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EVALUATION REPORT

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ANCHOR DIAMOND® RETAINING WALL SYSTEM

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I. **Subject:** Anchor Diamond® Retaining Wall System.

II. **Description:** A. **General:** The Anchor Diamond Retaining Wall System utilizes s combination of weight and batter to construct gravity retaining walls. Construction of reinforced soil retaining walls is achieved by combining the Anchor Diamond unit and geosynthetic reinforcement. The wall system is assembled in running bond without mortar or grout and with horizontal layers of geosynthetic reinforcement in the backfilled soil mass.

Concrete blocks are available in two face styles, as shown in Figure 1. Straight-face units weigh 73 pounds (33 kg), have a trapezoidal shape, and measure 12 inches (305 mm) deep, 6 inches (152 mm) high and $17^1/_4$ inches (438 mm) wide at the exposed face, tapering to 11 inches (279 mm) at the rear face. Bevel-face units weigh 68 pounds (31 kg), have a trapezoidal shape, and measure 12 inches (305 mm) deep, 6 inches (152 mm) high and 16 inches (406 mm) wide at the exposed face, tapering to 11 inches (279 mm) at the rear face. Both units must comply with U.B.C. Standard 21-4, with a minimum 28-day compressive strength of 3,000 psi (2069 MPa) on the net area and a maximum water absorption of 7 percent. Block tolerances must comply with Section 21.406 of U.B.C. Standard 21-4.

B. **Design:** The system is designed based on the National Concrete Masonry Design methodology for reinforced and gravity soil retaining wall systems, which depend upon the weight and geometry of the unit or reinforced soil mass to resist lateral earth pressures and other lateral forces. Lateral earth pressures are determined using the Coulomb theory. The design must include evaluation of both external and internal stability and must include consideration of external loads such as surcharges and seismic activity. External stability analyses are similar to those required for conventional gravity retaining walls. Minimum safety factors are 1.5 for sliding, 2.0 for overturning and 2.0 for bearing capacity. Internal stability analyses of reinforced walls must consider allowable reinforcement tension pull-out resistance of the reinforcement behind the active failure plane and the strength of reinforcement connections at the facing. Required seismic safety factors are 75 percent of the minimum allowable static safety factors.

C. **Assembly:** The angle of wall inclination is approximately 10.6 degrees from vertical towards the backfill as determined in the $1^1/_8$-inch (29 mm) setback per course provided by the blocks' lip. The block foundation subgrade must be level and consist of at least 6 inches (152 mm) of granular fill compacted to at least 95 percent of the maximum dry density determined by ASTM D 698. Specific foundation requirements for each site must be determined by the soils engineer.

Backfill used in the reinforced soil mass must consist of appropriate material placed in compacted lifts. The backfill soil properties, lift thickness, degree of compaction and width behind the block are as determined by the soils engineer. If the retained soil or backfill have poor drainage qualities, granular drainage layers and/or perforated drains must be installed to prevent buildup of hydrostatic pressures behind the wall. Provisions for drainage must be determined by the soils engineer.

Blocks are stacked and aligned using the vertical lip at the lower rear edge. The top units are set back approximately $1^1/_8$ inches (29 mm) from the lower units, guided by the lip. Geosynthetic reinforcement may be placed at the elevations specified in the design. The backfill must be placed and compacted to a level approximately 1 inch (25 mm) below the top block elevation where geogrid placement is required. The geogrid is embedded a minimum 8 inches (203 mm) into the block units and the next course of units is placed such that the geosynthetic is deformed to the back side of the lower units and underneath the lip of the top units. The geogrid layers must be pulled taut and anchored to the compacted backfill prior to backfilling over the geogrid.

Blocks may be assembled with an inside or outside curved layout.

D. **Structural Analysis:** Structural calculations must be submitted to the building official for each wall system. Structural analysis is based on accepted engineering principles, Section 2107 of the code, and the National Concrete Masonry Association (NCMA) "Design Manual for Segmental Retaining Walls" (1st edition, 1993). All contact surfaces must be in compression. The compression stress is limited to 100 psi (689 kPa). A net resultant tension force is prohibited throughout the retaining wall. The shear resistance of the block lip is determined by the following equation:

$$V_u = 1100 + W_w \tan 34°$$

For **SI:** $$V_u = 16\,053 + W_w \tan 34°$$

where:

V_u = Shear resistance, lb/ft (N/m).
W_w = Weight of wall above interface, lb/ft (N/m).

E. **Geosynthetic Reinforcement:** To increase the performance of the Anchor Diamond retaining wall system, geosynthetic reinforcement is placed in horizontal layers to enhance the mass of the composite structure and thereby increase the resistance of the system to destabilizing forces generated by retained soils and surcharge loads. Geosynthetic reinforcement is a planar structure of networks of connected polymeric tensile elements, which extend through the interface between the wall units and into the soil to create a composite gravity mass structure.

F. **Geogrid: Miragrid:** Miragrid geogrid, produced by Mirafi, Inc., consists of polyester yarns with acrylic latex coating, formed in a grid shape with 1.3-inch (33 mm) by 1.2-inch (30 mm) openings. Prolonged exposure to sunlight must be avoided. Three grades are available: 5T, 7T and 10T. The grid is installed by hooking the grid over the block lip and pulling tight. The roll or warp direction is in the direction of the main reinforcement. After rolling, the geogrid is tensioned by hand until taut, free of wrinkles and flat. Adjacent rolls are overlapped 4 inches (102 mm) minimum. Structural design is in accordance with Section II D. Applicable properties are described in Table 1. Geogrid is stored at a minimum tem-

perature of –10°F. (–23°C.), and contact with mud, wet cement, epoxy or other adhesive materials must be avoided. Pullout resistance is determined by the following equation:

$$P = 700 + W_w \tan 8°$$

For **SI:** $$P = 10\,216 + W_w \tan 8°$$

where:

P = Pullout resistance, lb/ft (N/m).

W_w = Weight of wall above interface, lb/ft (N/m).

G. **Special Inspection:** Special inspection during installation must be observed according to Section 1701.5.7.1 of the code. The inspector's responsibilities include verifying:

1. Unit dimensions.
2. Unit compliance with U.B.C. Standard 21-4, including compressive strength and water absorption as described in Section II A.
3. Foundation preparation.
4. Unit placement, including alignment and inclination.
5. Geosynthetic reinforcement placement.
6. Backfill placement and compaction.

H. **Identification:** Each pallet of blocks is identified with the manufacturer's name.

III. **Evidence Submitted:** Descriptive literature, calculations and test reports.

Findings

IV. **Findings: That the Anchor Diamond Retaining Wall System complies with the 1994 *Uniform Building Code*™, subject to the following conditions:**

1. **The system is designed and installed in accordance with this report, the manufacturer's instructions and accepted engineering principles.**
2. **Anchor Diamond Wall units comply with this report and U.B.C. Standard 21-4 as Type N-1.**
3. **Special inspection is required for backfill placement, block installation is in accordance with Section II F.**
4. **The NCMA Design Manual is submitted to the building official with each project.**
5. **The wall design is approved by the building official.**
6. **A foundation investigation in accordance with Section 1804 of the code is provided for each project site.**

This report is subject to re-examination in two years.

TABLE 1-A—MIRAGRID PROPERTIES

GRADE	THICKNESS WARP/FILL (mils)	WEIGHT (oz/yd²)	LONG-TERM ALLOWABLE TENSION LOAD WARP (lbf)
5T	55/35	6	700
7T	55/45	7	930
10T	85/45	11.5	1,730

For **SI:** 1 mil = 0.0254 mm, 1 oz/yd² = 33.9 g /m², 1 lbf = 4.45 N.

TABLE 1-B—SHEAR STRESS INTERACTION

SOIL CLASS	COEFFICIENT
GW	0.9
SW & SP	0.8
MH	0.7

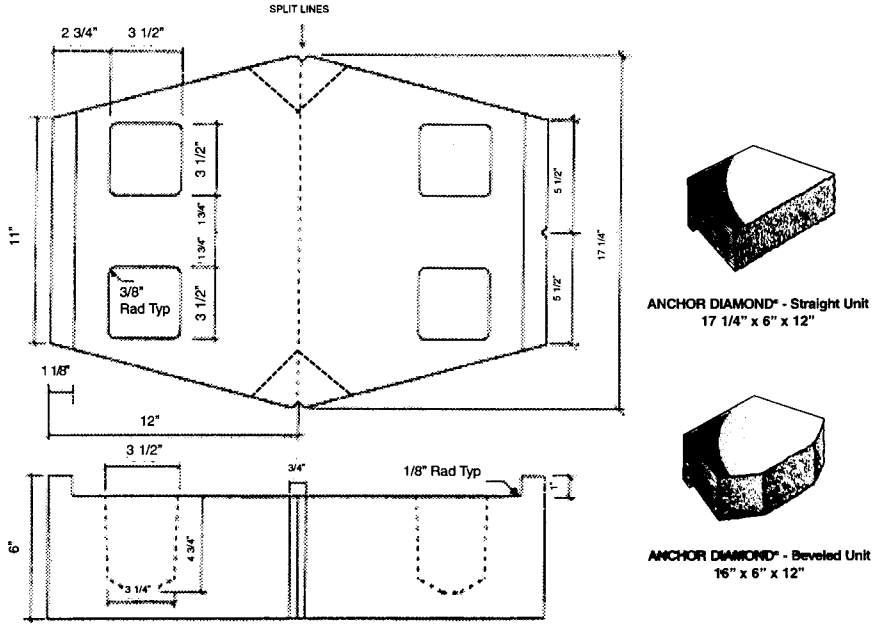
TABLE 2-A—TENSAR PROPERTIES

GRADE	WEIGHT (oz/yd²)	LONG-TERM ALLOWABLE TENSION LOAD, MD (lbf)
UX1400 HP	15	698
UX1500 HP	25	1,395
UX1600 HP	33	1,904

For **SI:** 1 oz/yd² = 33.9 g /m², 1 lbf = 4.45 N.

TABLE 1-B—SHEAR STRESS INTERACTION

SOIL CLASS	COEFFICIENT
GW & GM	1.00
SW & SM	0.90
SC & ML	0.80
CL	0.70



For **SI:** 1 inch = 25.4 mm.

FIGURE 1