be removed, stabilized or braced, provided they are located either immediately adjacent to a normally inaccessible court or yard or another building. In the case of an adjoining building, the top of the parapet of the building under consideration shall not be more than 12 inches (0.305 m) above the top of the parapet of the adjoining building. In order to qualify for this exception, the owner must execute an agreement with the Department to voluntarily abate any hazard that may arise as a result of changed conditions such as demolition of the adjacent building or development or occupancy of the adjoining court or yard. The owner must record the agreement with the County Recorder on a form satisfactory to the Department and supply a copy of the recorded agreement to the Department.

Parapets previously exempted that would not be exempted under Exception 2 above shall be removed, or stabilized or braced when the building is strengthened.

The maximum height of an unbraced unreinforced masonry parapet above the lower of either the level of tension anchors or roof sheathing shall not exceed 1½ times the thickness of the parapet wall. If the required parapet height exceeds this maximum height, a bracing system designed for the forces determined in accordance with Chapter 16 shall support the top of the parapet. Parapet corrective work must be performed in conjunction with the installation of tension roof anchors.

The minimum height of a parapet above any wall anchor shall be 12 inches (0.305 m).

EXCEPTION: If a reinforced concrete beam is provided at the top of the wall, the minimum height above the wall anchor may be 6 inches (170.44 mm).

1613C.7 Veneer.

1613C.7.1 Anchorages. Veneer shall be anchored with approved anchor ties, conforming to the required design capacity specified in this code and placed at a maximum spacing of 24 inches (610 mm) with a maximum supported area of 4 square feet (0.372 m^2).

EXCEPTION: Existing anchor ties for attaching brick veneer to brick backing may be acceptable, provided the ties are in good condition and are corrugated galvanized iron strips not less than 1 inch (25.4 mm) in width, 8 inches (203.2 mm) in length and 1/16 inch (1.59 mm) in thickness or equal.

1613C.7.2 Verification. The location and condition of existing veneer anchor ties shall be verified as follows:

1. An approved testing laboratory shall verify the location and spacing of the ties and shall submit a report to the Building Official for approval as part of the structural analysis.

2. The veneer in a selected area shall be removed to expose a representative sample of ties (not less than four) for inspection by the Building Official.

1613C.8 Nonstructural Masonry Walls. Unreinforced masonry walls which carry no design vertical or lateral loads and are not required by the design to be part of the lateral force resisting system shall be adequately anchored to new or existing supporting elements. The anchors and elements shall be designed for the out-of-plane forces specified in Chapter 16. The height or length to thickness ratio between such supporting elements for such walls shall not exceed 13.

1613C.9 Truss and Beam Supports. Where trusses and beams, other than rafters or

joists, are supported on masonry, independent secondary columns shall be installed to support vertical loads of the roof or floor members.

1613C.10 Adjacent Buildings. Where elements of adjacent buildings do not have a separation of at least 5 inches (127 mm), the allowable height-to-thickness ratios for "all other buildings" per Table 16C-B shall be used in the direction of consideration.

SECTION 1614C — IN-PLACE MASONRY SHEAR TESTS

1614C.1 Scope. This section applies when this chapter requires in-place testing of the quality of masonry mortar.

1614C.2 Preparation of Sample. The bed joints of the outer wythe of the masonry shall be tested in shear by laterally displacing a single brick relative to the adjacent bricks in the same wythe. The head joint opposite the loaded end of the test brick shall be carefully excavated and cleared. The brick adjacent to the loaded end of the test brick shall be carefully removed by sawing or drilling and excavating to provide space for a hydraulic ram and steel loading blocks.

1614C.3 Application of Load and Determination of Results. Steel blocks, the size of the end of the brick, shall be used on each end of the ram to distribute the load to the brick. The blocks shall not contact the mortar joints. The load shall be applied horizontally, in the plane of the wythe, until either a crack can be seen or slip occurs. The strength of the mortar shall be calculated by dividing the load at the first cracking or movement of the test brick by the nominal gross area of the sum of the two bed joints.

SECTION 1615C — TEST OF ANCHORS IN UNREINFORCED MASONRY WALLS

1615C.1 Scope. Shear and tension anchors embedded in existing masonry construction shall be tested in accordance with this section when and as required by this chapter.

1615C.2 Direct Tension Testing of Existing Anchors and New Bolts. The test apparatus shall be supported on the masonry wall. The distance between the anchor and the test apparatus support shall not be less than one-half the wall thickness for existing anchors and 75 percent of the embedment for new embedded bolts. Existing wall anchors shall be given a preload of 300 pounds (136.4 kg) prior to establishing a datum for recording elongation. The tension test load reported shall be recorded at 1/8 inch (3.18 mm) relative movement of the existing anchor and the adjacent masonry surface. New embedded tension bolts shall be subject to a direct tension load of not less than 2.5 times the design load but not less than 1,500 pounds (682 kg) for five minutes (10 percent deviation).

1615C.3 Torque Testing of New Bolts. Bolts which are embedded in unreinforced masonry walls shall be tested using a torque calibrated wrench to the following minimum torques:

1/2-inch-diameter bolts - 40 foot-pounds.

(12.7 mm) (5.54 M-Kg)

5/8-inch-diameter bolts - 50 foot-pounds.

(16 mm) (6.93 M-Kg)

3/4-inch-diameter bolts - 60 foot-pounds.

(19 mm) (8.31 M-Kg)

1615C.4 Prequalification Test for Bolts and Other Types of Anchors. This section is applicable when it is desired to use tension or shear values for anchors greater than those permitted by Table 16C-E. The direct tension test procedure set forth in Section

1615C.2 for existing anchors may be used to determine the allowable tension values for new embedded or through bolts except that no preload is required. Bolts shall be installed in the same manner and using the same materials as will be used in the actual construction. A minimum of 5 tests for each bolt size and type shall be performed for each

class of masonry in which they are proposed to be used. The allowable tension value for such anchors shall be 40 percent of the average value of the tests for each size and type of bolt and class of masonry.

Shear bolts may be similarly prequalified. The test procedure shall comply with ASTM E 488-90 or such other procedure as is approved by the Building Official.

The allowable values determined in this manner may exceed those set forth in Table 16C-E.

1615C.5 Reports. Results of all tests shall be reported. The report shall include the test results as related to anchor size and type, orientation of loading, details of the anchor installation and embedment, wall thickness and joist orientation.

SECTION 1616C — POINTING OF UNREINFORCED MASONRY WALLS

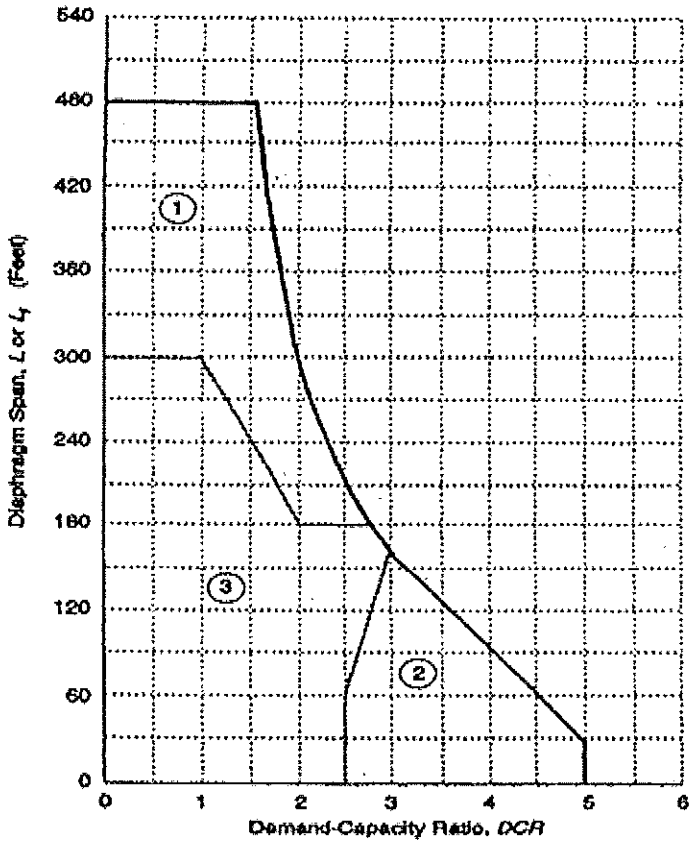
1616C.1 Scope. Pointing of deteriorated mortar joints when required by this chapter shall be in accordance with this section.

1616C.2 Joint Preparation. The old or deteriorated mortar should be cut out, by means of a toothing chisel or non-impact power tool, to a uniform depth of ¾ inch (19.1 mm) until sound mortar is reached. Care shall be taken not to damage the brick edges. After cutting is completed, all loose material shall be removed with a brush, air or water stream.

1616C.3 Mortar Preparation. The mortar mix shall be Type N or S proportions as required by the construction specifications. The pointing mortar shall be pre-hydrated by first thoroughly mixing all ingredients dry, and then mixing again, adding only enough water to produce a damp unworkable mix which will retain its shape when pressed into a ball. The mortar shall be kept in a damp condition for 1½ hours; then sufficient water shall be added to bring it to a proper consistency that is somewhat drier than conventional masonry mortar.

1616C.4 Packing. The joint into which the mortar is to be packed shall be damp but without freestanding water. The mortar shall be tightly packed into the joint in layers not exceeding ¼ inch (6.35 mm) in depth until it is filled; then it shall be tooled to a smooth surface to match the original profile.

FIGURE 16C-1 — ACCEPTABLE DIAPHRAGM SPAN



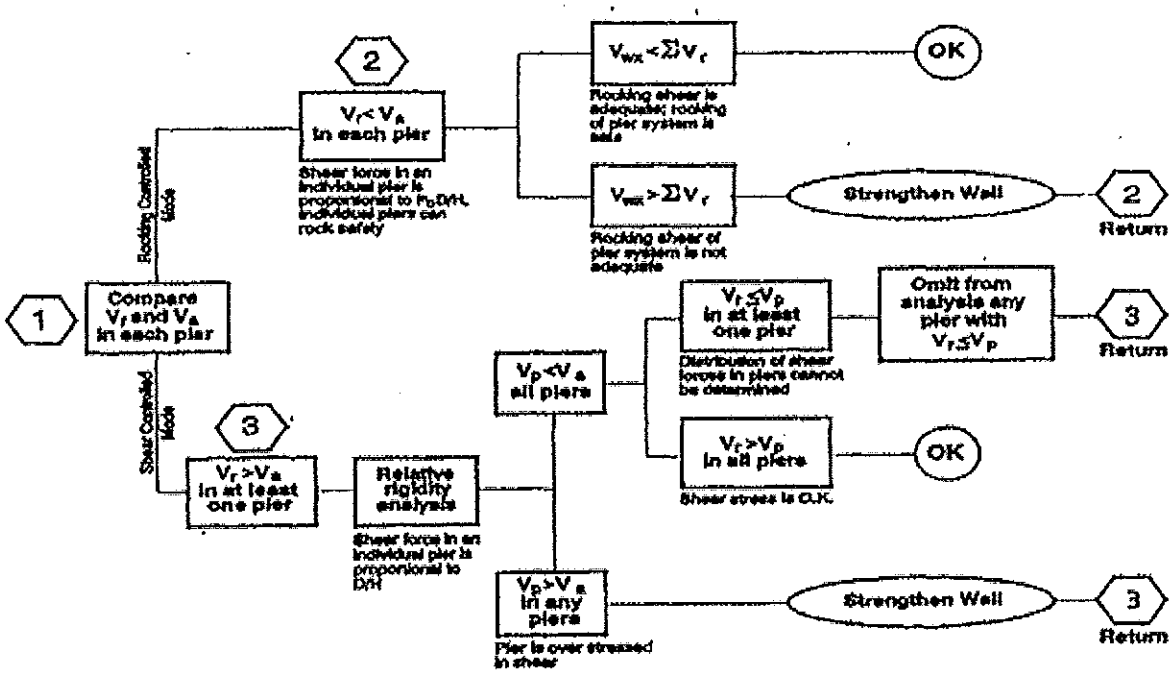
① Region of demand-capacity ratios where crosswalls may be used to increase *h/t* ratios.

② Region of demand-capacity ratios where *h/t* ratios of "with crosswalls" may be used.

③ Region of demand-capacity ratios where *h/t* ratios of "all other buildings" shall be used.

NOTE: To convert feet to meters, multiply by 0.3048.

FIGURE 16C-2 — ANALYSIS OF UNREINFORCED MASONRY WALL IN-PLANE SHEAR FORCES



V_r = **Rocking shear capacity of pier.**

V_{wx} = **Total Shear Force resisted by the wall.**

Σv_r = **Rocking shear capacity of all piers in the wall.**

V_p = **Shear force assigned to a pier on the basis of a relative shear rigidity analysis.**

V_a = **Allowable shear strength of a pier.**

TABLE 16C-A -- ELEMENTS REGULATED BY THIS CHAPTER

ELEMENTS	SECTION	PROCEDURE			
		BOLTS- PLUS	SPECIAL	GENERAL	3403.5 3401.7[2]
Masonry Shear Strength	1606C.3.3	X	X	X	X
Diaphragms	1610C.1			X	
	1611C.4		X		
	1604.11			X	
Diaphragm Shear Transfer	1610C.1	X[1]			
	1611C.5	X[1]	X		
	1613C.2	X	X	X	
Chords	1611C.4			X	
Diaphragm Capacity Ratios	1604		X		
Collectors	1613C.3			X	
	1611C.4		X		
	1604.11				X[4]
Analysis of Vertical Elements	1612C		X	X	
Crosswalls	1611C.3		X		
Shear Walls	1610C.3		X		
	1611C.6		X		
	1604.11				X[3, 4]
Out of Plane Wall Anchorage	1613C.1	X	X	X	
	1604.11			X	
Ties & Continuity	1613C.4		X	X	
	1604.11			X	X
Wall Bracing	1613C.5	X	X	X	X[5]
Parapets	1613C.6	X	X	X	X
Veneer	1613C.7	X	X	X	X
Nonstructural Masonry Walls	1613C.8		X	X	X
Truss & Beam Supports	1613C.9		X	X	X
Adjacent Buildings	1613C.10		X	X	X
Subdiaphragms	1604.11				X

	ASCE 7-05 Section				

1 Diaphragm shear transfer forces shall be calculated using the General Procedures unless the building qualifies for the use of the Special Procedure.

2 Retrofit procedure per Section ~~3403.5~~ 3401.7.

3 Wood shear walls allowed only for one- or two-story building per Section ~~2305.1.5~~ 2305.1.

4 Only in-plane shear check required. (Rocking not allowed.)

5 Use (h/t) for "All other walls" from Table 16C-B.

TABLE 16C-B — ALLOWABLE VALUE OF HEIGHT-TO-THICKNESS RATIO OF UNREINFORCED MASONRY WALLS

WALL TYPES	BUILDINGS WITH CROSSWALLS[1]	ALL OTHER BUILDINGS
Walls of one-story buildings	16[2,3]	13
First story wall of multistory buildings	16	15
Walls in top story of multistory buildings	14[2,3]	9
All other walls	16	13

1 Applies to the Special Procedure of Section 1611C and the Bolts-plus Procedure of the last paragraph of Exception 1 to Section 1609C.2 only. See Section 1611C.7 for other restrictions.

2 This value of height-to-thickness ratio may be used only where mortar shear tests establish a tested mortar shear strength, v_t, of not less than 100 psi (689.48 kPa). This value may also be used where the tested mortar strength is not less than 60 psi (413.69 kPa) and a visual examination of the collar joint indicates not less than 50 percent mortar coverage.

3 Where a visual examination of the collar joint indicates not less than 50 percent mortar coverage, and the tested mortar shear strength, v_t, is greater than 30 psi (206.84 kPa) but less than 60 psi (413.69 kPa), the allowable height-to-thickness ratio may be determined by linear interpolation between the larger and smaller ratios in direct proportion to the tested mortar strength.

TABLE 16C-C — HORIZONTAL FORCE FACTOR, C_p[1]

CONFIGURATION OF MATERIALS	C_p
Roofs with straight or diagonal sheathing and roofing applied directly to the sheathing, or floors with straight tongue-and-groove sheathing	0.50
Diaphragms with double or multiple layers of boards with edges offset, and blocked plywood systems	0.75

[1] Applicable to the Special Procedure of Section 1611C only.

TABLE 16C-D — ALLOWABLE VALUES FOR EXISTING MATERIALS

[Amended 10-7-2003 by Ord. No. 245-03]

EXISTING MATERIALS OR CONFIGURATION OF MATERIALS[1]	ALLOWABLE VALUES
1. HORIZONTAL DIAPHRAGMS[2]	(x 14.5939 for N/m)
a. Roofs with straight sheathing and roofing applied directly to the sheathing	100 pounds per foot seismic shear
b. Roofs with diagonal sheathing and roofing applied directly to the sheathing	250 pounds per foot seismic shear
c. Floors with straight tongue-and-groove sheathing	100 pounds per foot seismic shear
d. Floors with straight sheathing and finished wood flooring with board edges offset or perpendicular	500 pounds per foot seismic shear
e. Floors with diagonal sheathing and finished wood flooring	600 pounds per foot seismic shear
2. CROSSWALLS[2,3]	(x 14.5939 for N/m)
a. Plaster on wood or metal lath	per side: 200 pounds per foot seismic shear
b. Plaster on gypsum lath	175 pounds per foot seismic shear
c. Gypsum wallboard, unblocked edges	75 pounds per foot seismic shear
d. Gypsum wallboard, blocked edges	125 pounds per foot seismic shear
3. EXISTING FOOTINGS, WOOD FRAMING, STRUCTURAL STEEL AND REINFORCE STEEL	(x 6.895 for kPa)
a. Plain concrete footings	**f'_c = 1,500 psi unless otherwise shown by tests[4]**
b. Douglas fir wood	**Allowable stress same as D.F. No. 1[4]**
c. Reinforcing steel	***f_t = 18,000 psi maximum*[4]**
d. Structural steel	**f_t = 20,000 psi maximum[4]**

1 Material must be sound and in good condition.

2 A one-third increase in allowable stress is not allowed

3 Shear values of these materials may be combined, except the total combined value shall not exceed 300 pounds per foot (2068.43 kPa).

4 Stresses given may be increased for combinations of loads as specified in this code

TABLE 16C-E — ALLOWABLE VALUES OF NEW MATERIALS USED IN CONJUNCTION WITH EXISTING CONSTRUCTION

NEW MATERIALS OR CONFIGURATIONS OF MATERIALS	ALLOWABLE VALUES[1]
1. HORIZONTAL DIAPHRAGMS[10]	**(x 14.5939 for N/m)**
a. Plywood sheathing nailed directly over existing straight sheathing with ends of plywood sheets bearing on joists or rafters and edges of plywood located on center of individual sheathing boards	225 pounds per foot seismic shear
b. Plywood sheathing nailed directly over existing diagonal sheathing with ends of plywood sheets bearing on joists or rafters	375 pounds per foot seismic shear
c. Plywood sheathing nailed directly over existing straight or diagonal sheathing with ends of plywood sheets bearing on joists or rafters with edges of plywood located over new blocking and nailed to provide a minimum nail penetration into framing and blocking of 1 5/8 inches (41.28 mm)	75 percent of the values specified in Table ~~2306.3.1~~ 2306.2.1(1)
2. SHEAR WALLS: (GENERAL PROCEDURE)	
Plywood sheathing applied directly over wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing.	100 percent of the value specified in Table ~~2306.3.2~~ 2306.2.1(2) for shear walls
3. CROSSWALLS: (SPECIAL PROCEDURE)	
a. Plywood sheathing applied directly over wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing	133 percent of the value specified in Table ~~2306.3.2~~ 2306.2.1(2) for shear walls
b. Drywall or plaster applied directly over wood studs	100 percent of the values in Table ~~2306.4.3~~ 2306.5
c. Drywall or plaster applied to sheathing over existing wood studs	The values in Table ~~2306.4.3~~ 2306.5 reduced as noted in Footnote a of that table[2]
4. TENSION BOLTS	(x 4.448 for N)
a. Bolts extending entirely through unreinforced masonry walls secured with bearing plates on far side of a 3 wythe minimum wall with at least 30 square inches (19,355 mm2) of area[3,4,11]	**1,800 pounds per bolt8** 900 pounds per bolt for 2 wythe walls[8]
b. Bolts extending to the exterior face of the wall with a 2½-inch (63.5 mm) round plate under the head and drilled at an angle of 22½ degrees to the horizontal, installed as specified for shear bolts[3,4,5]	**1,200 pounds per bolt**
5. SHEAR BOLTS	
Bolts embedded a minimum of 8 inches into unreinforced masonry walls and centered in a 2½-inch diameter hole filled with dry-pack or non- shrink grout. Through bolts with first 8 inches as noted above and embedded bolts as noted in item 4b. [4,5,9]	**½ inch dia. = 350 pounds[7,8]** **5/8 inch dia. = 500 pounds[7,8]** **¾ inch dia. = 750 pounds[7,8]**
6. INFILLED WALLS	
Reinforced masonry infilled openings in existing unreinforced masonry walls. Provide keys or dowels to match reinforcing.	Same values as for unreinforced masonry walls
7. REINFORCED MASONRY	
Masonry piers and walls reinforced per Chapter 21	Same values as specified in Section 2107[6]
8. REINFORCED CONCRETE	
Concrete footings, walls and piers reinforced as specified in Chapter 19 and designed for tributary loads	Same values as specified in Chapter 19[6]

1 A one-third increase in allowable stress is not allowed, except as noted.

2 In addition to existing sheathing value.

3 Bolts to be ½ inch (1.27 mm) minimum in diameter.

4 Drilling for bolts and dowels shall be done with an electric rotary drill. Impact tools shall not be used for drilling holes or tightening anchors and shear bolt nuts.

5 Embedded bolts to be tested as specified in Section 1607C.

6 Stress given may be increased for combinations of load as specified in this code.

7 A one-third increase in allowable stress is allowed for short-term loading.

8 Other bolt sizes, values and installation methods may be used, provided a testing program is conducted in accordance with Section 1615C. Bolt spacing shall not exceed 6 feet (1.83 m) on center and shall not be less than 12 inches (0.305 m) on center.

9 Tension and shear from seismic loads need not be assumed to act simultaneously.

10 Values and limitations are for nailed plywood. Higher values may be used for other approved fastening systems such as staples when approved by the Building Official.

11 Plate size may be reduced to not less than 9 square inches (5805 mm^2), provided the bearing stress on the masonry at design load does not exceed 60 pounds per square inch, psi (414 kPa).

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 2:

Name: CAC Structural Subcommittee
Date: March 9, 2010

Comments/Findings:
Approved and forwarded to full CAC committee.

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

COMMENT 3:
Name: Code Advisory Committee Date:
Comments/Findings:

Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	

Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:
			X

SECTION 1601D thru 1604D

Chapter 16D
PARAPETS AND APPENDAGES – RETROACTIVE PROVISIONS

COMMENT 1:

Name: David Leung-DBI
Date: March 9, 2010

Comments/Findings:
Add the following chapter:

Chapter 16D
PARAPETS AND APPENDAGES – RETROACTIVE PROVISIONS

SECTION 1601D — GENERAL

Every parapet or appendage which is supported on or attached to an exterior wall of a building adjacent to a property line, passageway, open courtyard or public way or which occurs in any other location where failure of such parapet or appendage would be hazardous to life or limb in such areas shall, when required by the Building Official, be subject to inspection by a licensed architect or civil engineer employed by the owner. The provisions of this section are retroactive and shall apply to and include buildings erected prior to the adoption of this code.

SECTION 1602D — CORRECTION OF HAZARDOUS PARAPETS AND APPENDAGES

Whenever the Building Official determines, by visual inspection or from the report furnished by the architect or civil engineer, that an existing parapet or appendage which is within the scope of this section is not adequate to resist the lateral forces due to earthquake as detailed in Chapter 16 of the Building Code which was in effect on July 1, 1969, the Building Official shall conclude that inadequacies exist and shall, by written notice to the owner or person or the agent in charge of the building, direct that necessary steps be taken to eliminate the hazard.

Upon receipt of such notice, the owner or person or agent in control of the building where such hazardous parapet or appendage exists shall:

1. Within one year from the date of receipt of such notice:

(1) Submit to the Building Official an acceptable written plan or procedure for the elimination of the hazardous condition by removal or alteration of the hazardous parapet or appendage.

(2) Obtain the necessary alteration permit in accordance with the procedures

set forth in Section 106A of this code.

2. Within one year after obtaining the alteration permit, complete all work indicated on the approved construction documents. A one-year extension may be granted by the Building Official when mitigating circumstances exist.

SECTION 1603D — VARIANCE PROCEDURE

Any person receiving a notice as set out in Section 1602D above may appeal for a variance from the notice to the Board of Examiners in the manner provided by Section 105A.1 or, in the case of parapets or appendages of unreinforced masonry bearing wall buildings, to the Unreinforced Masonry Building Appeals Board in the manner provided by Section 105A.7.

SECTION 1604D — UNREINFORCED MASONRY PARAPETS AND APPENDAGES

The removal, stabilization or bracing of unreinforced masonry parapets or appendages, the application for a permit for which was filed after February 15, 1993, shall comply with Section 1613C.6. Certain parapets or appendages, previously exempted under this section, shall be removed, or stabilized, or braced when required by Section 1613C.6.

[Note: To carryover 2007 San Francisco Amendments to 2010.

Recommend to be brought to the full CAC committee for further action.]

Place an X in one of the following:	**Retain as is:**	**Update as noted:**	**Revise:**	**Delete:**
			X	

Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**
			X

COMMENT 2:

Name: CAC Structural Subcommittee
Date: March 9, 2010

Comments/Findings:
Approved and forwarded to full CAC committee.

Place an X in one of the following:	**Retain as is:**	**Update as noted:**	**Revise:**	**Delete:**
			X	

Place an X in one of the following:	**More Restrictive:**	**Less Restrictive:**	**Neither more nor less:**
			X

COMMENT 3:				
Name: Code Advisory Committee Date:				
Comments/Findings:				
Place an X in one of the following:	Retain as is:	Update as noted:	Revise:	Delete:
			X	
Place an X in one of the following:	More Restrictive:	Less Restrictive:	Neither more nor less:	
			X	