



BUILDING CODE MANUAL

A3313

Article 1

04-14-05

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REQUIREMENTS FOR SEGMENTAL EARTH RETAINING WALLS

The following policy establishes guidelines for segmental earth retaining walls. For the purposes of this manual, segmental earth retaining walls refer to fill slopes reinforced with multiple layers of geosynthetic fabric embedded into the soil backfill and mechanically tied to facing units. By placing tensile reinforcing elements such as geosynthetic fabric in the soil, the strength of the soil can be improved significantly such that the vertical face of the soil/reinforcement system is essentially self supporting. The facing units provide surficial stability and prevent the soil from raveling out between the rows of reinforcement.

Most commonly, the slope is reinforced with geogrid material, but geotextiles, geomembranes, geonets, steel strips and steel grids can also be used. Common facing units include precast concrete panels, dry cast modular blocks, metal sheets and plates, welded wire mesh, shotcrete, and wrapped sheets of geosynthetics. This manual does not apply to other types of mechanically stabilized walls.

In addition to Appendix Chapter 33 of the 2002 Los Angeles County Building Code (LACBC), this document shall be used to identify the requirements for the installation of such systems. The following minimum standards shall be implemented on the plans and in the field as described below.

General Requirements

Segmental earth retaining walls shall be reviewed and processed as part of a grading permit application. Geotechnical and Materials Engineering Division shall review the consultants' recommendations for overall sliding and overturning stability of the walls, internal stability of the soil/reinforcement, embedment length, and durability of the reinforcement. In addition, GMED shall review the seismic analysis for all earth retaining systems exceeding 12' in height.

A building permit is not required for segmental earth retaining walls in which the facing units do not support an active soil wedge and only provide surficial slope stability. However, the mechanical connection of the facing units to the geogrid material must be reviewed by a building or grading plan checker for structural stability. Each wall system shall have an approved ICBO Evaluation Report/ICC-ES Legacy report or a review from Research section will be required. For gravity wall systems in which the design depends on the structural capacity of the individual facing units, a more detailed structural analysis and a building permit shall be required.

Design Requirements

- No structure shall be supported by any segmental earth retaining wall.

- No structure shall be located within a minimum of 10' horizontally from the limit of the embedment area of the proposed geogrid material. Restricted use areas shall be established and recorded 10' beyond the limits of the proposed geogrid material as part of the final Tract or Parcel map for subdivisions or in accordance with the attached "Maintenance Covenant for a Restricted Use Area" sample for single lot development. Copies of the Restricted Use Area covenant(s) shall be placed in the job jackets of all affected properties, and a note shall be placed on the associated House Numbering Map indicating the Restricted Use Area and document number(s) of the covenant(s).
- All segmental block facing units shall have a mechanical interlocking mechanism between adjacent units, such as formed lips, pins or keys, that will resist horizontal movement out of the plane of the wall. The geogrid shall be mechanically anchored to the block units through the use of aggregate interlock, pins, pipes, etc. Formed lips in block units will not provide adequate anchorage unless configured to mechanically engage the geogrid.

Adequacy of the mechanical interlock must be maintained if separation in block courses due to settlement of the lower course, uplift of the upper course, or bulging of the surface between geogrid layers occurs. The design performance objective is to limit course separations to 1/4" maximum for the life of the wall.

The geogrid manufacturer and grid types shall be identified and the allowable long-term design strength and pullout of grid-to-block values provided.

- Drainage pipes and aggregate backfill shall be provided between the facing units and the reinforced soil mass as recommended by the Geotechnical Engineer and the manufacturer of the wall system. The backfill shall extend full height and length of the wall at a minimum thickness of 1'-0" and shall meet the compaction requirements as specified by the Geotechnical Engineer and the manufacturer.
- Surface drainage at the top and bottom of the wall shall be directed away from the wall.
- Geogrid material shall not extend into the road right of way under the paved road or in parkway areas where utilities are typically installed. In no event shall any encroachment be allowed into the geogrid embedment area that will puncture the geogrid material unless specifically approved by the Geotechnical Engineer and detailed on the plans.
- The bottom elevation of the segmental earth retaining wall shall be setback from the property line in accordance with 3314.3 of the 2002 LACBC for toe of fill slope setbacks or 10' from the limits of the geogrid embedment area, whichever is greater.
- The facing units of all segmental earth retaining walls must be closed faced cells with no landscaping or irrigation proposed on the surface of the walls.

Geotechnical Requirements

A California licensed civil engineer shall prepare a soil investigation report for each project site in accordance with 1804.3 of the 2002 LACBC. The report must include the following:

- Recommendations for preparation of the reinforced soil mass and slope stability above and below the retaining wall (if necessary).

- Provide material specifications of the reinforced fill and shear strength parameters for the reinforced fill, foundation soils, and retained soils. In the internal stability analysis, a cohesion of $c=0$ psf must be used for the reinforced fill.
- Address external (global) stability of the slope and the segmental earth retaining wall.
- Address internal stability of the wall. The Rankine method of analysis with the reinforced soil having zero cohesion must be used to analyze the internal stability of the wall. Each wall must be designed to resist sliding by at least 1.5 times the lateral force and overturning by at least 1.5 times the overturning moment, as specified in 1611.6 of the 2002 LACBC. Provide recommendations for the maximum allowable reinforcement tension and pull-out resistance of the reinforcement behind the active failure zone.
- If the retained height of the segmental earth retaining wall exceeds 12 feet, the wall must also be designed to resist the additional earth pressures caused by seismic ground shaking. Seismic parameters provided in the report will be reviewed and verified by GMED. In determining the additional earth pressures that could result from future seismic forces, an acceleration equal to 50% of the site ground acceleration shall be utilized in the internal stability analysis of the structure.
- Address durability of the reinforcement for the structure life.
- Provide calculations justifying the geogrid embedment length, spacing, and number of geogrid layers.
- Provide surface and subsurface drainage recommendations for the wall.

Submittal Requirements

Complete design calculations and details of the retaining system shall be submitted and included for review and approval with the details shown on the grading plans. Details shall include all the Geotechnical Engineer's and manufacturer's recommendations, notes, and specifications. Drawings shall include the following information:

- Locations and elevations of the top and bottom of all wall sections including the foundations. Provide specific sections/elevations for the wall face, wall endpoints, curved/cornered walls, and walls adjacent to drainage courses.
- Geogrid type, location, spacing, and embedment lengths behind the interior face of the block units.
- Connection detail of geogrid material to facing unit.
- Subsurface and surface drainage considerations, including details and specifications of all subdrain components and details for surface drainage devices and outlets.
- Limits of Restricted Use Area with bearings, distances, and curve data for geogrid embedment areas.
- Soil gradation requirements including maximum allowable rock size, assumed soil design properties, placement/compaction specifications for the reinforced backfill and

block fill material, overexcavation requirements, and minimum distance of compaction equipment to facing units.

Inspection Requirements

- It is strongly recommended that a representative from the manufacturer of the earth retaining wall be present at the pre-grade meeting. It is critical that the contractor and Geotechnical Engineer create an inspection schedule for construction of the wall, and the manufacturer's representative can provide technical assistance in that process.
- Continuous inspection of the construction of the segmental earth retaining wall is required by the Geotechnical Engineer (or his representative). The following special inspections are required:
 - The modular concrete unit dimensions.
 - Concrete unit identification compliance.
 - Foundation preparation.
 - Concrete unit placement, including alignment and inclination.
 - Geosynthetic reinforcement type and placement.
 - Shear strength parameters of soil to verify that minimum values used in the analysis are met.
 - Backfill placement and compaction.
 - Drainage provisions.
- The Geotechnical Engineer shall submit a letter of certification verifying the segmental earth retaining wall has been properly installed in accordance with the engineered plans and manufacturer's specifications. The letter must specifically include the following certifications:
 - The completion of the required special inspections as listed above.
 - The concrete or concrete masonry mix design and strength evaluation for the precast units comply with Chapters 19 and 21 of the 2002 LACBC. Also specify the manufacturer's name and address, name of product and unit type. Include applicable laboratory compressive strength and absorption test results.
 - Indicate the geosynthetic material supplier's name and address, name of product and the product designation meeting the requirements of the project's design. Include the roll numbers and identification procedures, sampling procedures, and the results of the quality control test which include flexural rigidity, tensile strength and modulus and junction strength for each batch of resin and each shift's production used.

RECOMMENDED BY:

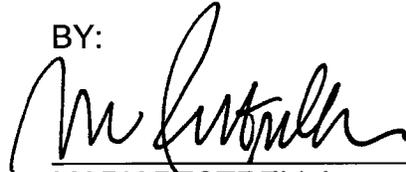


MITCH MILLER
Senior Civil Engineer

APPROVED,

RAJ PATEL
Superintendent of Building

BY:



MARK PESTRELLA
Assistant Superintendent of Building

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Attachment A:

Typical Segmental Retaining Wall Details

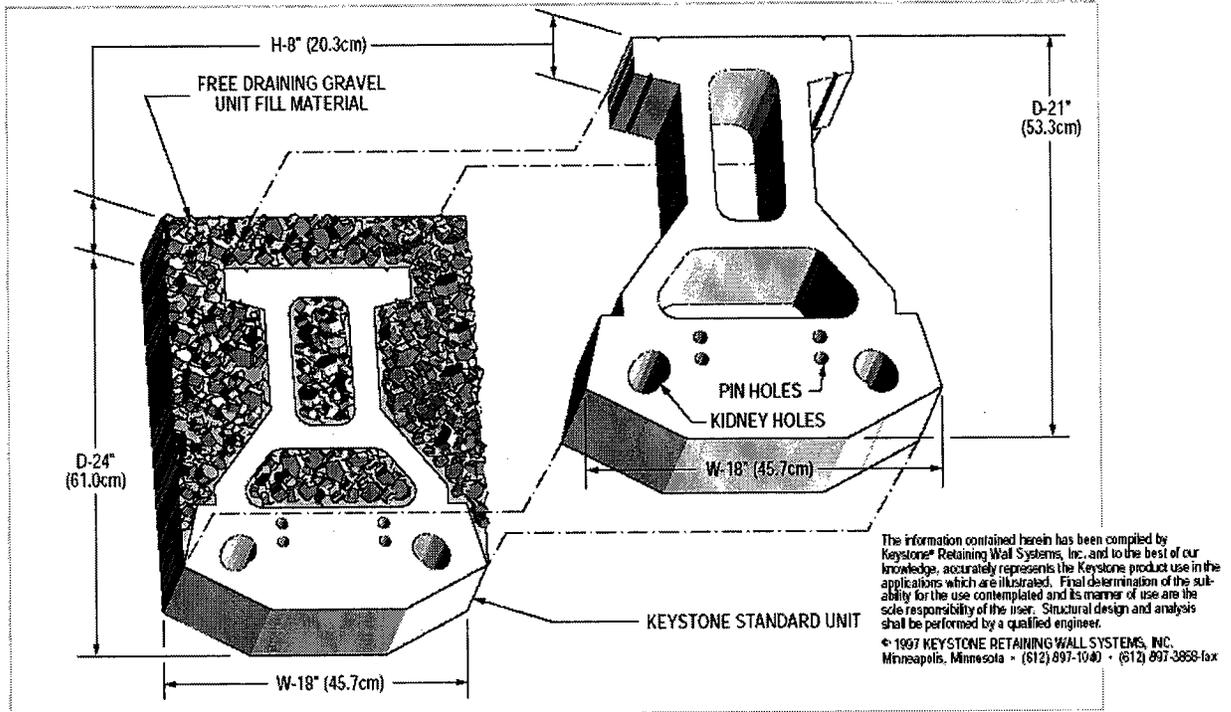


Figure 1: Typical Detail of Block Facing Unit

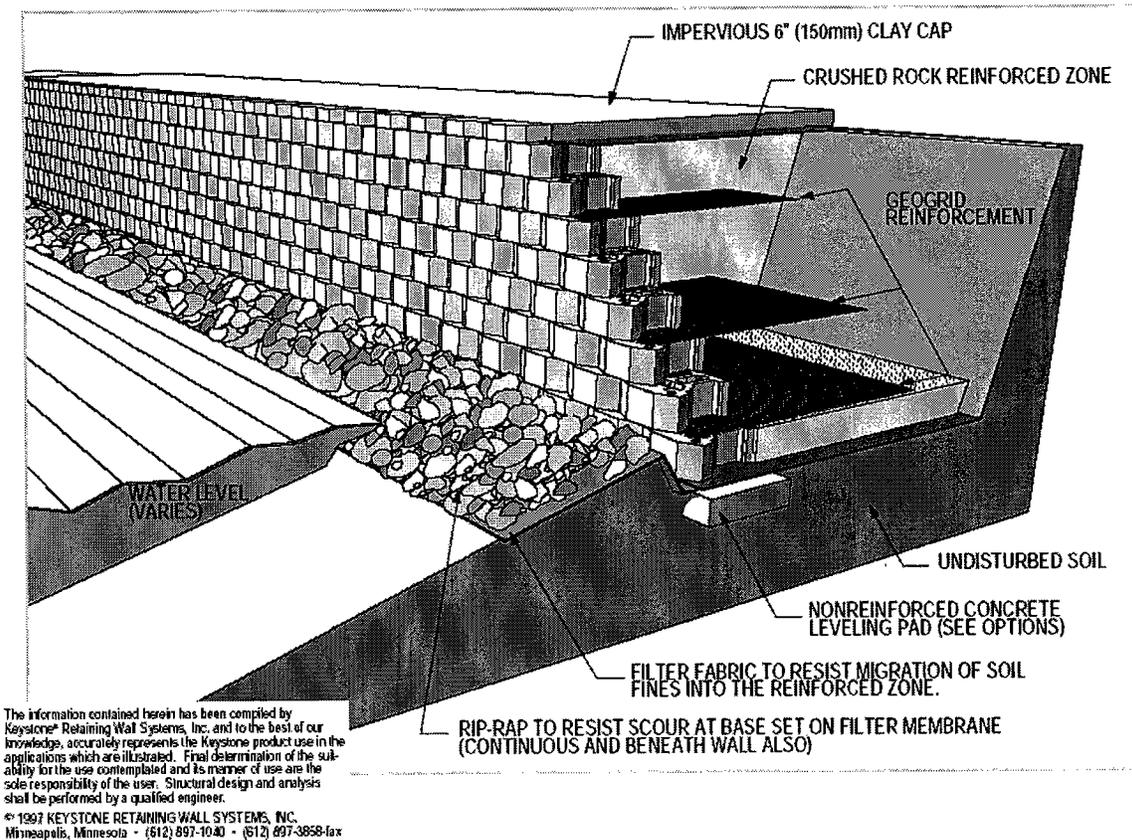
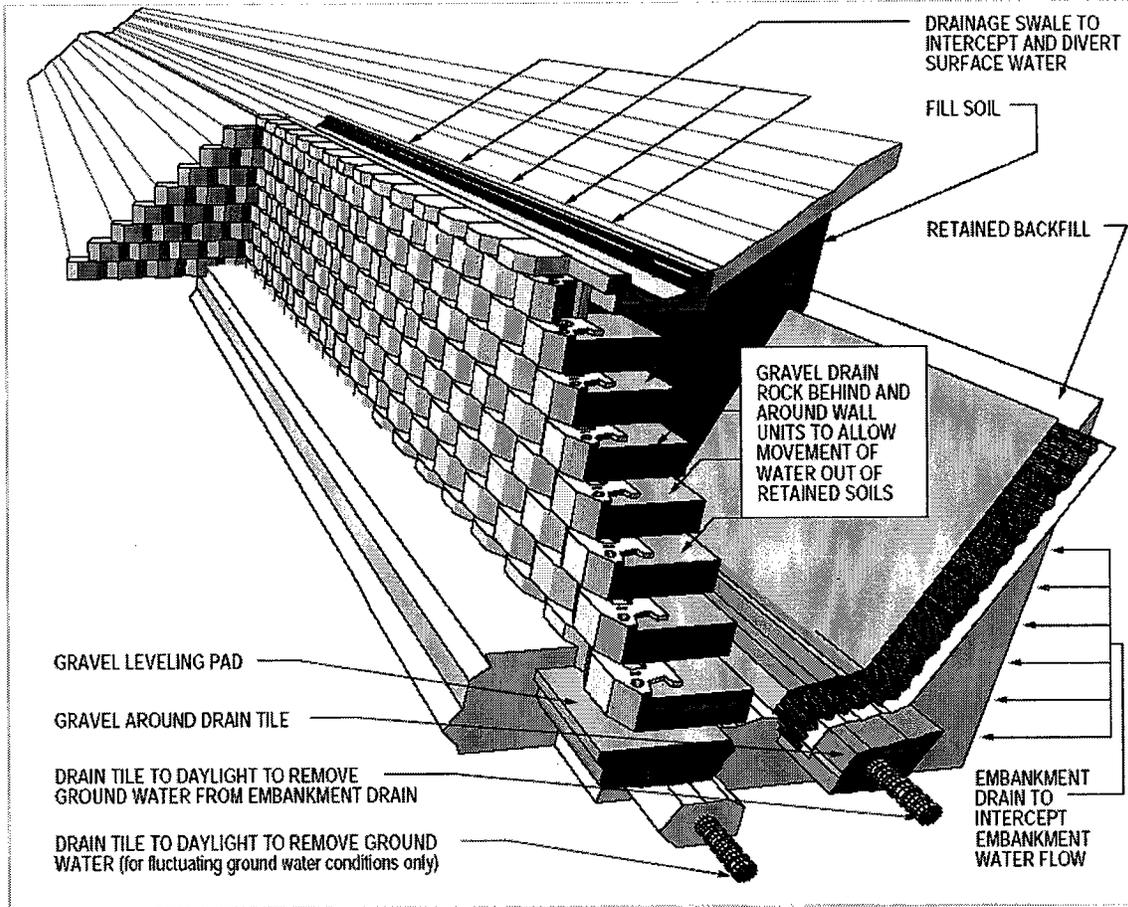


Figure 2: Typical Wall Application and Installation



The information contained herein has been compiled by Keystone® Retaining Wall Systems, Inc. and to the best of our knowledge, accurately represents the Keystone product use in the applications which are illustrated. Final determination of the suitability for the use contemplated and its manner of use are the sole responsibility of the user. Structural design and analysis shall be performed by a qualified engineer.

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Minneapolis, Minnesota • (612) 897-1040 • (612) 897-3828-fax

Figure 3: Typical Surface and Subsurface Drainage Recommendations

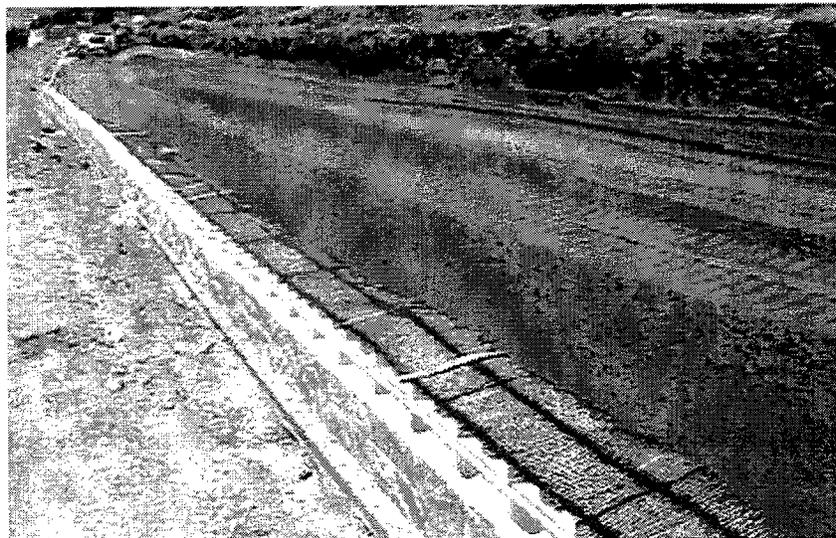


Figure 4: Construction in Progress

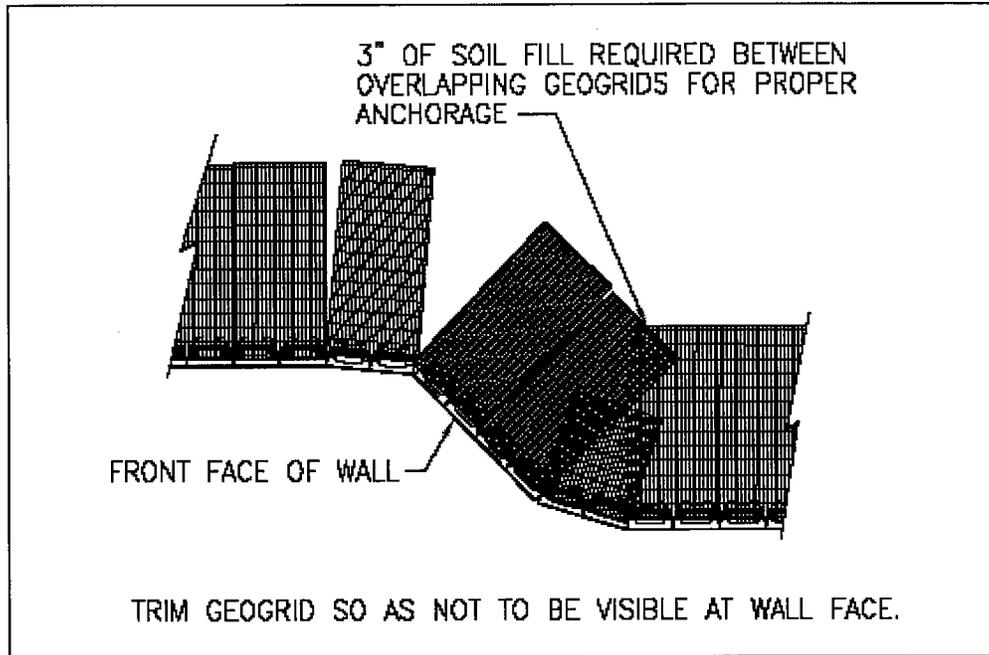


Figure 5: Typical Geogrid Placement Detail

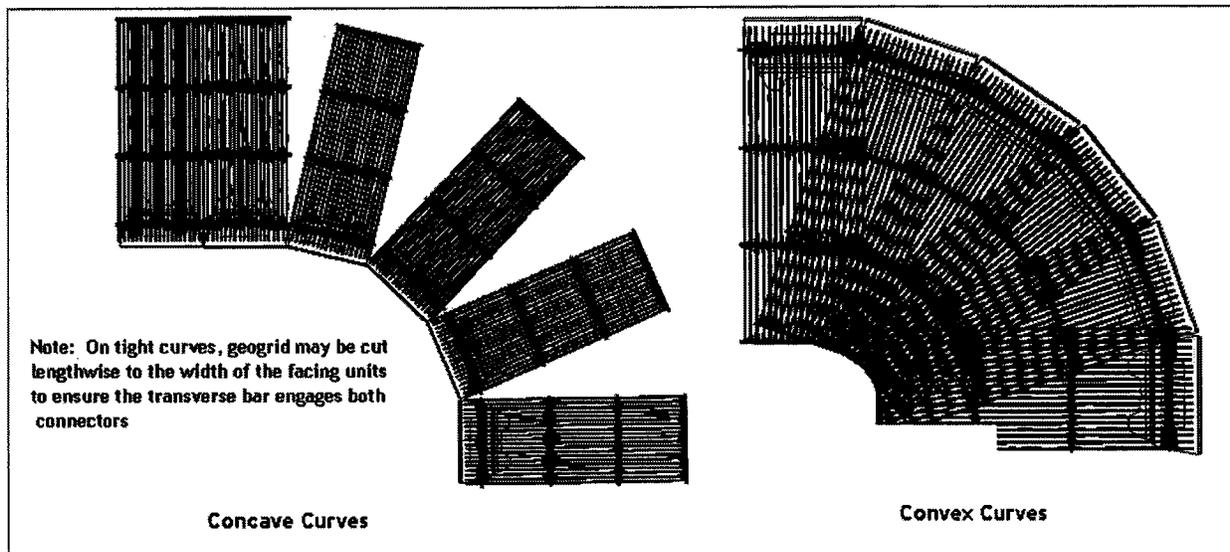


Figure 6: Typical Geogrid Alignment on Curves

Attachment B:**Table 1: ICBO Evaluation Reports/ICC-ES Legacy Reports for Segmental Earth Retaining Walls**

<u>Manufacturer</u>	<u>ICBO/ICC Report</u>
Keystone Retaining Wall System	ER-4599
VERSA-LOK® Retaining Wall System	ER-4625
Anchor Diamond® Retaining Wall System	ER-4952
Allan Block Retaining Wall System	ER-5087
Verdura and Candura Segmental Retaining Wall Systems	ER-5515
Anchor Diamond Pro Segmental Retaining Wall (SRW)	ER-5809
LOCK+LOAD Retaining Wall Systems	ER-5893

RECORDING REQUESTED BY AND MAIL TO:

COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
BUILDING AND SAFETY DIVISION
900 S. FREMONT AVENUE, 3RD FLOOR
ALHAMBRA, CA 91803-1331

Space above this line is for Recorder's use

MAINTENANCE COVENANT FOR A RESTRICTED USE AREA

Pursuant to Section 110 of the County of Los Angeles Building Code, Title 26, the defined area as shown on the attached exhibit is recorded as a "RESTRICTED USE AREA". This area shall remain clear of any future construction and/or landscaping unless approved by the Building Official. The purpose of which is to maintain stability of the wall facing and the geogrid fabric behind the wall.

LEGAL DESCRIPTION

ASSESSORS ID # _____ TRACT NO. _____ LOT NO. _____
ADDRESS: _____

I (we) _____, hereby certify that I (we) am (are) the legal owner(s) of
(Legal Name of Property Owners)
property indicated above, and as such owners for the mutual benefit of future purchasers, their heirs, successors, and assigns, do hereby fix the following protective conditions to which their property, or portions thereof, shall be held, sold and/or conveyed.

Owner(s):

By: _____ Date: _____

By: _____ Date: _____

(PLEASE ATTACH NOTARY)