Underground Storm Water Detention & Retention Systems

American
Concrete Pipe
Association

Underground storm water detention and retention systems are popular items in construction sites for many reasons, some of which are as follows:

- May enable smaller sizes of mainline pipe.
- Possible utilization of existing drainage when developing new areas.
- The surface area made available due to underground storage can be utilized as valuable, developable land.
- Less liability – less insurance – than storm water management ponds.
- Less maintenance costs than maintenance costs for storm water management ponds.
- Environmental benefits from the storage of storm water that can later be discharged into the municipal system at a controlled rate.
- In dry areas, water can be stored for times of need.

Many companies have attempted to capitalize on the need for storm water storage and use with new products and new configurations. None of these products has proven to be a good substitute for the tried and true precast concrete pipe and box sections. Regardless of the necessary volume, the structural strength requirements, or the need for special fittings, precast concrete is the solution.

One of the materials that has been promoted for storage systems is HDPE – pipe and chambers. The historical performance of these products has not been good. Although the initial and replacement costs may be transparent, the litigation costs, which usually are not revealed, also may be very large. Following are examples of their poor performance.

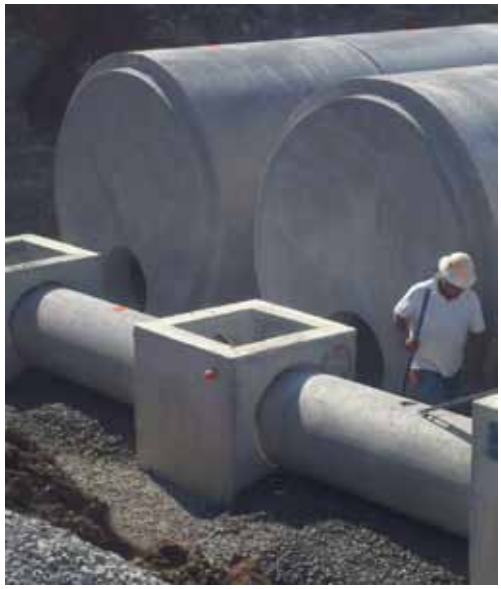
An elementary school parking lot collapsed over an HDPE pipe detention system in Columbia, SC. The School Board spent valuable funds on a replacement system consisting of 2,000 feet of 48" diameter precast reinforced concrete pipe.

There have been three reported HDPE bundled pipe and chamber detention system failures in Illinois. In each case the HDPE material collapsed and consequently the parking lots collapsed. At least one of these systems was replaced with precast concrete box sections.

An HDPE detention system failed at Ft. Bragg, NC before the entire project was finished. The volume of the system was 65,000 cu.ft. It was replaced with concrete pipe.

In a business park near Valrico, FL a header section of a very large 60" diameter HDPE detention system was severely deflected and had to be replaced. It was revealed that the project specifica-

tions, which required using a Class I or Class II backfill material for a fully encapsulated backfill envelope, were not followed. Instead, a Class I stone material was placed up to the springline and in situ material was used for the balance of the backfill. This failure, which occurred early in the project, delayed the work to complete the parking lot and begin construction of the buildings in the office park.



A large detention system consisting of HDPE chambers in a suburban mall in Massachusetts failed approximately ninety days after installation. The forensic analysis performed after the failure revealed the detailed project plans and product drawings and the fact that the product was installed according to plans. The conclusion was that the product just simply was not strong enough for the application.

So why should a designer consider using precast concrete products for underground detention and retention. The many attributes of reinforced concrete pipe (RCP) and precast concrete box sections become clear when these products are considered for underground detention and retention systems. Following are benefits of using concrete pipe and/or precast concrete boxes:

- Ease of Design - Precast concrete products can be designed for any site condition. Designers are more familiar with and have more design knowledge of concrete than any other product.
- Size and Shape Options – RCP and precast concrete boxes provide the designer with a large range of shapes and sizes.
- Footprint Efficiency - The use of precast concrete products allows large volumes of water to be handled in a relatively small footprint.
- System Cost – Efficient footprint and shallow installation due to brute strength allow for a cost effective water storage system (reduced excavation, reduced select backfill, less compaction/installation time when compared to flexible systems).
- Construction Time Reduction- precast systems allow quick installations and immediate backfilling so overall site work can progress on or ahead of schedule.
- Water Quality - Precast concrete storage systems can be used in conjunction with structural storm water quality units. The systems can contain or be designed to provide storm water quality treatment incorporated into the precast system.
- Service Life - Whatever precast concrete product is selected, the owner can rest assured of a structurally designed system that will outlast all other products at a competitive cost.
- System Access, Inspection, Maintenance – Precast systems can be designed for inspection and maintenance access. The flat bottom of precast box sections provides for easier and more efficient cleaning/maintenance.

When considering an underground detention or retention system, contact a member of the American Concrete Pipe Association to discuss the best and most cost effective precast solution for your project.

Project Examples – Footprint (Capacity) Comparisons

Example 1:

Value Engineering of Storm Water Management Systems

Project Requirements:

System #1

Total Storage Volume Required: 24,535 CF

Option #1(*Flexible*)			**Option#2(RIGID)**		
			8	FT	Width of Precast Concrete Box Sections
60	inches	Diameter of Pipe	8	FT	Height of Precast Concrete Box Sections
1250	LF	Length of Pipe required	396	LF	Length of Box required
19.625	SF	Area of Pipe / LF	62	SF	Area of Box / LF
24	inches	Minimum Cover Limits for H20 Live Load	0	inches	Minimum Cover Limits for H20 Live Load
Total Storage Volume =		24,531 cubic feet	Total Storage Volume =		24,535 cubic feet
625	FT	Length - excavation required	396	FT	Length - excavation required
15	FT	Width - excavation required	9.33	FT	Width - excavation required
7.5	FT	Depth - excavation required	9.33	FT	Depth - excavation required
1,696	CY	Select Backfill(stone) Required less bedding	365	CY	Select Backfill(stone) Required less bedding
174	CY	Bedding Required	68	CY	Bedding Required
9,375	SF	Footprint of system	3,693	SF	Footprint of system
2,604	CY	Total excavation	1,277	CY	Total excavation

Comparison of excavation:

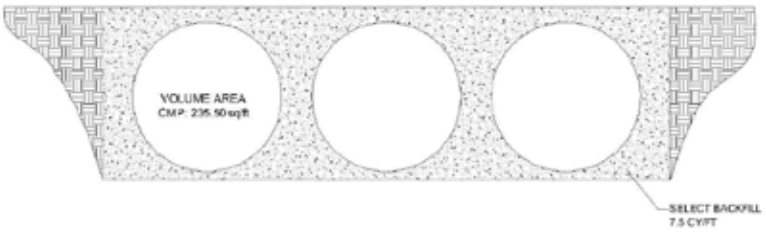
Option #2 has **51.0%** less of excavation than Option#1.
Option#2's footprint is **60.60%** less than that of Option#1's.
This means less excavation into unknown materials, such as rock.
With Option#1 there is **1,696** CY more stone required for backfill than with Option#2.

Comparison of estimated costs:

	$ / FT	Diameter of pipe		$ / FT	Precast Concrete Box Sections
	$/CY	Excavation Costs - standard not rock		$/CY	Excavation Costs - standard not rock
	$/CY	Select Backfill Costs		$/CY	Select Backfill Costs
	$/CY	Bedding Costs		$/CY	Bedding Costs
		Fabrication Costs (Fittings/bends/ect.)			Fabrication Costs (Fittings/bends/ect.)
		Total Material Price			Total Material Price
		Total Excavation Costs for Footprint			Total Excavation Costs for Footprint
		Total Select Backfill / Bedding Costs			Total Select Backfill / Bedding Costs
$	-	Total estimate for pipe system	$	-	Total estimate for Precast Box Sections system

Example 2:

<u>Project breakdown</u>:
Storage requirements – 135,000 cf
2 alternate designs, CMP or precast box sections
10’ diameter CMP – 78.5 sf/foot
10’x10’ box sections – 98.0 sf/foot



<u>Precast Box Sections Advantages</u>:
A box system has 20% volume advantage per linear foot
1,736’ of CMP 10 barrel w/ header pipe
1,378’ of box 11 barrel w/ bulkheads
28% less footprint with box sections
No special stone backfill around boxes
Low cover limits – in parking lot