

Structural design of a flexible pipeline is usually based on analysis of long-term structural stability of the pipeline affected by a variety of external loads while supported by the surrounding ground. Both behaviour of pipes and level of reinforcing support of surrounding soil play important role in performance and durability of pipelines.

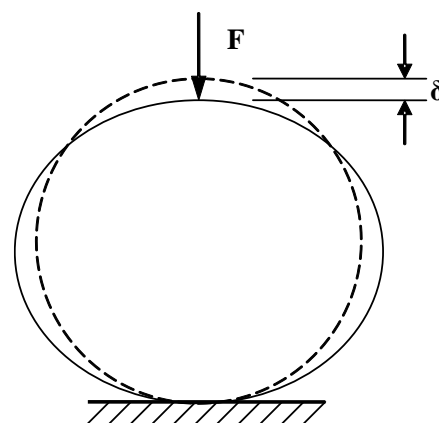
Thermoplastic materials like polyethylene and polypropylene are viscoelastic – they exhibit such time-dependant properties as creep and stress relaxation. Under a load a pipe of viscoelastic materials deflects with time until pipe/soil structure stabilizes. Thanks to stress relaxation properties, while strain in the pipe is increasing or remains constant, inner stresses in the pipe decrease.

Unsupported flexible pipe when subjected to point loading deforms (see drawing), degree of deflection being dependent on stiffness of the pipe and loading duration. Deformation of a pipe ( $\delta$ ) is a function of the load value, of the material and geometric stiffness.

Structural design of flexible pipelines according to AS/NZS 2566.1 is utilizing ring-bending stiffness value in order to determine pipe deflection or strain in the pipe wall. The ring-bending stiffness may be calculated from the following equation:

$$S = \frac{EI}{D^3} 10^6$$

- where
- $S$  – ring-bending stiffness, N/m/m,
  - $I$  – second moment of area of pipe wall, m<sup>4</sup>/m;  
for plain wall pipe:  
$$I = \frac{t^3}{12}$$
  - $D$  – diameter at neutral axis of pipe wall, m,
  - $t$  – minimum plain pipe wall thickness, m.



Point loading of flexible pipe

Stiffness may also be determined experimentally, in a parallel plate deformation test of pipe samples according to AS/NZS 1462.22, where stiffness is defined by the force required to achieve 3% diameter deformation.

The nominal stiffness rating (SN) is used to classify drainage pipes:

- For Bosspipe:
  - ◆ SN16 – minimum nominal stiffness of 16 kN/m<sup>2</sup>, or 16000 N/m/m,
  - ◆ SN8 – minimum nominal stiffness of 8 kN/m<sup>2</sup>, or 8000 N/m/m,
  - ◆ SN6 – minimum nominal stiffness of 6 kN/m<sup>2</sup>, or 6000 N/m/m.
- For plain wall polyethylene drainage pipes, SN rating can be approximated to standard dimension ratio (SDR) as shown in the table (source - AS/NZS 5065):

SN	Minimum nominal stiffness, kN/m <sup>2</sup>	SDR
2	2	33
4	4	26
8	8	21
16	16	17