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NEWS Health & Safety in Precast Plants **CONCRETE TECHNOLOGY** Mode of action of different superplasticisers **CONCRETE PRODUCTS** Conbloc Internusa from Indonesia goes for a fully automatic concrete block production **CONCRETE PIPES AND MANHOLES** Competitive product analysis to discover fundamental differences between pipe materials that strengthen specifications for concrete pipe **PRECAST CONCRETE ELEMENTS** Form liner handling system for the production of architecturally sophisticated sandwich wall elements

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Competitive product analysis to discover fundamental differences between pipe materials that strengthen specifications for concrete pipe

Over the 170-year plus history of the American concrete pipe industry, precast concrete pipe products have not been the only choice for specifiers. Alternative materials have ranged from wood to clay to steel and thermoplastics and now there are composites. However, there has never been a time as there is now when there have been as many choices of alternative materials for pipeline systems and culverts. In addition, while choices are being made, new materials are being introduced to the marketplace. The traditional and new competitive materials are flexible pipe commodities that are mass produced and sold directly from the source, or through a national network of distributors. Concrete pipe, on the other hand, is an engineered product available only from the concrete pipe production facility.

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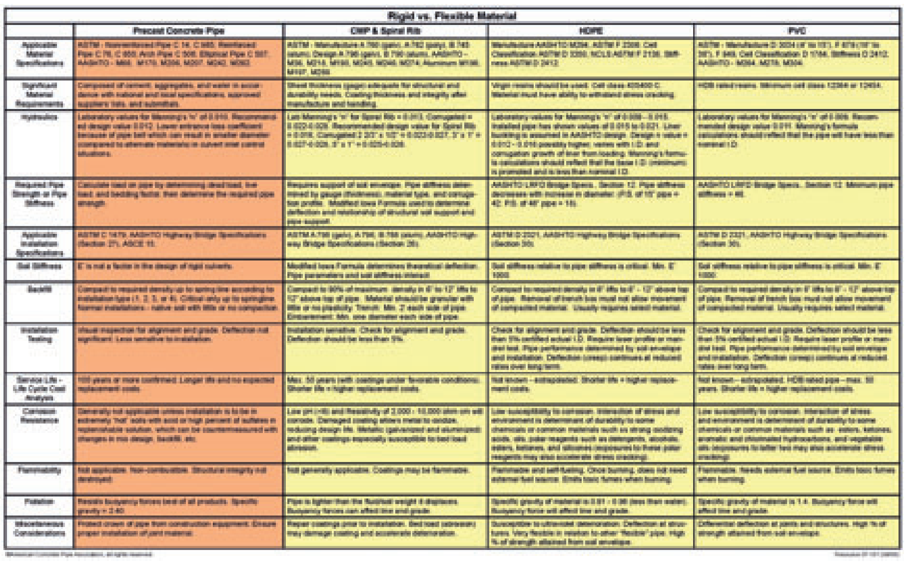
The concrete pipe industry primarily competes with corrugated metal pipe (CMP), high density polyethylene (HDPE) and polyvinyl chloride (PVC). The new flood of competitors includes ribbed PVC, triple wall polypropylene, steel reinforced polyethylene (SRPE), and fiberglass. Clay pipe is still used for sanitary sewers in some states, but wood pipes are now relegated to history. To complicate the competitive environment, market forces and trade agreements are permitting concrete pipe and flexible products from other countries to enter the U.S. market. The concrete pipe industry prepared for the onslaught of new competitive pipeline and culvert materials through the 1980s, 90s and early 21st century. Concrete pipe producers introduced new concrete pipe designs and took the production and quality of concrete pipe to new heights through education/certification of industry personnel, research, new product development, and the rebuild of plants with the option of totally robotic facilities.



www.concrete-pipe.org/brochures/Rigid-vs.-flexible-material.pdf

Rigid and flexible pipe are not the same

With all these choices of materials and products for pipelines and culverts, it is now imperative that designers and specifiers know how drainage pipe materials perform over the design life of a project. To manage their professional liability, they must under-

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stand how materials interact in sewer systems that may be comprised of, among other things, multiple product materials including pipes, manholes, catch basins, stormwater detention and retention systems, and treatment devices. All pipelines and culverts must function as a conduit and a structure, and there are fundamental differences between units of rigid and flexible pipe (Figure 1). This tenet is the start-point for any pipeline and culvert designer and/or specifier.

Another consideration by many as a start-point, or certainly to be considered with the type of installation (rigid vs. flexible), is the cost of the pipeline. Here, specifiers undertake a Least Cost Analysis (LCA). The cost, however, must be analyzed over the lifetime (design life) of a project and should include initial, maintenance, rehabilitation, direct and indirect replacement. In addition, there are tangible factors such as planning, specifications, hydrology, hydraulics, structures, installation, durability and economics. Intangible costs include travel delay; loss of business due to road blocks and detours; political implications; and the owner's liability. Calculations of an LCA account for future costs, considering present value, replacement costs, inflation, residual value, maintenance, rehabilitation and user delay. For each material, system or structure, the LCA method determines the present value or the total initial and future costs deducted back to today's value to give a pipeline designer or specifier a true picture of the product that is the most economical over the life span of a project.

Least Cost Analysis can be described by the following equation:
LCA = Initial Cost + Present Value of Future Costs (Replacement + Rehabilitation + Maintenance – Residual Value + User Delay)

With rigid pipe, up to 85% of the structure is delivered to the job site leaving the remaining 15% of the strength to come from the soil support once the product is installed. A flexible pipe system on the other hand, relies on up to 85% of its structural strength to come from the soil structure that is built in the field around the pipe. Although a rigid pipe might have a greater capital cost, the final costs of a proper installation are similar. Often, a concrete pipeline has a lower installed cost. And, it is proven that concrete pipelines last much longer with little maintenance. Figure 2 is a cost analysis of the pipe envelope comparing a rigid and flexible pipe installation showing similar installation costs.

The project design life is normally set by the owner or an authority responsible for the project and varies according to the system classification, end use, and location. Where a roadway or facility cannot be disrupted to replace the pipe, a project design life of 100 years or greater is warranted. Material service life factors include fabrication, durability, and installation. The 3-edge-bearing test in concrete pipe plants ensures that the concrete pipe will perform as expected. Flexible products and rigid products do not share the same durability properties. The U.S. Army Corps of Engineers (USACE) agrees that the product service life for concrete pipe is between 70 and 100 years. The service life of steel, aluminum, and plastic (flexible) is 50 years in most environments when properly installed. The concrete pipe industry considers the USACE estimate as conservative and is confident that properly installed concrete pipelines and culverts will function as designed for much longer than 100 years.

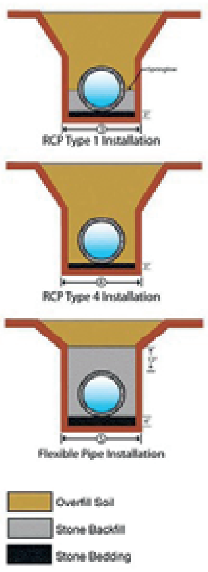
Measuring the performance and value of competitive products before specifying pipeline and culvert material is critical to building resilient sewer systems and culverts. John Ruskin (1819-1900), renowned English critic, social commentator, and economist of the Victorian Age got it right when considering products and services competing for the same consumer:

"It is unwise to pay too much, but it is worse to pay too little. When you pay too much, you lose a little money. When you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do. The common law of business balance prohibits paying a little and getting a lot-it can't be done. If you deal with the lowest bidder, it is well to add something for the risk you run. And, if you do that, you will have enough to pay for something better."

Figure 2 C.A.P.E. (Cost Analysis of Pipe Envelope)
Comparison Between Installed RCP and Flexible Pipe

Installation Type	Pipe Diameter	Stone Volume FT³ / LF	Stone Cost $ / LF
RCP Type 4	12"	0.58	$0.55
RCP Type 1	12"	1.25	$1.17
Flexible Pipe	12"	4.44	$4.17
RCP Type 4	18"	0.73	$0.68
RCP Type 1	18"	1.69	$1.58
Flexible Pipe	18"	5.81	$5.44
RCP Type 4	24"	0.88	$0.82
RCP Type 1	24"	2.13	$1.99
Flexible Pipe	24"	7.17	$6.72
RCP Type 4	30"	1.02	$0.96
RCP Type 1	30"	2.56	$2.40
Flexible Pipe	30"	8.53	$7.99
RCP Type 4	36"	1.17	$1.09
RCP Type 1	36"	3.00	$2.81
Flexible Pipe	36"	9.89	$9.27

Installation Type	Pipe Diameter	Stone Volume FT³ / LF	Stone Cost $ / LF
RCP Type 4	42"	1.35	$1.27
RCP Type 1	42"	3.83	$3.59
Flexible Pipe	42"	12.18	$11.42
RCP Type 4	48"	1.54	$1.45
RCP Type 1	48"	4.76	$4.47
Flexible Pipe	48"	14.67	$13.75
RCP Type 4	54"	1.73	$1.62
RCP Type 1	54"	5.79	$5.43
Flexible Pipe	54"	17.35	$16.26
RCP Type 4	60"	1.92	$1.80
RCP Type 1	60"	6.92	$6.48
Flexible Pipe	60"	20.22	$18.95
RCP Type 4	66"	2.10	$1.97
SCP Type 1	66"	8.14	$7.63
Flexible Pipe	66"	23.29	$21.84



Notes:
① Stone cost is based on $15 per ton in place.
② Stone unit weight is 125 pounds per cubic foot in place
③ Per AASHTO, the trench width for Type I, II and III installations are as follows:
D_o + 12" for RCP 36" diameter or less
D_o + ⅙D on either side of the pipe for RCP greater than 36" diameter
④ Per AASHTO, Type IV installations have no minimum trench width.
The above criteria in Note ③ will be used for these pipe envelope calculations.
⑤ Per AASHTO the following trench widths are required for plastic pipe with less than 10' of cover:
D_o + 18" for plastic pipe 36" Diameter or less
D_o + ½D on either side of the pipe for plastic pipe greater than 36" diameter.

www.concrete-pipe.org/p3training/techmod2/techmod2-cost-analysis.pdf

FURTHER INFORMATION

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