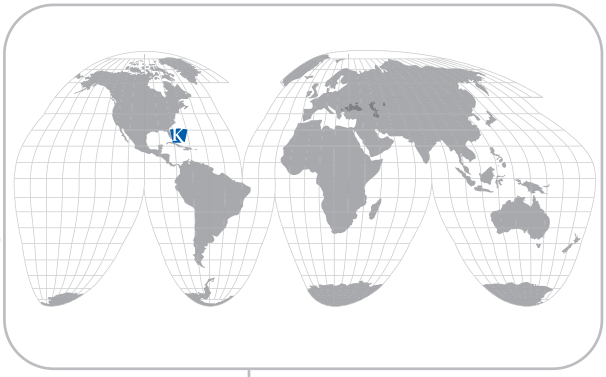
KEYSTONE® RETAINING WALL SYSTEMS
A CONTECH COMPANY

Retaining Excellence™

CASE STUDY

Wall 15 at Hacienda Real

Carolina, Puerto Rico

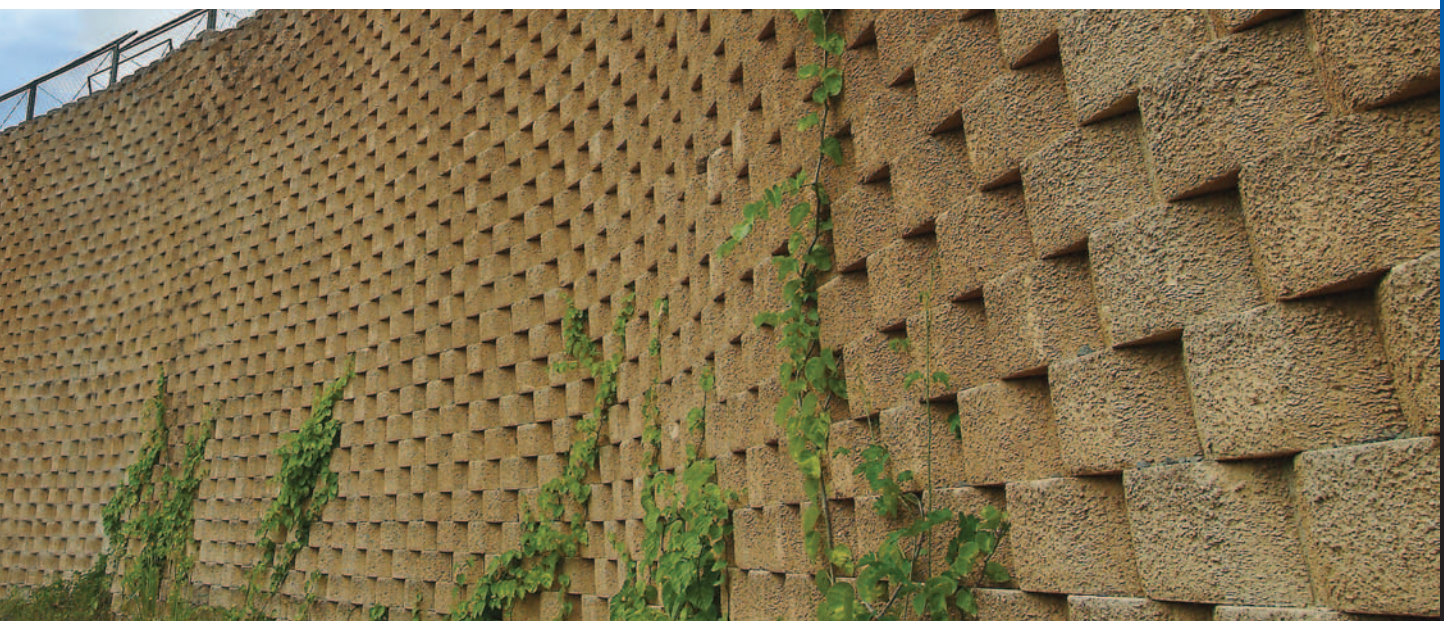


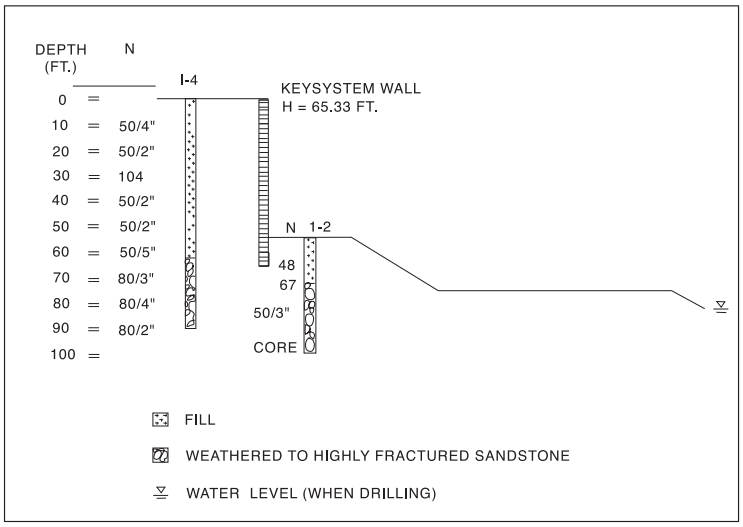
Project:	*Wall 15 at Hacienda Real*
Location:	*Carolina, Puerto Rico*
Keystone Product:	*Keystone KeySystem I™*
Keystone Supplier:	*The Paving Stone Co., a Carmelo Company Sebana Seca, Puerto Rico*
Square Feet:	*45,159 sq. ft.*
Wall Height:	*65 ft. 4 in.*
Wall Length:	*1,422 ft.*
Wall Contractor:	*MSE Constructions, Inc.*
Engineer:	*MSE Designs*

With land suitable for building at a premium, Puerto Rican developers look for ways to turn hills, slopes, canyons, and cliffs into usable land. The solution for the Hacienda Real developers in Carolina, Puerto Rico, was a Keystone retaining wall that created usable land for residential construction at a considerable cost saving over other alternatives. This wall also turned out to be the world's tallest, single-tier segmental retaining wall constructed to date.

"During the planning stages several alternatives were considered: an over-steepened reinforced soil slope; a 2H:1V reinforced slope; a geosynthetic reinforced Keystone wall; and the KeySystem I™ steel reinforced wall. The slope options would have lost valuable land to complete the desired home building," states J.L. Morales, P.E., of MSE Designs. "We looked into using a geosynthetic reinforcement material," Morales notes, "but the geosynthetics were not cost-effective at the heights necessary in this project. And we certainly could not consider a reinforced concrete wall because of the even higher costs involved in that application."

"There was no question that the only product able to reach the height requirements of this project was the Keystone KeySystem I™," said Franco Melendez of MSE Construction, Inc., the wall installation contractor. "The Hacienda Real wall was the tallest





retaining wall my crews have ever built, and KeySystem I made construction fast and [relatively] simple. We didn't have to mess around with concrete footings, mortar, reinforced steel, or temporary forms which saved us a lot of time and labor."

KeySystem I retaining walls are specifically designed for heavy-loading conditions, and use patented Keystone modular concrete units coupled with inextensible steel reinforcement. The result is a retaining wall system that is superior in durability and structural integrity, while offering maximum flexibility to respond to site variations, including the seismic conditions of Puerto Rico.

Because of its installation ease, the KeySystem I wall construction was no more challenging to install than any typical retaining wall structure. The only construction concern at Hacienda Real was in building a wall of this magnitude on the existing soil foundations. The structural integrity and flexibility of the KeySystem I wall made it efficient to design for bearing pressures of almost 10,500 psf., making it the perfect structure for the Hacienda Real soil conditions.

KeySystem I works by incorporating a dry-stacked, modular concrete segmental retaining wall system with steel ladder grids that are designed and fabricated to specific lengths and strengths to meet site and design requirements. The Hacienda Real customized steel ladder grids, placed every three courses vertically, served to "tie back" the Keystone units and active soil wedge to form a composite gravity mass. Steel pins provided a mechanical connection to the modular concrete units for a strong, interlocked facing system that could handle the extreme loading conditions from the retaining soil mass and the site construction above.

Once the Hacienda Real wall was complete, it stood over 65 feet (20 meters) high – a world record in single tier segmental retaining walls.

KeySystem I, manufactured in Puerto Rico by The Paving Stone Co., a Carmelo Company, also offered Hacienda Real a visually stunning wall to complement the area's natural appeal. The KeySystem I aesthetic options allowed for a wide range of completed wall appearances without the high cost of customization, and at 65 feet, KeySystem I was the only wall system to provide the design freedom and installation ease for curves and corners.

KeySystem I is just one of the many products offered by Keystone Retaining Wall Systems, Inc. Keystone has a wide variety of retaining wall systems to fit any type of heavy duty or lightweight landscape construction – from commercial and residential to industrial, highway and waterway applications.

For more information on Keystone products and services, please visit **www.keystonewalls.com** or call (800) 747-8971.

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