TECHNICAL BRIEF

Understanding Flexible Plastic Pipe

Concrete Pipe Association
of Australasia

WHEN DESIGNING A PIPELINE YOU ARE DESIGNING BOTH A CONDUIT AND A STRUCTURE

The conduit is sized to transmit a predetermined volume of fluid at a nominated rate (discharge). The structure carries the imposed external loads and maintains the conduit's (hydraulic) geometry and integrity.

When buying a rigid Steel Reinforced Concrete Pipe, the purchase covers both structure and conduit. When buying a flexible plastic pipe the purchase covers only the conduit.

The strength and performance of Rigid Steel Reinforced Concrete Pipe continues to be proven after more than 100 years. With its unique load carrying capacity Steel Reinforced Concrete Pipe is the proven option for stormwater drainage.

By comparison flexible plastic pipes have limited service history. They rely on the adequacy of the installation to provide strength and long-term performance.

FACT **1**

Installation methods for flexible plastic pipe and traditional Steel reinforced concrete pipe are not the same:

With rigid pipes such as traditional steel reinforced concrete pipe, the inherent structural strength of the pipes carries imposed earth and traffic loads. Methodology for installation of steel reinforced concrete pipes is described in AS/NZS 3725.

Flexible plastic pipes are by comparison structurally weak and rely predominantly on the interaction between soil backfill and pipe deflection for their structural integrity. Failure to install flexible plastic pipes in accordance with AS/NZS 2566.2 would compromise structural integrity and increase the risk of pipeline failure.

FACT **2**

Designing flexible plastic pipelines is far more onerous than traditional steel reinforced concrete pipelines:

Flexible plastic pipe relies predominantly on the composite action of the soil/pipe structure for its structural integrity. The soil boundary condition encompasses not only the trench backfill material but also an envelope of native soil outside the trench boundary. Contamination of this boundary condition may compromise the design and lead to failure.

In undertaking design, it is necessary to have specific data on the pipe section properties, and to nominate a value for the embedment soil modulus when calculating:

- construction and service loads ,
- effective combined soil modulus,
- theoretical pipe deflection,
- long term bending strain,
- shape factor, and
- buckling pressure.

The complexity of flexible plastic pipe design demands that designers understand the fundamentals – they cannot simply rely on proprietary software.

FACT **3**

Not all plastic pipes are the same:

The broad range of materials that are covered by the generic term "plastic" continues to grow and become more complicated to understand. This complexity has the potential to become a breeding ground for confusion.

Products available in the stormwater market include polyethylene, polypropylene, steel reinforced polyethylene, and

polyvinyl chloride. These products all have different characteristics that need to be taken into account at the design phase.

Some manufacturers are substituting recycled materials either in part or completely. This can impact on physical properties such as stiffness.

FACT **4**

Flexible plastic pipe structures are complex and costly to install, compared to rigid steel reinforced concrete pipes:

AS/NZS 2566.2 Buried flexible pipelines Part 2 Installation, details all the requirements for the satisfactory installation of flexible plastic pipes. These requirements are significantly different to those of AS/NZS 3725 for rigid steel reinforced concrete pipe.

Cost comparisons between the rigid pipe installation (AS/NZS 3725) and the flexible pipe installation (AS/NZS 2566) demonstrate that a rigid pipe installation is of the order of 25% cheaper than that for an equivalent size flexible plastic pipe installation.

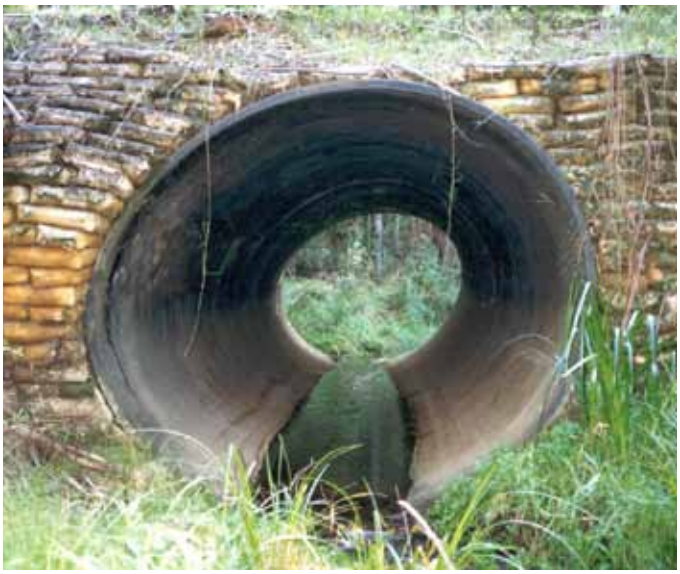
One might expect that the temptation to cut corners when installing flexible plastic pipe is high.

FACT **5**

Flexible plastic pipe does not have the track record of steel reinforced concrete Pcipe:

Flexible plastic pipes have a limited track record in stormwater applications in Australasia. In fact most product variations that are now available on the market are relatively new to the Australasian scene.

Experience in USA with many types of flexible plastic pipes installed in stormwater applications spans only about 15 years. In that time there have been a number of documented pipeline failures leading to a significant number of industry wide issues and concerns. These key issues were reinforced in the Condition Investigations of HDPE Pipe In-Service In the United States (Six States) report conducted by Wiss, Janney, Elstner Associates Inc** in January 2002. This report found that there were notable defects in 95% of the



pipelines surveyed. Defects included excessive deflection, joint separation, buckling and misalignment.

There are parallels in conditions and pipe laying practices between Australasia and USA and the same problems are beginning to be seen here.

** WJE Associates is a firm of structural engineers, architects and material scientists headquartered in Chicago with twenty offices throughout the United States of America. A copy of their report is available from the CPAA.

FACT **6**

Deflection testing is critical to assure both the short and long term life of a flexible plastic pipeline:

When a flexible plastic pipe is installed it will deflect. This deflection may continue to increase as the pipe loses strength with time or as a result of the consolidation of fill material.

Flexible plastic pipes rely predominantly on interaction between soil backfill and pipe stiffness for their structural integrity. The key measure of this structural integrity is the extent of the deflection that has occurred in the installed pipe. AS/NZS 2566.2 specifies deflection limits for each material type within a given time frame. It also details the rigorous process for deflection testing which cannot be compromised if the design life of the pipeline is to be achieved. If the pipe deflection exceeds these specified limits the pipe has failed.

Failure to detect even one deflection which has exceeded the specified limits could result in catastrophic failure of the pipeline.

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