RECON Wall Systems™

Water Application Guide

Recon Solutions

Recon is a leading provider of retaining wall solutions, known for combining aesthetic appeal with superior structural strength. Recon is dedicated to delivering value to its customers through:

- Engineering and testing for tall gravity walls and even higher geogrid-reinforced walls
- Flexible solutions that adapt to specific wall requirements, rather than imposing rigid designs
- Long-lasting durability with wet-cast, air-entrained concrete
- A variety of product shapes and sizes to suit diverse project needs

As weather patterns continue to shift and severe storms become more frequent, Recon has emerged as a trusted solution for stabilizing lake shores, riverbanks, streams, drainage channels, retention ponds, and sea walls. The substantial mass of the Recon block, combined with the durability of wet-cast, air-entrained concrete, makes it an ideal choice for the demanding conditions in many water-related applications.

Rustic

Weathered Edge

Northshore Granite

Old World

LeSueur County Limestone

Designing Walls to Last

Recon recognizes the critical importance of designing retaining walls that can withstand unique challenges, particularly when water is present at the base of the structure. Water at the toe of a retaining wall can create additional stress, demanding precise engineering solutions to ensure long-term stability and performance.

To address these complexities, Recon offers a suite of tools and resources, including advanced Design Software that allows for detailed modeling and analysis, a comprehensive range of construction details, best practices, and technical support to guide contractors and engineers through every phase of a project, from planning to completion.

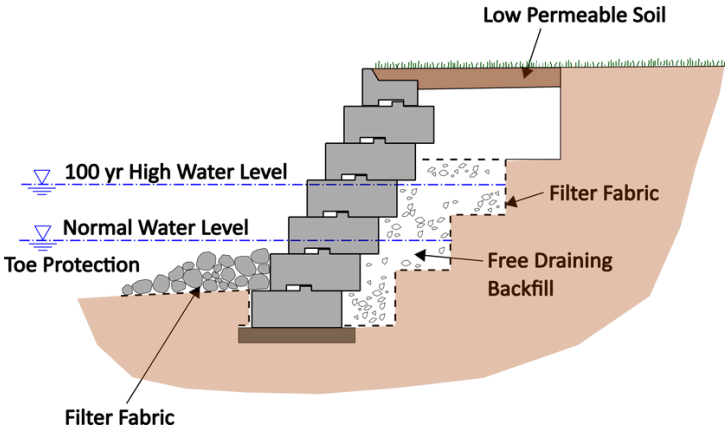


Figure 1: Gravity Wall - 8" (20.3cm) Setback

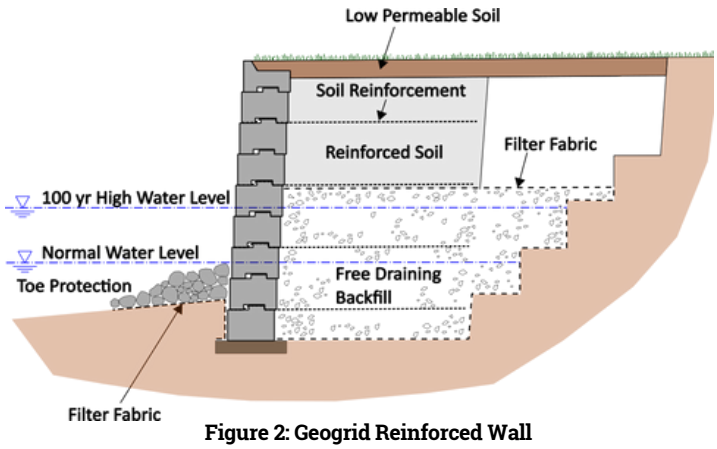


Figure 2: Geogrid Reinforced Wall

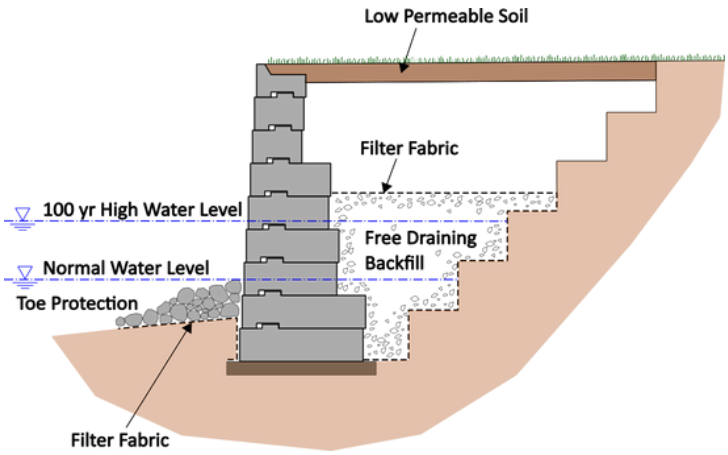


Figure 3: Gravity Wall - Standard Setback

Designing Walls to Last

Water is commonly recognized as a primary factor in retaining wall and foundation failures, particularly in water-affected environments. This is because water infiltration saturates the soil, significantly increasing hydrostatic pressure behind the wall. Additionally, buoyancy reduces the effective weight of retaining wall blocks, which are critical for maintaining wall stability. The buoyancy also reduces the bearing capacity of the foundation soil, further jeopardizing structural integrity. For fine-grained soils, such as silt and clay, the introduction of water can create excess pore water pressure, leading to a loss of shear strength, which can result in settlement.

In scenarios where walls are placed along moving water, such as streams or rivers, scour effects become a major concern. Scour can erode the soil in front of the wall, undermining the structure and leading to potential failure if not accounted for in the design. This process can be magnified in environments with high flow rates or wave action, which can intensify the erosive forces at the base of the wall.

To properly engineer a Recon wall near bodies of water, it is essential to gather the following data:

- **Normal water level and high-water level:** This helps define the range of hydrostatic pressures and buoyant forces that will act on the wall during various water conditions.

- **Flow rates:** For stream and river applications, understanding flow rates is critical for determining the potential depth of scour, which informs how deep the foundation must be placed and whether additional erosion control measures are required.

- **Wave forces:** In seawall or coastal applications, wave dynamics must be analyzed to assess the forces that will impact the wall, especially during storms or high tides, where wave energy can cause significant erosion or stress.

This data forms the foundation for creating a proper design that takes into account both the static and dynamic forces introduced by water, ensuring that the retaining wall can perform reliably in challenging water-affected environments.

Designing Walls to Last

Based upon the gathered data previously mentioned, below is a list of items for the Engineer to consider that will help ensure optimal performance and longevity of the retaining wall in water-affected environments:

1. **Surface Water Management:** Rainwater falling on the surface above the wall should be directed away from the wall to minimize water infiltration and a layer of low-permeability soil should be placed on top of the backfill soils to help prevent water from penetrating behind the retaining structure.

2. **Free-draining Backfill:** For gravity walls, it is critical to place a free-draining backfill, typically a clean gravel, starting behind the base block and extending at a 1:1 slope up to 12 inches (30 cm) above the high-water elevation. Similarly, for reinforced walls, the free-draining should be placed starting behind the tail of the grids and extending at a 1:1 slope up to 12 inches (30 cm) above the high-water elevation.

3. **Filter Fabric:** To prevent the migration of fine-grained soils (such as silt or clay) into the free-draining backfill, it is recommended to install filter fabric wrapped around the drainage material.

4. **Leveling Pad:** A compacted stone or concrete leveling pad should be constructed at the base of the wall to provide adequate bearing capacity and maintain a level foundation.

5. **Embedment Depth:** The wall base should be embedded to a sufficient depth to account for potential scour. While a minimum embedment of 6 inches (15 cm) is generally acceptable, water-related applications, especially those near streams or rivers, typically demand deeper embedment to resist the effects of water erosion and shifting soils.

6. **Toe Protection:** In certain cases, toe protection may be necessary to prevent scour at the base of the wall. Rip-rap or other erosion-resistant materials should be installed at the toe of the wall, with filter fabric placed beneath the rip-rap to maintain soil stability and prevent the removal of fine particles by flowing water.

Designing Walls to Last

7. **Wall Drains:** If the Engineer determines that wall drains, or draintile, is necessary, it is recommended that they are designed with the outlet elevation positioned above the normal water level. This ensures that water can properly release from behind the wall, reducing the risk of hydrostatic pressure.

8. **Additional Seawall and Stream Precautions:** For seawalls and certain stream applications, where walls are subject to wave action or high-flow conditions, additional precautions may need to be taken to prevent the blocks from being displaced. Waves or fast-moving water can increase the likelihood of overtopping, and in such cases, enhanced reinforcement or protective measures may be required to ensure the structural integrity of the wall.

These detailed design considerations help to mitigate the risks posed by water and ensure the long-term durability and performance of Recon retaining walls in challenging environments.

The following set of case studies provide real-world examples that highlight the successful application of these design considerations. Each project demonstrates ideas around proper water management, the use of free-draining backfill, filter fabric, and how appropriate embedment depths contribute to the stability and durability of retaining walls in challenging, water-affected environments. These case studies illustrate how Recon's engineered solutions have been applied to overcome site-specific challenges, including the risks posed by scour, buoyancy, and hydrostatic pressure, ensuring long-lasting performance in both gravity and reinforced earth wall systems.

Feature Retention Pond

Eaton Place – Beachwood, OH

Project: Eaton Place
Location: Beachwood, OH
Product: Recon Series 50 Gravity Wall
Recon Manufacturer: Norwalk Concrete Industries
Wall Area: 10,200 SF
Wall Contractor: Mr. Excavator
Engineer: Civil Design Professionals

Recon Creates Custom Block for Unique Application

A standard Recon block measures 16 inches by 48 inches (40cm by 120cm), providing a finished face area of 5.33 square feet (0.5 square meters). With standard installation, each course of blocks is set back one-inch (2.54cm) from the course below, resulting in a batter of 3.6 degrees. Recon offers five distinct face texture options, including the signature "Old World" texture, which attracted the interest of a corporate customer for a specialized application due to its unique appearance.

The project involved a 336 feet (102m) diameter reflection pond, located in front of a new $170 million, 600,000-square-foot corporate headquarters in Beachwood, Ohio. Given the pond's prominent location, aesthetics were a top priority. The developers were drawn to Recon's wet-cast durability, which could withstand constant exposure to standing water.

While the "Old World" texture provided the desired architectural finish, the standard Recon block did not meet the required geometry. The pond walls needed to be 10 feet tall (3m), with the normal water level set at 6 feet (1.8m) above the base of the wall. The original design called for 12 inch (30cm) high blocks with a 12 inch (30cm) setback, creating a stepped appearance leading down to the water and addressing safety concerns associated with a 10 foot (3m) nearly vertical wall.

As the developers considered modifying the wall design to accommodate a standard Recon block, Recon collaborated with our producer to offer a custom solution tailored to their exact needs. The proposed block for this project measured 12 inch (30cm) in height, 72 inch (182cm) in width, and 30 inch (76cm) in depth, featuring two custom shear knobs on each block that enabled a 12 inch (30cm) setback for each course.

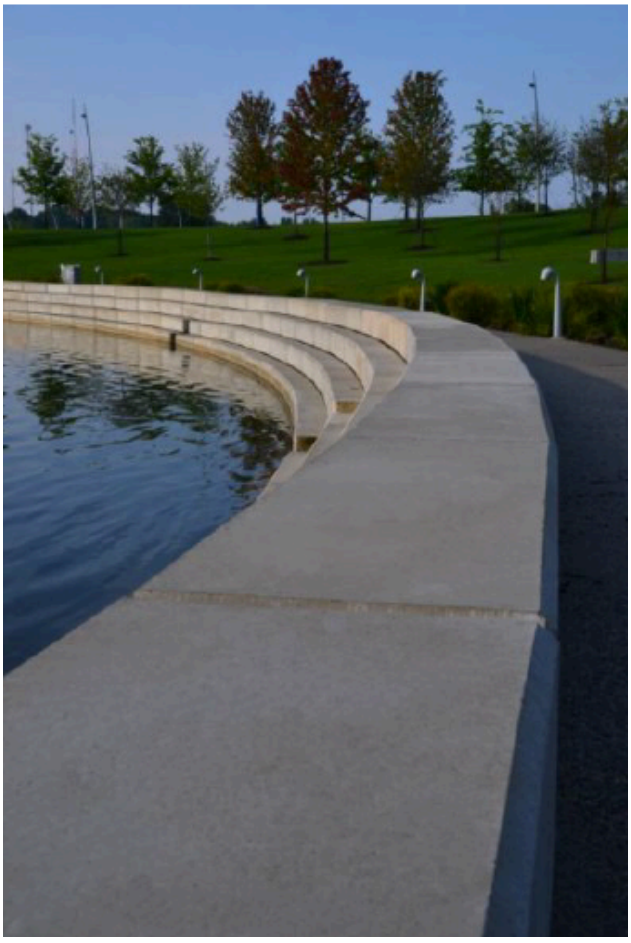
Feature Retention Pond

Eaton Place – Beachwood, OH

The pond wall was built in a perfect circle, with no defined starting or ending point. Even with standard Recon blocks, which feature a one-inch setback (2.54cm) per course, curved walls can cause a bond shift that, if not managed properly during construction, can become noticeable and unsightly. Given that this wall followed a continuous curve and had an extreme 12 inch (30cm) setback per course, we anticipated this challenge and addressed it before construction began.

The complexity arose from the fact that with each course set 12 inches (30cm) back from the one below, the wall's diameter expanded significantly—from 316 feet (96m) at the base to 336 (102m) feet at the top. This meant the top course was over 60 feet (18m) longer than the base course. The owner wanted to maintain a consistent running bond throughout, which required that each course contain the same number of blocks despite the changing wall diameter.

The solution for maintaining the running bond involved two key elements. First, a 60 inch (158cm) wide block was introduced at specific intervals on each course, preventing the bond from shifting more than 12 inches (30cm) to the left or right of the block above or below. Second, a highly detailed set of shop drawings was developed to account for every block in the wall, ensuring consistent running bond on each course. Ultimately, Recon delivered a block design that met the owner's aesthetic vision while also fulfilling the structural and timing requirements of the project.



Drainage Channel Wall

Crystal Creek – Shiller Park, IL

Project: Crystal Creek Flood Control
Location: Shiller Park, IL
Product: Recon Series 50 Channel Gravity Wall
Recon Manufacturer: Service Konstruction Supply
Wall Area: 25,000 SF
Wall Contractor: Albin Carlson & Company
Engineer: Highland Engineering, PC

In Schiller Park, IL, a suburb of Chicago, an existing flood control channel required significant upgrades. The channel was in disrepair, needed minor realignment, and required increased flow capacity. Located in a densely populated residential area, the channel ran directly behind existing homes, leaving extremely limited space for excavation. Due to these tight constraints, constructing a gravity wall was essential for the project.

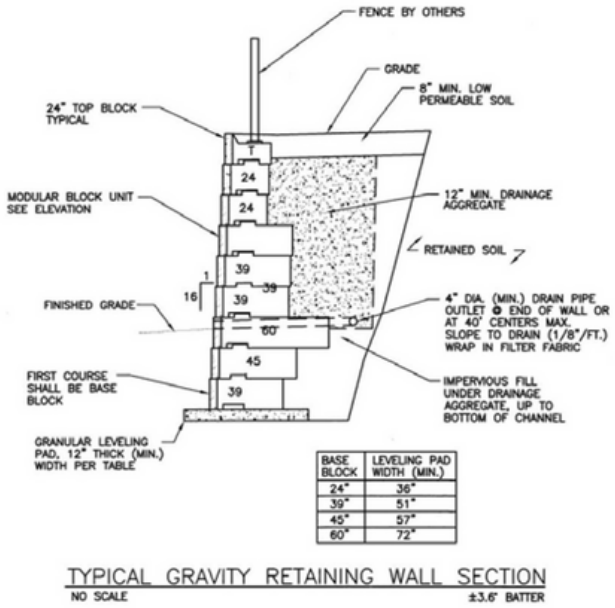
The solution took a highly innovative approach, prioritizing minimal excavation and near-vertical construction to avoid encroaching on existing structures and neighboring properties. This method also eliminated the need for temporary shoring. The result was a gravity wall design with a unique twist, tailored to meet the project's specific challenges.

Drainage Channel Wall

Crystal Creek – Shiller Park, IL

To minimize excavation at the base of the wall, a 39 inch (99cm) deep block was initially used. While this block didn't provide sufficient mass or base depth for the design, it allowed for a less invasive cut compared to a 60 inch (152cm) deep block.

To achieve overall stability, the wall transitioned from a 39 inch (99cm) block at the base to a 45 inch (114cm) deep block, and then to a 60 (152cm) deep block. The cut had to be laid back for safety, allowing for a gradual transition to these deeper blocks. The 39 inch (99cm) and 45 inch (114cm) blocks were completely embedded, and low-permeability soil was required behind them. By starting with the 39 inch (99cm) block, the depth of the cut was minimized, solving the right of way issues. Since a vertical cut was not possible, this approach created the necessary space for the deeper blocks to be installed within the wall section.



TYPICAL GRAVITY RETAINING WALL SECTION

NO SCALE ±3.6° BATTER

Channel Observation Wall

Kinnickinnic River Naturalization – Milwaukee, WI

Project: Kinnickinnic River Naturalization
Location: Milwaukee, WI
Product: Recon Series 50 Gravity Wall
Recon Manufacturer: Dalmaray Concrete Products, Inc.
Wall Area: 15,300 SF
Wall Contractor: Edgerton Contractors
Engineer: Giles Engineering Jeff Miller P.E.

The goal of the Kinnickinnic River Naturalization project was to transform the KK River from a concrete channel in southern Milwaukee into a natural, meandering river. The aim was to reduce flooding risks and restore native plants and fish species. Listed by American Rivers as the 7th most endangered river in the U.S., the KK River needed to be revitalized from a hazardous urban eyesore into a clean, natural waterway that could become a source of community pride.

The project involved acquiring several homes along the river, removing the existing concrete, and widening the river channel. This required excavation into the riverbanks and a method for stabilizing the embankments. The Recon Block system, with its gravity design capability, was chosen for the job. Its design minimized the required excavation and eliminated the need for geogrids. Recon Blocks lined approximately 600 linear feet (180m) of the shoreline, with the base of the new wall set back outside the normal river basin.

The Recon Walls played a crucial role in stabilizing the riverbanks and enhancing flood protection during significant storm events. These improvements have not only reduced flood risks but have also fostered a resurgence of aquatic life in the river. Additionally, residents now have access to a newly created green space along the channel, allowing them to enjoy the natural beauty of the Kinnickinnic River. This revitalization project not only benefits the local ecosystem but also enhances the quality of life for the community. In recognition of its positive impact and innovative approach, the American Public Works Association named this project its National Project of the Year in 2013.

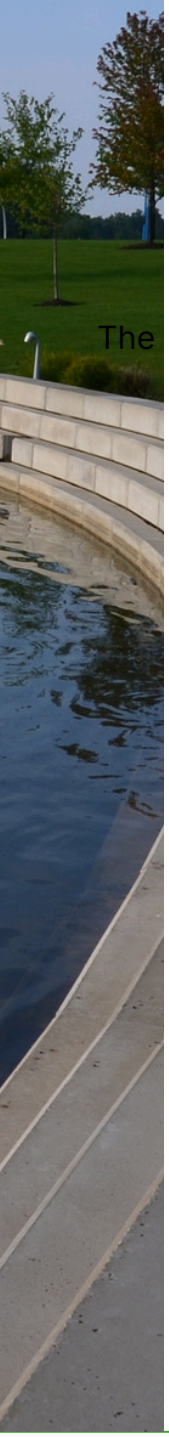
Drainage Inlet Wall

Orchards Channel – Roanoke, VA

Project: Orchards Channel
Location: Huntridge Rd., Roanoke, VA
Product: Recon Northshore Granite
Recon Manufacturer: Boxley Materials Company
Wall Area: 925 SF
Wall Contractor: Roanoke County
Engineer: Circeo Geotech Engineering

The existing drainage channel at the Orchards Subdivision in Roanoke, VA, was highly susceptible to erosion during heavy rain events, leading to environmental concerns and potential damage to the surrounding infrastructure. To address these issues, the County aimed to mitigate erosion, slow the flow of runoff, and enhance the aesthetic appeal of the channel. The project included plans to develop a retention pond area that would feature strategically placed weirs to capture and manage runoff before it entered the existing culverts integrated into a headwall beneath Huntridge Road. This comprehensive approach not only aimed to improve water management but also to create a more visually pleasing landscape.

The result was a visually appealing retention basin and two weirs, all constructed using Recon Northshore Granite Gravity Wall Blocks. The project was managed by the Storm Water Operations Division, which successfully executed the construction. Jeffery Altice, the Storm Water Operations Supervisor, commented that while the team had experience building various walls in the past, this project proved to be significantly easier on the crew from a physical perspective. The design and materials used not only enhanced the functionality of the drainage system but also contributed to the overall aesthetics of the area.



Drainage Inlet Wall

Orchards Channel – Roanoke, VA

Since the blocks were machine-set, a small team of employees could construct the wall with minimal effort. Even though this was their first experience with a Recon Wall, the learning curve was reported to be very straightforward.

Boxley Materials supplied the blocks for this project, with the engineering completed by Mike Circeo.

Gravity Retention Pond

Retention Pond – Plymouth, MN

Project: Retention Pond
Location: Plymouth, MN
Product: Recon Le Seuer County Limestone
Recon Manufacturer: Forterra Pipe and Precast
Wall Area: 5,000 SF
Wall Contractor: Hardscape Construction
Engineer: Civil Design Professionals

An office complex in Plymouth, MN, faced the challenge of replacing a failing retaining wall while minimizing disruption to the existing parking lot and ensuring a proper connection to the current stormwater inlet pipes and outlet structure.

To achieve these goals while maintaining structural integrity, the Recon gravity wall system was selected. This choice not only helped minimize the impact on existing conditions but also ensured durability, which was crucial due to the deicing chemicals commonly used on the parking lot and the harsh freeze-thaw cycles typical in Minnesota. The design aimed to provide a long-lasting solution that would effectively support the landscape while accommodating the complex's operational needs.

Recon's gravity wall system offered the advantage of minimal disruption to the existing structures, making it an ideal choice for the project. Its wet-cast air-entrained concrete not only met the necessary durability criteria but also provided resilience against the harsh weather conditions typical in the region.

The construction process involved initially dewatering the retention pond to facilitate the installation of the wall. This step was crucial to ensure a stable work environment and prevent any flooding during construction.

Gravity Retention Pond

Retention Pond – Plymouth, MN

Unfortunately, Mother Nature proved to be an obstacle during the project, as the area experienced an unexpected 9 inches of rain over the construction timeframe. This excessive rainfall necessitated multiple dewatering efforts to manage the water levels effectively and ensure the construction site remained safe and operational. Despite these challenges, the team persevered, and was able to deliver a wall that not only met the project's structural requirements but also enhanced the overall stability and aesthetic appeal of the office complex, showcasing the team's ability to adapt to adverse conditions while delivering a high-quality result.