



DESIGN OF BASEMENT & SITE RETAINING WALLS

ISSUE:

Building Code Section 1805.5 requires foundation walls to be designed in accordance with Chapters 19 or 21 for concrete or masonry, respectively. Section 1610.1 requires retaining walls to be designed to resist the soil loads in Table 1610.1, unless otherwise specified by a soils investigation. Also, Section 1802.2.7 # 1 states that a structure in Seismic Design Category D, E, or F requires a geotechnical investigation in order to determine the lateral pressures on basement and retaining walls due to earthquake motions. However, such reports and seismic analyses have not historically been required in our jurisdiction for basement or cantilevered site retaining walls under 12-feet in height.

POLICY:

In accordance with the State of California Public Resources Code; for the Alquist-Priolo Earthquake Fault Zoning Act and the Seismic Hazards Mapping Act, (Sections 2621 and 2690 respectively), only structures intended for human occupancy are required to comply with the design provisions of the aforementioned sections, and as such, site retaining walls are exempt.

Additionally, Building Code Section 1806A.1, the California Division of the State Architect – Structural Safety, and the Office for Statewide Health Planning and Development, Divisions 1 and 4 specify the inclusion of seismic forces on retaining walls only when they retain more than 12-feet of material.

In concert with the aforementioned state agencies and the language of the Public Resources Code, it is the opinion of Building and Safety that since the California Public Resources Code specifically addresses the geotechnical condition of strong ground shaking, and; furthermore, specifically exempts non-habitable structures from geotechnical investigations in hazard areas, the general provisions within the Building Code should not take precedence over the specific recommendations of statewide geotechnical professionals.

Due to the variability in soil properties throughout the County of Los Angeles, the design professional must take care in his or her analysis of basement and site retaining walls. Without the substantiation of a soils investigation to recommend otherwise, the following table shall be used to determine the equivalent fluid pressure for design of retaining walls.

TABLE OF EQUIVALENT FLUID WEIGHTS FOR ACTIVE PRESSURE

(Reference: Table 1610.1 for minimum loads at level backfill condition)

SURFACE SLOPE OF RETAINED MATERIAL HORIZONTAL TO VERTICAL*	<u>CANTILEVER</u> EQUIVALENT FLUID WEIGHT (ACTIVE PRESSURE) (PCF)	<u>RESTRAINED</u> EQUIVALENT FLUID WEIGHT (AT REST PRESSURE) FOR 8'-12' WALLS SUPPORTED BY A RIGID DIAPHRAGM** (PCF)
LEVEL	45	60
5 to 1	49	64
4 to 1	53	68
3 to 1	57	72
2 to 1	61	76

* Where the surface-slope of the retained earth varies, the design slope shall be obtained by connecting a line from the top of the wall to the highest point on the slope whose limits are within the horizontal distance from the stem equal to the stem height of the wall.

** Reference County of Los Angeles Building Code Section 1610, Exception; walls 8-feet or less may be designed using active pressure. Rigid diaphragm shall be a structural slab or equivalent with capacity to resist deflection of the top of the retaining wall.

Active pressure shall be distributed vertically based on a triangular loading and at rest pressure shall be distributed based on rectangular loading. Note that the above values are minimum lateral loads and do not account for any surcharge other than the slope as shown. The design professional is responsible for complete analysis in accordance with Section 1806.1.

FOR CONSTRUCTION ASSOCIATED WITH A GROUP R-3, R-3.1, and R-4 OCCUPANCIES:

BASEMENT RETAINING WALLS AND CANTILEVERED SITE RETAINING WALLS 12-FEET OR LESS IN HEIGHT, AS MEASURED FROM THE TOP OF THE FOOTING, DO NOT REQUIRE A GEOTECHNICAL INVESTIGATION OR THE INCLUSION OF AN ADDITIONAL SEISMIC LATERAL FORCE WHEN CONSTRUCTED ON RESIDENTIAL PARCELS INTENDED FOR GROUP R-3 (UP TO THREE UNITS) OR APPURTENANT GROUP U OCCUPANCIES. WALLS OVER 12-FEET IN HEIGHT SHALL BE DESIGNED PER A GEOTECHNICAL INVESTIGATION AND REPORT AND SHALL INCLUDE AN ADDITIONAL SEISMIC LATERAL FORCE AS SPECIFIED IN THE GEOTECHNICAL REPORT.

FOR CONSTRUCTION ASSOCIATED WITH ANY NON-GROUP R-3, R-3.1 and R-4 OCCUPANCIES:

CANTILEVERED SITE RETAINING WALLS 8-FEET OR LESS IN HEIGHT, AS MEASURED FROM THE TOP OF THE FOOTING, DO NOT REQUIRE A GEOTECHNICAL INVESTIGATION OR THE INCLUSION OF AN ADDITIONAL SEISMIC LATERAL FORCE WHEN CONSTRUCTED ON NON-RESIDENTIAL PARCELS, AND MAY BE DESIGNED IN ACCORDANCE WITH THE VALUES IN THE TABLE ABOVE. WALLS OVER 8-FEET IN HEIGHT SHALL BE DESIGNED PER A GEOTECHNICAL INVESTIGATION AND REPORT AND SHALL INCLUDE AN ADDITIONAL SEISMIC LATERAL FORCE AS SPECIFIED IN THE GEOTECHNICAL REPORT.

Referral to the Geotechnical and Materials Engineering Division shall be based on the "GMED Flow Chart". Also, any design with a geotechnical report that includes a seismic lateral force

shall be referred to GMED for review and approval of seismic forces.

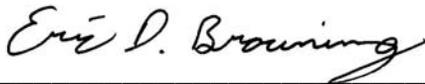
Retaining walls designed using code tabulated values shall meet the conditions cited below:

1. Fill materials behind retaining walls shall be fully drained of water and other fluids by means of sub-drain, weep holes and/or other approved method at least equivalent to the attached detail.
 2. All superimposed loads, other than retained earth, shall be considered as surcharges and accounted for in the design. Uniformly distributed loads may be considered as equivalent added depth of retained earth. Surcharge loads due to continuous or isolated footings shall be determined by equivalent methods acceptable to the Building Official.
 3. Walls located in Flood Hazard Areas shall be designed in accordance with Building Code Section 1612. The Regional Drainage Engineer shall notify the building plan check engineer when flood loads are required to be considered and shall be responsible for verifying the forces on the walls. The building plan check engineer shall verify the adequacy of the wall for the given flood loads.
 4. Loads applied within a horizontal distance equal to wall stem height, measured from the back face of the wall shall be considered as a surcharge.
 5. The resultant of all vertical loads and lateral pressures shall pass through the middle one third of the footing.
 6. Walls shall be restrained against sliding by one or more of the following methods using values from Building Code Table 1804.2 for Class 5 Materials:
 - A. Lateral Sliding Resistance equal to 130 psf of contact area or $\frac{1}{2}$ the dead load in accordance with Section 1804.3, whichever is less.
 - B. Lateral Bearing against the soil as measured in feet below natural grade.
 - C. A rigid element such as a slab on grade may be used provided it is designed for the reaction force of the footing it supports.
 7. If keys are used, the depth of lateral bearing shall be measured from the top of the footing to the bottom of the key unless a compaction report is provided to justify a greater depth.
 8. Wood shall not be employed in the construction of retaining walls.
- ◆ *Retaining walls greater than 8-feet (for non-R-3) or 12-feet (for R-3) in height shall be designed for seismic lateral forces in addition to all horizontal and vertical loads. Seismic forces shall be specified in a geotechnical investigation prepared by a licensed geotechnical engineer. The report shall be referred to, reviewed and approved by GMED and the plan check engineer shall verify that the loads approved by GMED are correctly applied in the calculations.*

9. Special inspection is required as specified in the Building Code Section 1704.5 except for those retaining walls (cantilever and restrained) with a stem wall height less than 6 feet 10 inches measured from top of footing to top of stem wall where the allowable design masonry stresses are reduced by one-half.

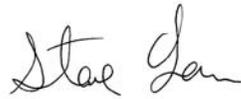
The Building Official, at any time and based on site specific information, may require the preparation and submittal of a geotechnical report for any project, even if it meets the exemption criteria specified above.

WRITTEN BY:



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REVIEWED BY:



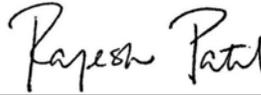
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RECOMMENDED BY:



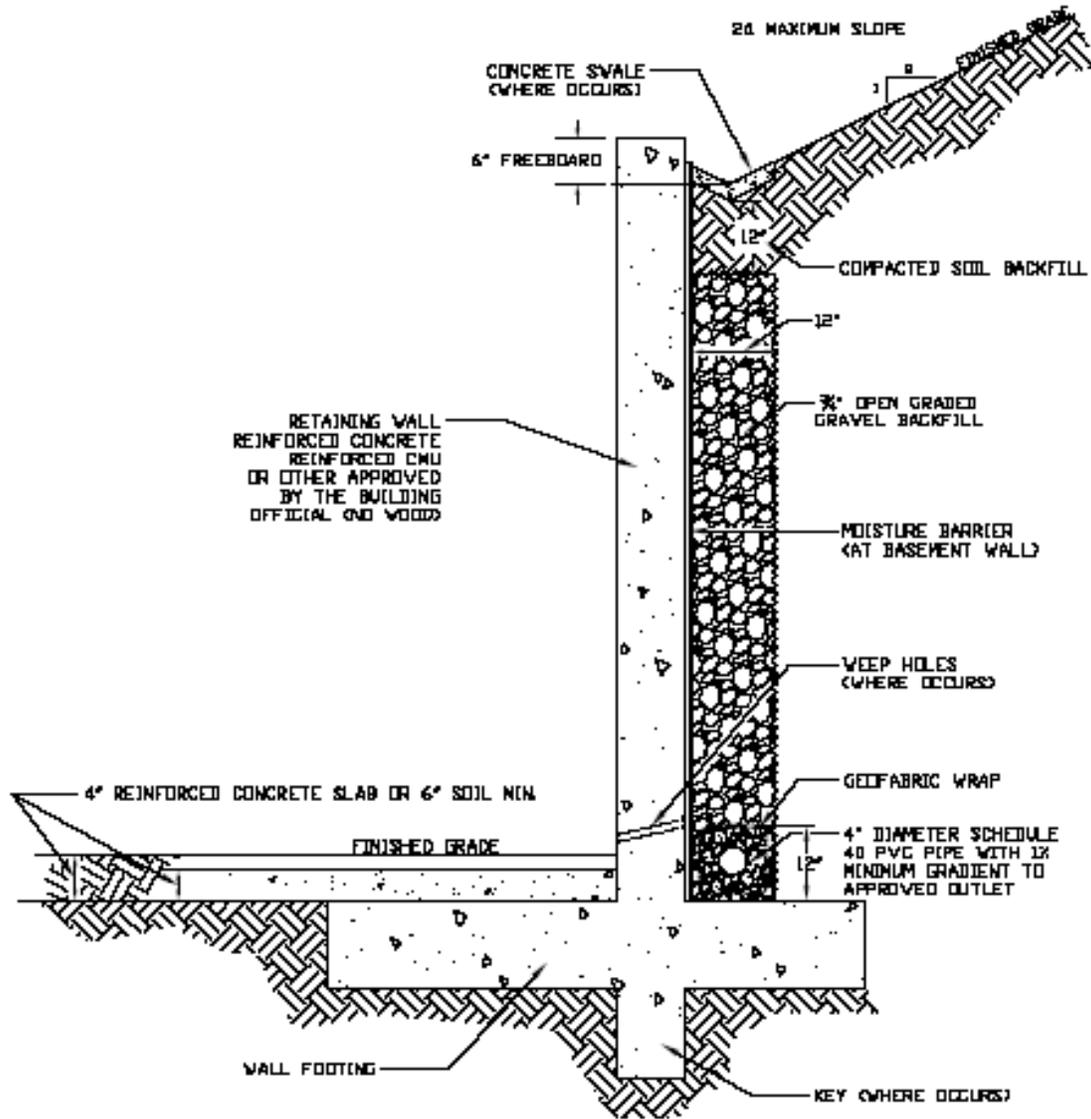
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APPROVED BY:



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Supersedes BCM 1806.1 Article 1 dated 07-21-08.



TYPICAL RETAINING WALL DRAINAGE SECTION

CS 1404B