

Abstract:

High-strain linepipes provide excellent strain capacity to withstand axial compression and bending deformation. Assuming the outside diameter, the wall thickness and the design factor of the linepipe as 762 mm, 15.6 mm, and 0.4, respectively, critical compressive strain of the X80-grade linepipe can be estimated to be 2.0% which is approximately 1.5 times larger than that of a conventional X80-grade pipe. The excellent strain capacity enables us to reduce construction costs and ensure integrity of buried pipelines in seismic areas and cold regions.

1. Introduction

High-strain linepipes provide excellent strain capacity to withstand axial compression and bending deformation. Assuming the outside diameter, the wall thickness and the design factor of the linepipe as 762 mm, 15.6 mm, and 0.4, respectively, critical compressive strain of the X80-grade linepipe can be estimated to be 2.0% which is approximately 1.5 times larger than that of a conventional X80-grade pipe. The excellent strain capacity enables us to reduce construction costs and ensure integrity of buried pipelines in seismic areas and cold regions.

(Table 1).

Table 1. Comparison of the results of the two methods.

3.2 Strain Capacity to Withstand Bending

The strain capacity to withstand bending is defined as the maximum strain of the reinforcement at the ultimate bending moment. The strain capacity to withstand bending is related to the ultimate bending moment capacity and the section modulus. The ultimate bending moment capacity is given by the following equation (10):

$$M_u = A_s f_y \left(d - \frac{A_s f_y}{2 f_c' b} \right) \quad (10)$$

where M_u is the ultimate bending moment capacity, A_s is the area of reinforcement, f_y is the yield strength of reinforcement, d is the effective depth, f_c' is the compressive strength of concrete, and b is the width of the section. The section modulus is given by the following equation (10):

$$S = \frac{b d^3}{12} \quad (10)$$

The strain capacity to withstand bending is given by the following equation (10):

$$\epsilon_s = \frac{M_u}{S} \quad (10)$$

4. Strain-Based

$$\epsilon_s = A \left(\frac{M_u}{S} \right) \quad (7)$$

where A is a constant, m is the modular ratio, and ϵ_s is the strain of the reinforcement.

Figure 3 shows the relationship between the strain capacity to withstand bending and the section modulus. The relationship is given by the following equation (10):

$$\epsilon_s = \frac{M_u}{S} \quad (10)$$

where M_u is the ultimate bending moment capacity, S is the section modulus, and ϵ_s is the strain of the reinforcement. The relationship between the strain capacity to withstand bending and the section modulus is shown in Figure 3. The relationship is given by the following equation (10):

$$\epsilon_s = \frac{M_u}{S} \quad (10)$$

