DRAINAGE DATASHEET
02

Durability and long Service Life is one of the main competitive advantages of concrete pipeline systems, as its performance is already supported by a long track record dating back to well over a hundred years. This factsheet explains why it is now possible to specify a minimum intended working life of 100-120 years for concrete pipeline products manufactured to BS 5911 and EN 1916/ EN 1917.

Concrete Pipeline Systems

100 years: Understanding the Intended Working Life of concrete in pipeline products and pipeline systems

1. Introduction

The UK's sewerage network is one of the largest in Europe, with a 565,000 km sewerage network (Water UK, 2018) and a daily discharge of well over 16 billion litres of sewage across the country. It is also one of the oldest sewerage systems in the world (Balacco et al, 2000). The state of the country's sewer network has been a major concern for a number of decades, with levels of renovation and replacement of sewers not keeping up with the rapidly ageing network (WRc, 2018). In 2011, HM Government warned that the replacement rate of failing public sewers in England and Wales has been so low (around 1% between 2000 and 2008) that it may take about 800 years before the whole system is covered (Defra, 2011). The durability and service life of pipeline products is, therefore, key for the ability of the sewerage network to perform.

There are already a number of documented cases of 19th Century or early 20th Century concrete pipes exhumed after long years in service and found to be compliant to current strength requirements. In the UK, there is already the well documented case of concrete pipes installed in Norwich in 1891 and 1903 and later exhumed in 1991 and found to be in an excellent shape.

In the US, there is the well documented case of a concrete drainage pipe installed in Mohawke, New York in 1840-1842. Parts of that concrete pipe were still in service up until very recently, serving for well 175 years.

These case studies are not exceptions. A survey by the Swedish Water & Wastewater Association (SWWA) in Malmö, in 2018, found that most 19th and early 20th Century concrete pipes within the city's sewerage network were still operating successfully 100 years after installation.

2. Factors affecting the service life of concrete pipes

There are a number of factors that can have an impact on the service life of concrete pipes. These factors need to be managed successfully to prolong the life of pipes and ensure that it serve for longer periods:

- **Product quality:** There is need for assurance that the concrete. Pipes are manufactured to the correct product standards. Concrete pipeline products are manufactured to BS 5911 (Parts 1, 3, 4 and 6) and harmonised standards BS EN 1916/ BS EN 1917. Concrete pipes in the UK are designed to strength class 120 as a minimum.
- **Chemical resistance:** Concrete made to Design Chemical class DC-4 can withstand most aggressive ground conditions in the UK. Both BS 5911 and sewers' adoption Design & Construction Guide (DCG) requires concrete pipeline systems to be designed to DC-4 unless a lower Design Chemical can be justified.
- **Hydraulic design:** It is important with any pipeline system design that proper attention is paid to hydraulic design as this will help negate internal chemical attack.
- **Installation:** installation is essential as the most common cause for sewers collapse is poor pipe laying techniques. This used to be a problem, specifically in the 1920s and 1960s, where problems with workmanship, third party damage and pressure testing used to be common.
- **Maintenance:** As with any structure, routine maintenance is essential to maintain the system's longevity.

3. Specification of the Intended Working Life for concrete pipes

In the UK, manufacturers of precast concrete pipeline systems design the concrete with a Design Chemical class of DC-4. Concrete designed to DC-4 can resist an Aggressive Chemical Environment for Concrete (ACEC) class of AC-4.

If surface carbonation is assured (i.e. 10 days minimum storage time prior to use) then the DC-4 class concrete pipe will have sufficient surface protection to resist an ACEC Class of AC-4 for an intended working life of at least 100 years.

BS 5911-1 was updated in 2021 and it now explains, for the first time, how a DC-4 mix can fulfil a "100 years" intended working life requirement. The standard states that "The preferred method to achieve AC-4 for a 100-year intended working life is the use of a DC-4 concrete with surface carbonation (i.e. precast concrete) and low permeability concrete to BS EN 1916:2002, 4.2.6.2, without the need for additional protective measures".

Moreover, Series 1700 of the Specification for Highway Roads in England (NG 1704) offers assurance that a concrete pipe, as part of the highway structure, is capable of fulfilling a 120-year asset service life.

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4. Reference Service Life (RSL) of Concrete pipeline products in carbon assessment studies

Environmental Product Declarations (EPD) and carbon footprint studies use a completely different method in determining the Reference Service Life (RSL) of construction products.

The RSL of a product is not its life expectancy, it is basically the "Design Life" of a construction product as defined in standards: The minimum number of years for which the product is designed and tested in accordance with Eurocode requirements or a product's European or British standard. RSL can also be obtained using a methodology identified in ISO 15686 "Building and constructed assets – Service Life Planning". This is why the RSL of a concrete pipe is not 180 or 200 years, but only 100 years (or 120 years for highways).

With modern manufacturing techniques and robust quality control standards, it is reasonable to expect a service life in excess of 120 years or more for concrete pipeline systems. For further advice on durability and service life requirements, please contact MPA Precast.

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MPA Precast represents the UK precast concrete manufacturers and members of the supply chain. We develop and disseminate best practice guidance to promote precast concrete in construction.

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