BULETINUL INSTITUTULUI POLITEHNIC DIN IAȘI
Publicat de
Universitatea Tehnică „Gheorghe Asachi” din Iași
Volumul 64 (68), Numărul 4, 2018
Secția
CONSTRUCȚII. ARHITECTURĂ

THE SHARES OF PIPELINES BURIED

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Received: October 17, 2018
Accepted for publication: November 23, 2018

Abstract. The increasing use of composite materials in the water supply pipe primarily for their qualities involves studying the behavior and the specific types of pipes it is subjected during operation. This article aims to provide those interested in the management of drinking water a working effectively with direct reference to the assessment of the various actions that occur during execution and service to their evolution and the effects of actions on pipelines by statically.

Keywords: pipelines buried; actions of pipelines; lifelines.

1. Introduction

Underground pipes are used in various engineering applications such as the water main, sewer networks, distribution networks of heat, gas pipes, etc.

Networks groundwater can be considered true "arteries" or lifelines (Ancaş & Atanasiu, 2011) for urban settlements.

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The main element of such a network is that the pipe must have sufficient strength and/or stiffness to exert their intended function smoothly.

The buried pipeline network design must consider various parameters, some of which have paramount importance pipe material properties and characteristics of the soil in which it is buried (Aschilean, 2009c). These parameters lead to an accurate assessment of the behavior of pipes in different actions exerted on them such as mobile actions due to traffic surface.

The need for accounting on the impact of mobile actions on pipelines occurs because manufacturers provide minimum and maximum mounting depth of only certain assumptions pipeline computing.

2. Statically GRP Pipe Buried

2.1. Soil Characteristics

Table 1 shows the mechanical characteristics of the four types of soil (Ancaş & Cirstolovean, 2018):

– G1 – non-cohesive soils;
– G2 – weak cohesive soil;
– G3 – cohesive soils, mixed;
– G4 – cohesive soils.

The above values of the modulus of elasticity of the efforts is recommended to values between 0 and 0.1 N / mm^2.

$$E_s = \frac{40}{G} \times \mathrm{e}^{-0.188\times(100-D_{PR})}, \tag{1}$$

where: G is the group number corresponding to the ground, D_{PR} – degree of compaction of the ground as in Table 1.

For greater efforts modulus values increase. Knowing the value p_E (kN/m^2) to load the stress in the coating, we will correct the value obtained for E_s the following:

$$E_{s,\sigma} = E_s \times \left(\frac{p_E}{100}\right)^z. \tag{2}$$

For other types of ground, which can not be classified as in Table 1 (organic soils, waste dumps), will determine the characteristics of each case. Keep in mind the behavior of variable while organic soils and moisture cohesive own using reduction factor (Aschilean, 2009a).

Table 1
Mechanical on Soils

Group soil	Unit weight X_s, (KN/mc)	Unit weight (undergraound water) X_s(KN/mc)	Internal Friction Angle Φ'	Modulus of elasticity of soils with different degrees of compaction E_s, [N/mm^2]						Exponent Z	Reduction factor f_1
				85%	90%	92%	95%	97%	100%		
G1- non-cohesive soils	20	11	35	2	6	9	16	23	40	0.50	1.0
G2- weak cohesive soil	20	11	30	1.2	3	4	8	11	20	0.35	1.0
G3- cohesive soils, mixed	20	10	25	0.8	2	3	5	8	13	0.20	0.8
G4 - cohesive soils	20	10	20	0.6	1.5	2	4	6	10	0	0.5

2.2. The Characteristics of the Pipe Material

In terms of design standards, pipe materials are placed into one of two general classes: rigid and flexible. Between the two large classes, some authors identified an intermediate class of semi-rigid pipes.

GRP-type piping (polyester reinforced fiberglass and insert sand) are in class flexible pipes. In the literature the concept of the flexible conduit relates to these pipes may deviate (can move, that deform) at least 2% without the occurrence of structural cracks.

Producing raw materials from which the tubes are glass fiber and resin. The resistance of the composite material of the glass fiber is provided which serves as reinforcing filler or reinforcement in a binder resin is glass fiber and ensures the protection and transmission of efforts by weight of the composite.

2.3. Actions on Buried Pipelines

Pipes buried under thoroughfares can be permanently or accidentally subjected to forces caused by traffic surface transport field. These actions are as mobile, static or quasi-static applied at a point or an area. To determine the traffic loads are considered standard vehicles as defined in DIN 1072, 1985.

Table 2
Features Standard Vehicles

Standard vehicle	Full Load (KN)	Load wheel (KN)	The width of the contact wheel (m)	Length (m)
HGV60	600	100	0.6	0.2
HGV30	300	50	0.4	0.2
CV12	120	Front20	0.2	0.2
		Back40	0.3	0.2

In the pipe (the pipe bed and cover up to 0.15 M over the ridge pipe with a lateral bounding at least 1.5 de) are permissible only compactable soils. Thus, it is necessary to verify the pipe to deformation (such as the GRP's), only the soil in the groups G1, G2, G3 acceptable. Beyond the dimensional limitations above, accepted and soils of group G4. Laying the organic fields require special filling and compaction, and the protection of any free ends of the pipes (Ancaş & Profire, 2017).

The way in which the buried pipe is decisive for determining the load distribution, the pressure distribution on the circumference and take over the work of a part of the side wall (Aschilean & Giurca, 2018). Very important is matching the angle of the trench with the statically. Any errors in compression, the support and the shortcomings of the embodiment of the fillers may be provided by the mathematical model used.

Table 3
Impact Factor φ

Standard vehicle	φ
HGV60	1.2
HGV30	1.4
CV12	1.5

Also, if the ground water is present, and this has not been taken into account in the design, there will be an increase in the load factor (according to

Table 3). The compaction should be achieved by heavy mechanical means only after filling the pipe crest exceeded 1 m.

Load distribution along the pipe is supposed to be uniform, so that ad hoc tasks and axial efforts are not taken into account.

Pipes can withstand loads of earth loads, traffic loads, and other local charges. It will take into account the differences in temperature, floating pipes, the internal pressure of the water, the weight of water in the pipe (Aschilean, 2009b).

2.4. The Ground Stress to the Upper Generatrix

First, the ground voltage is calculated independently of the pipe material. Loads and loads uniformly distributed load earth. It uses the theory that the friction between the walls of the trench and the filler may result in a reduction of the effort, under the assumption that these walls will continue to exist for a long period. The average effort due to loading of the earth down a horizontal section of the filler from the surface to the depth *h* is:

$$p_E = k \times \chi_s \times h. \tag{3}$$

For an evenly distributed load, vertical average effort can be corrected as follows:

$$p_E = k_0 \times p_0. \tag{4}$$

Formulas (3) and (4) are available for the compaction of filler material D_{PR} > > 90%. For thicker, the width of the trench, k_0, k are the unit, so the effect of the trench wall disappears:

$$p_E = \chi_s \times h + p. \tag{5}$$

The dependence of the average effort reduction coefficients in the horizontal section vertical to the width of the trench and the wall friction coefficient δ is given by the following formulas:

$$k = \frac{1 - \mathrm{e}^{-2\frac{h}{b}k_1 \times \mathrm{tg}\,\delta}}{2 \times \frac{h}{b} \times k_1 \times \mathrm{tg}\,\delta}; \quad k_0 = \mathrm{e}^{-2\frac{h}{b}k_1 \times \mathrm{tg}\,\delta}. \tag{6}$$

For $\delta = 0 \rightarrow k_0 = 1$**;** $k = 1$, thus reducing also disappears.

3. Coating Conditions for the Filling

For the trench filling material of the coating is different four conditions:

– A1: filler compacted in layers on the ground level, with supporting, without checking the degree of compaction;

– A2: vertical supporting sides of the trench, with sequential removal after filling;

– A3: support for vertical piling, panels, etc., removed after compacting;

– A4: filler compacted in layers on the ground level, to check the degree of compaction. It is suitable for land G4.

Table 4

Reduction Coefficient of Wall Friction and Effort

Conditions of coverage	k_1	Δ
A1	0.5	$(2/3) \times \varphi'$
A2	0.5	$(1/3) \times \varphi'$
A3	0.5	0
A4	0.5	φ'

φ' is the coefficient of internal friction of the ground.

The calculation of the ground voltage according to the height and diameter of the coating can be calculated using the diagrams below specific standard vehicle type:

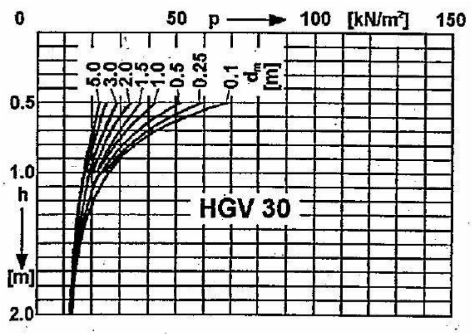

Fig.1 Effort in the soil, for HGV30, *h* between 0.5 m,...,2.0 m.

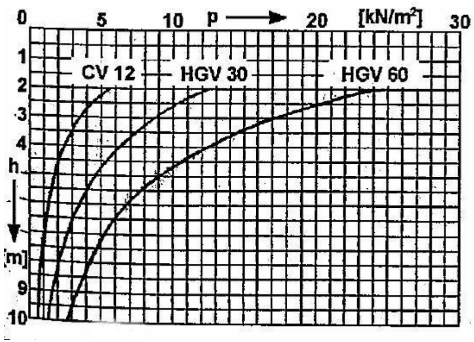

Fig.2 Effort in the soil, for HGV30/60, CV12, h between 2.0 m,...,10.0 m.

The effort resulted in traffic loads should be multiplied by the impact factor according to Table 3.

4. Conclusions

In practice it often happens that information about installation conditions and/or type of soil is not very accurate, so the selection input is up to the engineer. In this article states that these data are very important in the development of static calculation. This calculation must be done for each particular situation individually.

The conclusions that can be drawn are:

– the quality of the pipes to be placed in the field is very important, given that a high degree of compaction will provide a much better predictability of response and structural behavior between the expected limits;

– increased depth of the pipe laying and movement causes lower pressure conduit when actions such as those mentioned.

On the basis of the calculation shown can develop a comparative simulation of the behavior of two similar pipe whose samples are buried in various fields for different loads.

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EVALUAREA ACȚIUNILOR ASUPRA CONDUCTELOR ÎNGROPATE

(Rezumat)

Utilizarea tot mai frecventă a materialelor compozite pentru conducte de alimentare cu apă în primul rând pentru calitățile acestora presupune şi studiul comportării conductelor la diferitele tipuri de acțiuni la care este supusă în perioada de exploatare. Articolul de față îşi propune să ofere celor interesați în gestionarea sistemelor de alimentare cu apă un instrument de lucru eficient cu referire directă la modul de evaluare a diverselor acțiuni care intervin pe durata de execuție şi de serviciu a acestora ca şi a efectelor acțiunilor asupra conductelor prin calculul static.