A DESIGNER'S GUIDE TO

PLASTIC SEWER PIPE STIFFNESS CLASSES

teppfa

INTRODUCTION

Plastic sewer pipes are manufactured in a range of stiffness classes to allow designers to develop the optimum solution for different site conditions. This TEPPFA guide aims to provide designers with useful information regarding the classes available, their characteristics and performance in order to assist with the selection of the appropriate stiffness class for a specific project.

The benefits of Flexible Pipes for Sewer Applications

The level of pipe deflection depends on the quality of trench backfilling

Flexible pipes are designed to work in conjunction with the surrounding soil. The extent of pipe deflection is governed primarily by the backfill material (soil type), the backfill compaction and the settlement of the soil in the pipe trench. When the trench backfill is fully consolidated, traffic and other loads do not have a further effect on pipe deflection.

Deflection depends far more on installation quality (backfill compaction) than on the pipe stiffness.

Flexible pipes transfer loads into the surrounding soil in a controlled way, while rigid pipes have to directly resist all external loads.

For more information on the performance of buried flexible pipes, please refer to the TEPPFA Buried Pipes Study:

https://www.teppfa.eu/applications/application-civils/buried-pipe/

Performance and Reliability of Plastic Sewer Pipe Systems

The complete sewer system (pipes, fittings and joints) is designed to perform at a consistent level. When installed, the stiffness of the whole system is at least as high as that of the pipe.

A range of quality control tests for plastic sewer pipes are routinely carried out in accordance with the relevant EN Product Standard to ensure performance levels are met. For example, a ring flexibility test requiring pipes to withstand a deformation of 30% without structural failure even though the maximum deformation in operation is typically 6 – 8%.

Fittings for flexible pipeline systems have tight dimensional tolerances and pipe joints are tested to retain their integrity even when pipes and fittings are deformed thus ensuring more reliable connections.

An extensive and independently assessed study conducted by TEPPFA on the reliability of plastic sewer pipes in-service demonstrated that:

> The average number of defects in flexible sewers is 80% lower than that of rigid sewers.
> On average, defect rates in flexible sewers that can cause infiltration of ground water or exfiltration of sewage are 75% lower than that of rigid sewers.
> Installation of flexible pipe systems significantly reduces risk to the environment.

To learn more about system reliability, please download the TEPPFA study on Sustainable Municipal Pipes:

https://www.teppfa.eu/media/industry-studies/pipe-failure-research-report-stein-smp/

Design & Installation of Plastic Sewer Pipe Systems

When installing flexible plastic pipes, compaction of the trench backfill is the most important parameter to ensure a good end result. Depending on the trench backfill compaction quality, the expected deflection levels in typical installation cases are shown in the following graph:

The level of pipe deflection depends on the quality of trench backfilling

- The above values are valid for installation depths from 1 to 6 metres, assuming backfilling is conducted using compactable soil types, and the pipe diameter is 1100 mm or less.
- In most cases, the expected deformation is well below nationally accepted levels, and therefore safety factors are very high. In many local installation documents, the maximum allowable deformation long-term is 8%, and the deformation limit value for good-quality thermoplastic pipe is approximately 15%.
- The final choice of SN class for any given thermoplastic pipe system is made by the design engineer. However it should be noted that the estimated deformation and performance levels quoted in this guide relate only to products manufactured in accordance with the relevant EN product standards.
- Pipe deformation does not significantly impact the flow properties of a thermoplastic pipe. For example with a deformation of 8% the reduction in full bore discharge will be approximately 2% (As gravity sewers are not generally designed to run full this will not have a detrimental effect).

For more detailed installation instructions, please refer to:

https://www.teppfa.eu/media/guides/guide-for-successful-installation/

How is the stiffness of plastic sewer pipes specified?

Plastic sewer pipes were first manufactured with a solid wall construction and the pipe stiffness could be directly related to wall thickness. The Standard Dimension Ratio or SDR was developed to provide a method to characterise performance in a consistent way across the diameter range. The SDR is simply the ratio of the pipe wall thickness to its outside diameter.

For example a 315 mm diameter SDR 34 pipe has a minimum wall thickness of 315 ÷ 34 = 9.2 mm

It should be remembered that the lower the SDR value the greater the wall thickness and thus the higher the pipe stiffness.

With the introduction of a range of European Product Standards for different types and configurations of plastic sewer pipes; PVC (EN 1401), PP (EN 1852), PE (EN 12666), PP-MD (EN 14758) and structured wall pipes PVC, PE & PP (EN 13476) a standard test method for characterising the ring stiffness of flexible pipes was developed which can be applied across all types of plastics and pipe wall constructions.

The ring stiffness or SN value is derived from a laboratory test which measures the force required to deform the pipe by a specified amount. By conducting tests on solid wall pipes a relationship was established between the SDR value and the SN Classes. This enables the designer to specify structured wall pipes with a performance level equivalent to that of a solid wall pipe with a specific SDR. The EN Product Standard for PVC, PP & PE Structured Wall pipes (EN 13476) includes a range of SN values from 2 to 16.

It should be remembered that for SN classes the higher the SN value the greater the pipe stiffness.

TEPPFA Calculation Tool for Assessing Long Term Pipe Deformation

Following a major research project completed by TEPPFA in 1999 an interactive tool was developed which allows a quick assessment of the extent of long term deformation. It uses a number of parameters including the pipe stiffness class, the assumed level of backfill compaction and pipe and trench dimensions.

For further information on the background and details of this project and for free access to the interactive design tool go to the TEPPFA Home Page www.teppfa.eu and click on "Buried Pipe Design"

Designer's Checklist for the Correct Selection of Pipe Stiffness Class:

> Give consideration to the level of compaction which will be achieved during backfilling of the pipe trench, taking into account both the type of backfill material and the expected quality of workmanship and site supervision.

> Select a pipe specification using both the relevant EN Product Standard and pipe stiffness class.

> Use the TEPPFA Buried Pipe Design tool to assess the likely level of deformation based on the above selections.

> Consider if the resulting deformation levels are appropriate for the project and meet local installation regulations.

> Remember to include reference to the EN Product Standard, the Pipes Stiffness Class and the required level of backfill compaction in the project specification.

About TEPPFA TEPPFA is The European Plastic Pipe and Fittings Association founded in 1992 with headquarters in Brussels. TEPPFA's multinational company members and national associations across Europe represent 350 companies that manufacture plastic pipes and fittings. TEPPFA's members have an annual production volume of 3 million tonnes directly employing 40,000 people with €12 billion combined annual sales. TEPPFA positions itself as polymer neutral. Its final products are subdivided into 3 application groups: 1. Building (above ground systems for hot & cold-water supply, surface heating & cooling, waste water discharge and rainwater drainage); 2. Civils (below ground pipe systems for sewers, stormwater management and sub soil drainage); 3. Utilities (below ground pipe systems for distribution of drinking water, gas, energy and telecommunications).

www.teppfa.eu

Registered Office: Avenue de Cortenbergh 71, 1000 Brussels, Belgium
tel: +32 2 736 24 06 e-mail: info@teppfa.eu www.teppfa.eu

The European Plastic Pipes & Fittings Association © TEPPFA, October 2020 AGC-M-PPS-2020

teppfa