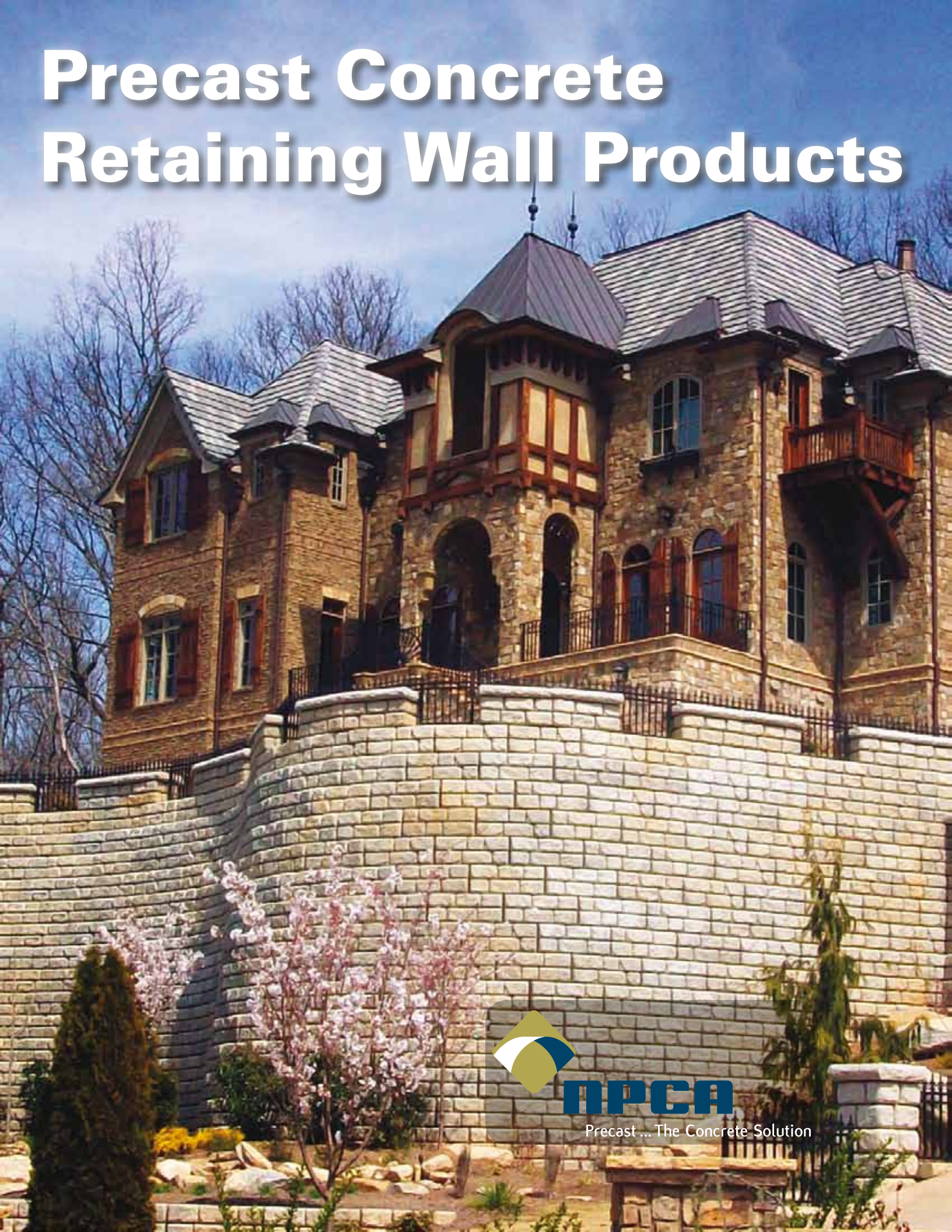
Precast Concrete Retaining Wall Products



NPCA

Precast ... The Concrete Solution

WHY PRECAST CONCRETE?

Precast concrete retaining wall systems have many advantages over competing materials.

Rough and Tough

The strength of precast concrete gradually increases over time. Other materials can deteriorate, experience creep and stress relaxation, lose strength, deflect over time and may not be able to withstand vehicular impacts. The load-carrying capacity of precast concrete is derived from its own structural qualities and does not rely on the strength or quality of the surrounding backfill materials. Studies have shown that precast concrete products can provide a service life in excess of 100 years. In severe conditions, additional design options are available to extend the life of concrete products.

We're Talking Quality Here

Because precast concrete products typically are made in a controlled plant environment, they exhibit high quality and uniformity. Problems affecting quality typically found on a job site- temperature, curing conditions, poor craftsmanship and material quality- are nearly eliminated in a plant environment.

Installation Is Easy

Setting precast concrete structures into place is easier because they do not require special rigging (such as fabric slings) to avoid structural damage. Other materials such as fiberglass can suffer structural damage during compaction. In contrast, precast concrete is less susceptible to vibratory damage while the surrounding soil is backfilled. Consequently, backfilling operations can usually proceed much faster around precast concrete structures.

Ready for Anything

While no material is completely immune to chemical attack, the mix designs used to produce precast concrete can be adjusted to help withstand anticipated corrosive agents. Materials such as steel and other materials quickly deteriorate in the presence of corrosive agents, some in the presence of water alone. To better protect reinforcement from corrosion, the precast concrete strength should be designed to 4,000 psi or more.

Engineering

Precast concrete walls are generally supported by engineering specific to both the particular wall system and to the project site conditions. This is not always the case with walls built from natural stone materials (i.e., boulders).

Durability

Precast concrete walls are usually made from wet-cast, air-entrained concrete that is very durable. Resistance to the adverse effects of repeated freeze-thaw cycles and road salts can be significant. Check with the producer to verify the mix design used (including the strength of the concrete) and to verify that the producer has a Quality Assurance program in place.

Aesthetics

Many of the precast concrete wall systems are made with an architectural finish that replicates natural stone. In addition, precast concrete walls can be stained with a number of commercially available stain products to further enhance and customize the look.

Looks Good in "Green"

Besides water, concrete is the most used material on earth. It is nontoxic and environmentally safe. Precast concrete is additionally beneficial because it is made from natural materials. Precast concrete products are used throughout the world as part of retaining wall systems of nearly every modern city.

Precast concrete is the choice material for products used in retaining wall systems. Precast structures are modular, can fit any design situation, are produced in a quality-controlled environment and are ready to install immediately upon arrival at the job site. Precast retaining wall components are easily produced to be durable during storage and transportation, easy to install, less vulnerable than competing products to damage during backfill, and are environmentally safe during operation.

SUSTAINABLE BENEFITS OF PRECAST DURING CONSTRUCTION

Recycling

Precast plants reuse formwork, in itself a conservationist move, and in doing so reduce construction waste that would otherwise be generated at a job site. In addition, cementitious materials used in concrete often contain manufacturing byproducts such as fly ash and blast furnace slag that would otherwise find their way to a landfill. Waste water can be recycled for use in manufacturing. Steel used for concrete reinforcement is typically composed of 95 percent post-consumer recycled content.

Reduced Site Impact

Since precast concrete retaining wall systems are manufactured off site, and delivered on demand, there is a significant reduction in truck traffic, dust, noise, and debris from formwork associated with pour in place products.

Because precast concrete retaining wall systems are modular and standardized, they are installed in a quicker fashion and result in reduced construction times and energy usage, noise and emissions from on-site equipment and in reduced site impact.

Natural Materials

The cement used in concrete is made of natural materials such as limestone and clay. Most cement plants rely on nearby limestone quarries.

Aggregates used in the manufacturing of precast concrete retaining wall systems are generally extracted and manufactured regionally.

Durability

Concrete is a very strong and durable material, which is a significant sustainable attribute. It will not rust, rot or burn and has a service life of in excess of 100 years.

Precast Concrete and LEED

Precast concrete retaining wall systems are a smart choice for projects applying for LEED certification. Most of the credits shown also have additional innovation in Design points that are tied to exemplary performance of the credit listed.

LEED for New Construction and Major Renovation 2009 Scorecard

Site Development: Protect or Restore Habitat (Sustainable Sites Credit 5.1)

Due to precast concrete retaining wall systems being plant cast and are delivered to the site ready to set so they require very minimal site disturbance to install.

Construction Waste Management: Divert 50% (75%) From Disposal (Materials and Resources Credit 2.1 and 2.2)

Due to precast concrete retaining wall products being plant cast and are delivered to the site ready to set and create minimal to zero amounts of onsite water material.

Recycled Content: 10% (20%) (post-consumer + ½ pre-consumer) (Materials and Resources Credit 4.1 and 4.2)

Precast Concrete retaining wall systems may contain supplementary cementitious materials such as fly ash and blast furnace slag which will add to the project's recycled content goals.

Regional Materials: 10% (20%) Extracted, Processed & Manufactured Regionally (Materials and Resources Credit 5.1 and 5.2)

The vast majority of materials that go into the construction of precast concrete retaining wall products are within a 500 mi radius of the precast plant.

MECHANICALLY STABILIZED EARTH (MSE)

MSE Systems

A common retaining wall used in recent years is the MSE wall system (Mechanically Stabilized Earth). It's classified as a gravity retaining wall that is designed to withstand lateral earth and water pressures, and any live and dead load surcharges.

Mechanically stabilized earth walls are built from individual panel sections. Mechanically stabilized earth systems have interlocking panels and are supported by steel straps that are mechanically attached to the back of the panel and extend back from the panel into the retained soil, resulting in a reinforcing zone behind the wall.

The reinforced soil's mass, along with the facing, acts as an improved gravity wall. The reinforced mass must be built large enough to retain the pressures from the soil behind it. Gravity walls usually must be a percentage as deep or thick as the height of the wall, and may have to be larger if there is a slope or surcharge on the wall.

Modular Block Walls

Modular block, or segmental, retaining walls employ interlocking concrete units that tie-back into the earth to efficiently resist loads. These pre-engineered modular systems are an attractive, economical, and durable alternative to stone or poured concrete retaining walls. The inherent design flexibility can accommodate a wide variety of site constraints, project sizes, and aesthetic preferences.

MODULAR BLOCK WALL SYSTEMS

UNREINFORCED MODULAR BLOCK

Large Precast Modular Block – Unreinforced/ Gravity Wall

Large reinforced precast modular walls are built from individual large concrete blocks and generally stacked in a running bond fashion. Large precast modular block systems usually have an interlocking feature or shear key mechanism that locks one course of block to the next. Large precast modular block systems retain the soil by virtue of their size and weight. There is typically not a need for additional soil reinforcement.

Large Precast Modular Block – Reinforced Wall

Large precast modular block systems are typically built from individual large concrete blocks and generally stacked in a running bond fashion. Large precast modular block (reinforced wall) systems incorporate soil reinforcement with these large precast blocks, given the height of the wall. The soil reinforcement used is generally a form of a geo-grid attached to the large blocks either frictionally or mechanically.

Cantilever Wall

Cantilever wall systems are typically large "L" type units with an extended footing on the front side of the wall. The footing helps resist the overturning moment. Cantilever wall systems retain the soil by virtue of their size and weight. No additional reinforcement of the soil is required.

COMMERCIAL/RESIDENTIAL RETAINING WALLS

Commercial/Residential Retaining Walls

Retaining walls are a staple in the contracting business, whether you work residential, commercial or government jobs. Whether your client wants one for attractive landscaping or for the more practical purpose of erosion control, there are several retaining wall solutions to consider.

SYSTEM INFORMATION

What should a civil engineer, architect, general contractor or developer know about retaining walls and precast concrete wall systems in particular?

The quality of a retaining wall is generally equal to the strength of the weakest link in the retaining wall chain. That chain includes upfront planning and design, quality of the retaining wall product chosen, quality of the site-specific engineering for the wall, quality of the information regarding the soils at the site, and the quality of the construction of the wall.

1. Retaining walls are frequently structural in nature and often critical to the proper development of a site. A first step in the proper planning for a retaining wall is to collect information about the soils at the location. Soil borings and follow-up shear testing of the soils are important and perhaps critical. In addition, the expense incurred to gather this information will generally pay dividends in the long run. Without the proper soils information, wall construction will be delayed until the information is collected, or "worst case" assumptions may be made. This may result in the wall being over-engineered, which may in turn cost more than it should. Suggestion: When the rig is on site taking borings for the building pad, have the rig take borings every 50 to 75 feet along the foundation wall.
2. Develop a grading plan that shows existing grades. The plan should include: those grades immediately outside the property lines of the parcel being developed; proposed grades; location of the wall(s); top of wall and bottom of wall elevations along the proposed wall; location of existing and proposed buildings, roads, etc.; location of utilities; and location of construction/excavation limits. Proper engineering of a wall must be done not only with knowledge of the soils, but also with knowledge of slopes and surcharges that may exist at the top of the wall and any slopes that may exist at the toe of the wall.
3. Select an engineer who is experienced in retaining wall design and who is familiar with the product chosen for the project.
4. Make sure the producer of the product has a Quality Assurance program in place.
5. Make sure the product brand selected has an engineering manual available that includes testing for items such as shear, sliding, and reinforcement connection.
6. Make sure the contractor selected for installation has experience with the installation of the product chosen. Is the company a certified installer? Does it have a Quality Assurance program for wall installation? For example, will the company perform compaction testing and provide results to the customer?

What safety factors should the retaining wall engineer calculate?

The retaining wall engineer should be calculating:

1. External Factors of Safety, including Overturning, Sliding and Bearing.
2. Internal Factors of Safety, including Pull Out.
3. Local Stability, including Shear.
4. Global Stability

Installation Procedures

The final and critical step to the completion of a precast retaining wall is proper wall installation. Each precast retaining wall system will / should have its own unique recommendations for proper wall component installation. It is essential that the precaster make available to the wall contractor wall construction guidelines. Such guidelines will generally cover site preparation, excavation, leveling pad preparation, base course installation, backfilling and compaction, drainage considerations, placement of additional courses, and geogrid placement.

CERTIFY EXCELLENCE

From start to finish, the NPCA Plant Certification program sets the highest standards for plant facilities, production operations and quality control procedures. NPCA certified plants are dedicated to manufacturing first-class products. To maintain their NPCA credentials, plants must pass periodic, on-site certification inspections.

The NPCA Plant Certification program enables quality-conscious agencies, architects, engineers and users to identify and select high-quality precast concrete manufacturers. At no cost to specifiers, NPCA certification prequalifies manufacturers as companies capable of superior workmanship. You save money because you do not need to spend valuable time and resources inspecting a plant to ensure that its products will meet or exceed your expectations. You also save time when you work with certified precast plants because products arrive on the job site ready for installation. Material and labor costs are kept in check because quality control starts before the work order reaches the precast plant.

The Certification Process

To become an NPCA certified plant, a precast concrete production facility must exceed a level of excellence defined by NPCA in accordance with relevant industry standards. Plant inspections are performed by an engineer from an independent, nationally accredited firm, and all certification applicants are graded on all critical aspects of plant operation. A standard grading schedule is used for all inspections to ensure uniformity. Inspections are performed during actual plant operation.

The NPCA Certified Plant

Precast concrete plant operators committed to excellence seek NPCA certification. Their certification plaques indicate the investment of time and resources necessary to meet the high standards demanded by the construction industry. Staffed by experienced personnel, plants complying with NPCA guidelines and practice quality assurance at every step of the production process. These guidelines require procedures and products to be inspected during each phase of manufacturing to ensure compliance with rigid industry requirements. As a result, products from NPCA certified plants are characterized by high quality, uniformity and consistency.

Each NPCA certified plant is also required to maintain an active plant safety program that meets or exceeds local, state, provincial, and federal laws, including Occupational Safety and Health Administration (OSHA) and Canadian Centre for Occupational Health and Safety requirements.

NPCA guidelines require certified plants to maintain extensive records to verify that materials used in the manufacturing process conform to appropriate specifications. Work orders, product drawings, equipment calibration records, aggregate and concrete test records, batching reports and product inspection reports are also required as management tools and quality assurance aids.

Industry Standards

The American Association of State Highway Transportation Officials (AASHTO) uses the FHWA Publication Number FHWA-SA 96-071 Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines (known as Demo 82) dated October 1996.

AASHTO is generally used for public and government projects. It calls for reinforcement depths equal to the greater of 70 percent of the wall height or 8 feet, requires uniform reinforcement depths, requires imported sand or gravel in the reinforced zone, and calls for a minimum embedment depth of 2 feet.
Other design methodologies may be available depending on the system used.

FIND A PRECAST CONCRETE RETAINING WALL PRODUCER

Whether you need a custom project or standard product visit www.precastsolutions.org or call (800) 366-7731 to find the producers in your area. Select a zip code radius or state specific location that will best benefit your project. The National Precast Concrete Association is the structure behind Precast Solutions. NPCA has proven itself a leader in the development of production and quality standards for precast products in addition to publishing manuals and underwriting research. NPCA Technical Services department staff also actively participates in standard establishing organizations as ASTM and ACI.

NPCA is happy to provide the data and support that you need to incorporate the latest precast concrete products into your design. We offer a Knowledge Base where you can find information addressing specific design issues; a Community Forum, where you can engage the entire precast concrete community regarding your particular issue. You can also contact NPCA Technical services directly either by techsupport@precastsolutions.org with a 48 hour response time or for more immediate needs directly at (800) 366-7731. This allows you to ask technical questions from staff engineers about any stage of the design or installation process.