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SEPTEMBER 2008

HARDSCAPE ISSUE

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Concrete Masonry DESIGNS

ON THE COVER:

Without proper protection, waterfront property can be lost to erosion. Homeowners on the Chesapeake Bay in Virginia chose to protect their investment with a segmental retaining wall that runs the length of their property.

Hardscape Issue | September 2008

FEATURES

DEPARTMENTS

Concrete Masonry Designs magazine showcases the qualities and aesthetics of design and construction using concrete masonry.

Concrete Masonry Designs is devoted to design techniques using standard and architectural concrete masonry units, concrete brick, unit concrete pavers, segmental retaining walls, and other concrete masonry products around the world. We welcome your editorial comments, ideas, and submissions.

Concrete Masonry Designs is published monthly by the National Concrete Masonry Association (NCMA), and distributed to advance and support the concrete masonry and hardscape industry and public interest.

Send address corrections and subscription inquiries to:
NCMA Sales and Marketing Department
13750 Sunrise Valley Drive
Herndon, VA 20171-4662
703-713-1900
Fax 703-713-1910
www.ncma.org

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Publisher:
James M. Gaidry

Editor:
Mary Arntson-Terrell, mterrell@ncma.org

Associate Editors:
Dennis W. Graber, P.E.
Harry W. Junk
Robert D. Thomas

Advertising:
Ron Churchill, rchurchill@ncma.org

SEGMENTAL RETAINING WALLS HELP TO MAKE THE MOST OF NATURE

Ocean waves, lakeshore views and flowing rivers can be beautiful, but they can also make developing land along a shoreline difficult. With each passing year, more and more waterfront property will be lost to erosion, washing away over time.

A main consideration when developing shoreline property is erosion control, and not just for the obvious safety and aesthetic reasons. According to Andy Mooney, of Eagle Bay Hardscape Products in Richmond, Virginia, waterfront property is now more valuable than ever.

"In today's real estate market, the one place we're seeing lots of growth is in shoreline property," Mooney said. "People want to be able to maximize the property they have, and they don't want to keep paying taxes on property that's washing out to sea."

While there are several methods of managing erosion control, Mooney believes segmental concrete retaining walls are the best option for three main reasons. First, segmental retaining walls (SRWs) are environmentally friendly. According to Mooney they

Private Residence, Onancock, Virginia

LANDSCAPE DESIGNER
James Brawley, Landmark Design Group
SRW LICENSOR
Anchor Wall Systems, Inc.
SRW PRODUCER
Eagle Bay Hardscape Products, Richmond, Virginia
SRW CONTRACTOR
Chris Cronin, Coastline

"are made from natural materials, and don't add or take away anything from the existing environment."

Second, segmental retaining walls are durable. With approximately twice the lifespan of wood and other erosion control methods, segmental retaining walls "require less upkeep and will ultimately cost the consumer less," according to Mooney.

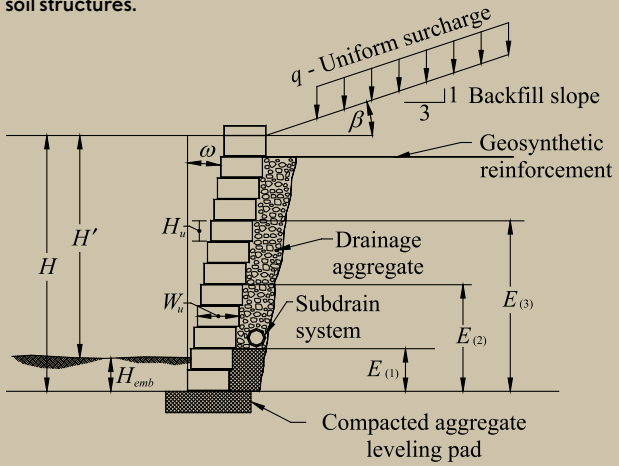
Third, segmental retaining walls provide aesthetic value and versatility to shoreline developments. "Segmental retaining walls look much cleaner and nicer than wood or vinyl erosion control methods," Mooney said. "By using segmental retaining walls for erosion control, people have the option of creating durable, safe shorelines that can be customized with steps and curves. You just couldn't do that with some of the other methods."

Nowhere is erosion control more important than in the Chesapeake Bay area of Virginia and Maryland. Acres of picturesque shoreline property combined with the constant presence of shifting tides make erosion control a primary concern for property owners and developers.

SOIL-REINFORCED SEGMENTAL RETAINING WALLS

Soil-reinforced SRWs are composite systems consisting of SRW units in combination with a mass of retained soil, stabilized by horizontal layers of reinforcement, typically a geosynthetic material. The reinforcement increases the effective width and weight of the gravity mass. Geosynthetic reinforcement materials are high tensile strength polymeric sheet materials. They may be geogrids or geotextiles, though current SRW construction typically uses geogrids.

The figure illustrates a typical soil-reinforced segmental retaining wall, and current design terminology. The geosynthetic reinforcement is placed between the units and extended into the soil to create a composite gravity mass structure. This mechanically stabilized wall system, comprised of the SRW units and a reinforced soil mass, offers the required resistance to external forces associated with taller walls, surcharged structures, or more difficult soil conditions. Soil-reinforced SRWs may also be referred to as mechanically stabilized earth (MSE) walls, the generic term used to describe all forms of fill-type reinforced soil structures.



Like many waterfront property owners, the owners of a residence in Onancock, Virginia, wanted to maintain and preserve their shoreline, before erosion took much of it away. Located on the Chesapeake Bay's Eastern shore, the home sits on a beautiful stretch of shoreline, surrounded by evergreen trees and natural vegetation. Unfortunately, the property was also eroding and losing value each day. As a result, the owners decided to install a retaining wall running the length of the shoreline to protect their property from the rising and falling tides.

According to Mooney, who worked with both the designer and contractor on the project, the owners had several concerns that ultimately led them to choose a segmental retaining wall for the project. First, they needed to meet county and state wetland preservation codes, and a segmental retaining wall allowed them to keep much of the land and shoreline intact. They also wanted, in Mooney's words, a "vanity factor." With so much boat traffic in front of the property, they wanted something that would look good from both land and water. Finally, they needed something easy to install, because the rising tides meant contractors could only work on the project for six hours a day.

After about three weeks of work, contractors installed 5,500 square feet (511 square meters) of SRWs at the shoreline edge of the property. More than just a retaining wall, the project incorporates steps, curves and subtle blended colors, making it truly impressive to see.

"The homeowners are just thrilled about it," Mooney said. "They couldn't be happier with how it turned out."

Mooney isn't alone in recommending segmental retaining walls for erosion control; the design and engineering community also recognizes their importance. According to Jon Huyck, P.E., Design Engineering Services Manager for Anchor Wall Engineering, in Minneapolis, Minnesota, managing erosion control is a highly important part of planning and building retaining walls, especially near water.

"When a project is near water, soil can erode from both behind and beneath the wall," Huyck said. "Eventually, the blocks won't have enough support and will collapse if erosion control isn't used."

The main challenge of erosion control is keeping the soil in place and protected from water. According to Huyck, hardscape contractors can employ erosion control by burying extra courses of block beneath the surface of the soil.

"There are several different ways to control erosion," Huyck said. "Things like extra vegetation and riprap can help with erosion control, but they may require more maintenance than a retaining wall."

Ultimately, any owner of shoreline property needs to take steps to manage erosion control and maximize the property. By choosing a durable, environmentally friendly and attractive segmental retaining wall system, property owners will not only be protecting and improving their shoreline space, they will be making sure it stays that way. **CMD**

Retaining Walls—A Building Guide and Design Gallery

The essential resource to constructing segmental retaining walls with detailed, easy-to-follow, complete diagrams/charts for do-it-yourself homeowners and landscape contractors.

Order number TR212.
Professional price $24.95

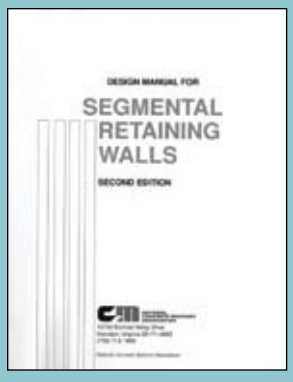
Segmental Retaining Wall Installation Guide

Educates contractors and owners in the proper techniques to install segmental retaining wall systems. This resource addresses the specific installation steps for engineered and non-engineered systems, and includes technical information regarding excavation, geosynthetic grids, and more.
Order number TR146.
Professional price $4.00

e-TEK and e-Details

NCMA's TEK series and Details provide architects, engineers, and specifiers up-to-date information on concrete masonry. TEKs include more than 130 technical bulletins on various topics related to the industry. A new TEK is published monthly, while others are revised to reflect code or building design changes, as necessary.

Electronic versions—called e-TEKs and e-Details—are free through select NCMA member websites. Find a member sponsoring e-TEKs and e-Details at ncma.org. All drawings in e-Details are downloadable electronically in DWG for AutoCAD and DXF, among other formats. Obtain hard copies of e-TEKs or e-Details at ncma.org or call the Publications Department at 703-713-1900.



Design Manual and Software for Segmental Retaining Walls

This manual provides a standardized, generic engineering approach for analysis and design of segmental retaining wall units. A segmental retaining wall is constructed of dry, stacked units (without mortar) that are usually connected through concrete shear keys or mechanical connectors. NCMA members provide a variety of proprietary units. Included in the manual is the latest design methodology for gravity and soil-reinforced earth walls, as well as design criteria, design tables, illustrations, installation procedures, and sample specifications. 289 pages; second edition, third printing (2002).

Order number TR127A.
Professional price $66.00

Design Software for Segmental Retaining Walls

SRWall version 3.22 covers design of both conventional gravity and soil reinforced walls, in accordance with NCMA's second edition Design Manual for Segmental Retaining Walls (TR127A) and Segmental Retaining Walls: Seismic Design Manual (TR-160) for walls subjected to earthquake loading. Users are highly encouraged to read the manuals for the respective procedures before using the program. Windows 95 or newer (2001). Note: This program will not run on Windows Vista.

Order number CMS11711.
Professional price $182.00

Buy the manual and software together and save $15.
Order CMS11711 and TR127A.
Professional price $233.00

Inspection Guide for Segmental Retaining Walls

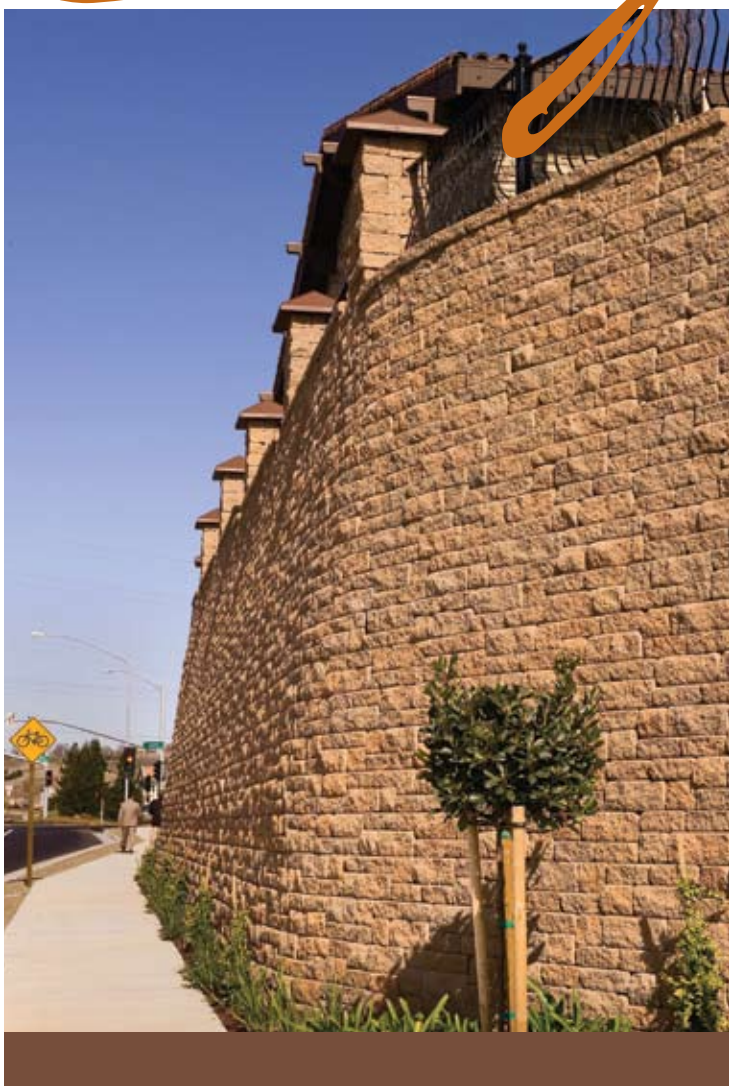
This publication provides an easy-to-understand resource for field use by installers, designers, and inspection personnel. The guide outlines parameters for design and construction requirements of segmental retaining walls, including basic engineering requirements, a design checklist, and a construction observation checklist—all based on NCMA's design methodology for segmental retaining wall systems. 6 pages (1998).

Order number TR159.
Professional price $3.50

Prices reflect purchase price only. Shipping and handling are additional.

To order visit www.ncma.org or call the publications department at 703-713-1900.

California



THE MONTAÑO DE EL DORADO

is a new retail/restaurant complex in El Dorado Hills near Sacramento that opened in 2007—but it almost never did. The topography of the project site featured a high end that required a substantial retaining wall in order to facilitate construction on top and prevent erosion.

The original plan called for a cast-in-place concrete wall about 20 feet (6 m) tall and 900 feet (274 m) long with a stucco finish. However, the price tag of the wall approached $1.5 million and threatened to sink the project. The engineer on the project contacted McNear Brick & Block for an alternative solution.

"The property went up very steep from the road elevation," says Steve Osborne, engineering specialist with McNear. "The main piece of the property was almost 20 feet (6 m) above the roadway, so both from an engineering and cost standpoint, it made sense to build a wall and construct the buildings on top of the property instead of excavating the property down to the road elevation."

Osborne organized a meeting with the developer, architect and engineer and proposed a total redesign of the wall using segmental retaining wall units accented with columns, decorative lighting and wrought iron fencing.

"I sent the plans off to the producer immediately and had them do a preliminary engineering take-

Montaño de El Dorado Complex, Sacramento, California

DEVELOPER
Sacramento Commercial Properties, Folsom, California

SRW LICENSOR
VERSA-LOK

SRW PRODUCER
McNear Brick & Block, San Rafael, California

SRW CONTRACTOR
Retaining Walls Company, Tracy California

Project Rescued with Cost-Effective SRW Units

off. They turned it around in less than a week," says Osborne. "I sent it out for bid to wall contractors, and it saved about $1 million on the walls. The developer said 'Okay, the project is back on.' The developer is thrilled to death. He ended up with a much higher-end look than a cast-in-place stucco-finish wall."

Vinal Perkins, partner with Sacramento Commercial Properties, concurs.

"They did an incredible job of coming together quickly to put together an alternative plan to build the wall we needed for this shopping and business center. They not only saved us hundreds of thousands of dollars, they saved the job altogether."

Explains Matthew Doss of Retaining Walls Company in Tracy, the contractor on the project: "This site presented several challenges, needing nearly 20 feet (6 m) of retention on a highly visible street corner within an affluent community. Two critical components needed to be addressed-form and function. With the SRW product, we delivered a functionally superior retaining wall by using a flexible segmental wall with an aesthetic look that is unmatched."

About 20,000 square feet (1860 square meters) of SRW units in a Mojave color were used in the construction of the mammoth wall, which stretches the length of the development along Latrobe Road and White Rock Road. Stepped and tiered sections with inset plantings, along with the Mosaic system's random pattern, break up the wall's face. Atop the wall, freestanding columns adorned with ornamental caps provide additional visual interest.

"The wall really captures the Old World look we were going for with the whole development," concludes Perkins. "I'm really impressed with how straight and well-engineered the structure is. It is much better than I envisioned the original concrete wall to be."

Adds Doss: "The project is nothing short of amazing from every vantage point. It is a flagship for the industry, and we are proud of having been a part of it." **CMD**

SRW WALL OFFERS PROTECTION FROM TENNESSEE RIVER FLOODS

At historic Ross's Landing on the Tennessee River in Chattanooga, Tennessee, the U.S. Army Corp of Engineers designed a structure to alleviate the erosion and slope instability caused by frequent flooding of the river.

A series of terraced retaining walls and walkways was proposed to replace the existing deteriorated structures along the river. The wall design called for a solution to eliminate erosion and enhance the historic river walkway and amphitheater.

SRW units are perfect for the application. The concrete units, high strength fiberglass shear pins and water resistant geogrids afford a free draining yet interlocked structural solution with the ability to meet the demands of flood conditions.

The project was designed as terraced walls, with the maximum single wall 12 feet (3.7 m) high and the maximum terrace series 18 feet (5.5 m) tall. The design required a slope stability evaluation along with a submerged hydraulic drawdown

Ross's Landing, Chattanooga, Tennessee

LANDSCAPE DESIGNER
U.S. Army Corp of Engineers
SRW PRODUCER
Keystone
SRW CONTRACTOR
ABS Services, Jackson, Mississippi

analysis due to the frequent flooding. Analysis for the one-year flood event called for waters to submerge the lower terrace by three feet and the 20-year event anticipates a total submersion of the entire structure at almost 20 feet (6 m).

The retaining walls were built by ABS Services of Jackson, Mississippi. After the lower terrace walls were completed, the system was immediately put to the test with river flooding inundating the lower walls. Construction halted until the waters subsided, where examination found no erosion or damage to the structure. To provide scour resistance to the wall base, heavy stone riprap over geotextile was used below the lower terraced walls.

Once the walls, reinforcing and backfill were in place, concrete sidewalks, light bollards, concrete coping and railings were added along with the final landscaping to provide the finishing touch.

Serpentine walls with the aesthetic appearance of stone maintain the meandering feel of the original Ross Landing. The Army Corp of Engineers was able to achieve its desired protection solution with the additional benefit of creating an inviting setting for pedestrian traffic and riverfront activities. **CMD**

Hardscape Solutions Come Together in Calgary

Before

After

Creating usable and beautiful space in your own backyard can be an exciting adventure as these homeowners in Calgary discovered when they decided to tackle their barren backyard. With several design factors to take into account, this total yard makeover took some very special planning. “We wanted to keep the yard open and inviting, while still being able to utilize the area to relax with family and entertain with friends, “ explains the owners.

In addition to the aesthetic needs of the homeowners, there were some structural challenges that had to be addressed. One of the challenges was an existing wood retaining wall built directly against the fence line. The wall was restricting proper drainage on the lot, causing the neighbor to have water problems every time it rained. With the help of their certified contractor, Neil Zeller of LeeDavid Landscapes Inc., they were able to create a design that regraded the lot and replaced the wood retaining wall with an SRW wall to address their water management issue.

The contractor chose to incorporate several different SRW products because of the ease in which the products work together. With the retaining wall topping out at 2 feet (0.6 m) at its tallest point, the contractor recommended using 4 inch (100 mm) high blocks to complete the retaining wall to give the wall a low profile and keep it to scale with the rest of the yard.

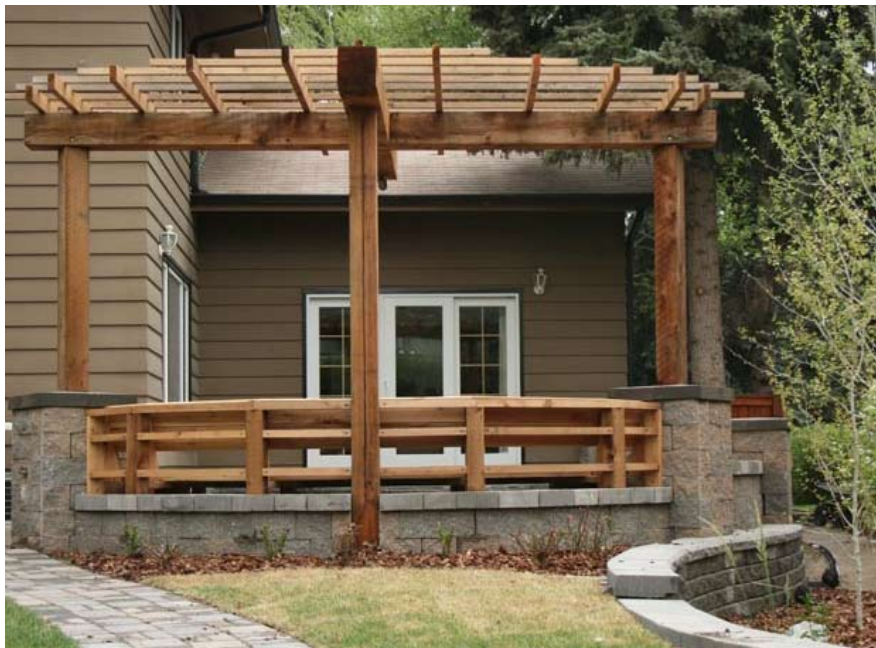
The design included a beautiful patio surround that incorporated benches, posts to support a pergola and an alcove for the home owner’s new spa.

The adventure continued as construction began and the contractor was faced with inclement weather, battling delays due to torrential rains and blinding snow storms. “Even though mother nature threw us for a loop and caused some delays, the project went together very smoothly”, stated Neil Zeller.

The task of planning, designing and building their new outdoor living space may be over, but the next chapter of enjoying their backyard has just begun. **CMD**

Private Residence, Calgary, Alberta, Canada

LANDSCAPE DESIGNER AND CONTRACTOR
LeeDavid Landscapes, Inc.,
Calgary, Alberta, Canada
SRW LICENSOR
Allan Block
SRW PRODUCER
CCI Industries, Calgary, Alberta, Canada



SEGMENTAL RETAINING WALL BASICS

Segmental retaining walls (SRWs) are gravity retaining walls that rely primarily on their mass (weight) for stability. The system consists of SRW units which are placed without the use of mortar (dry stacked), and which rely on a combination of mechanical interlock, unit to unit interface friction or shear capacity and mass to prevent overturning and sliding. The units may also be used in combination with horizontal layers of soil reinforcement which extend into the backfill to increase the effective width and weight of the gravity mass.

Segmental retaining walls are considered flexible structures, so the footing does not need to be placed below the frost line provided there is sufficient foundation bearing capacity.

SRW units are manufactured in conformance with industry standards and specifications to assure that units delivered to a project are uniform in weight, dimensional tolerances, strength, and durability—features not necessarily provided in site cast materials.

Segmental retaining walls can be designed as either conventional (as shown in Figure 1) or as reinforced soil, as illustrated in Figure 2. The structural capacity of the SRW system will vary with the SRW unit size, shape, batter, etc. Manufacturers recommendations should be followed regarding the capacity of their particular system for the soil loads under consideration.

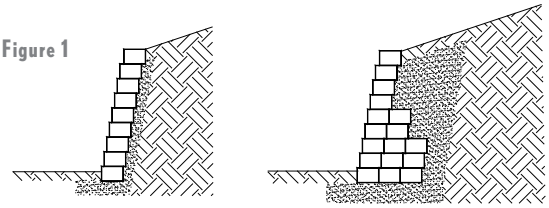
WALL TYPES

CONVENTIONAL

Conventional SRWs are constructed with either single or multiple depths of units. For stability, the conventional SRW structure must have sufficient mass to prevent both sliding at the base and overturning about the toe of the structure. Since the system consists of individual units dry stacked one atop another, shear capacity is an important component to assure that the units act together as a coherent mass.

Taller walls can also be achieved by using multiple depths of units, shown in Figure 1b. The multiple depths of units increase the weight of the wall system and provide a more stable base and greater resistance to soil pressures.

Figure 1



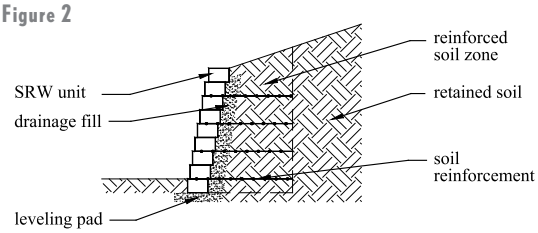
1a. Single depth

1b. Multiple depth

REINFORCED SOIL

Reinforced soil walls should be specified when the maximum height for conventional gravity walls is exceeded or when lower structures are surcharged by sloping backfills, live loads, and/or have poor foundations. A reinforced soil SRW is designed and constructed with multiple layers of soil reinforcement placed between the SRW courses and extending back into the soil behind the wall at designated heights and lengths as shown in Figure 2. The geosynthetic reinforcement and the soil in the reinforced zone acts as a composite material, effectively increasing the size and weight of the gravity wall system.

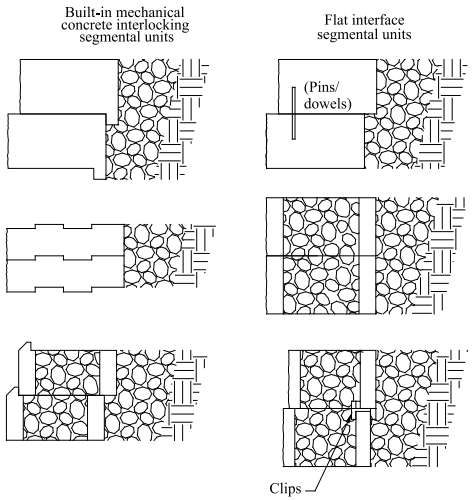
Figure 2



BATTERING

Structural stability of the SRW can be increased by increasing the wall batter. Batter is achieved through the setback between SRW units from one course to the next. In most cases, the batter is controlled by the location of shear pins or leading/trailing lips (Figure 3), however, some systems allow some adjustment to the batter.

Figure 3



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AIA QUESTIONS (CIRCLE THE CORRECT ANSWER)

1. **A major advantage of SRWs in providing shoreline protection is:**
   a. They are environmentally friendly
   b. They are durable
   c. They provide aesthetic value and versatility
   d. All of the above.

2. **Another option available with SRWs for shoreline protection not normally possible with many other systems is:**
   a. Clear view panels to ensure no erosion is occurring
   b. behind the wall
   c. Solid grouted panels
   d. Steps and curved walls
   e. Vertical post-tensioned reinforcement

3. **Soil Reinforced Segmental Retaining Walls are:**
   a. Concrete masonry units thrown on the shore for protection much like riprap
   b. Are formed from cast-in-place concrete
   c. Composite systems consisting of SRW units in combination with a mass of retained soil.
   d. Concrete masonry units contained by steel wire mesh.

4. **Soil Reinforced SRWs are also referred to as:**
   a. Mechanically stabilized earth (MSE) walls
   b. Grout filled walls
   c. Reinforced masonry walls
   d. Mortared masonry walls

5. **A method of retaining soil in place and protected from the water is:**
   a. Placing additional drainage stone underneath the SRW walls
   b. Placing larger rock behind the SRWs
   c. Using impermeable backfill behind the SRWs
   d. Burying extra courses of SRWs beneath the surface of the soil

6. **For the Montaño de El Dorado complex**
   a. It was more economical to build a retaining wall and fill the steep portion next to the road than to excavate the whole site to road level
   b. The retaining wall cost was reduced from $1.5 million to $0.5 million by going with SRWs instead of cast-in-place concrete.
   c. Both a and b above

7. **SRWs are the perfect solution for areas subject to floods due to:**
   a. High shear value
   b. Water resistant geogrids
   c. Free draining yet interlocked structural solution
   d. All of the above

8. **With short retaining walls, 4-inch (100 mm) high units can be used to give the wall a low profile and keep it to scale.**
   a. True
   b. False

9. **Two basic types of segmental retaining walls are:**
   a. Super elevated and elevated
   b. Conventional and soil reinforced
   c. Plain and mild reinforced
   d. Vanilla and exotic

10. **Increasing the batter of the wall decreases its structural stability**
    a. True
    b. False

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