HYDRAULIC CALCULATIONS OF CULVERTS OF THE RAILWAY LINE

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Abstract

This article shows the hydraulic calculation of culverts, which are the most common type of artificial structures in roads and railways. For the passage of water at the intersections of watercourses with the roadbed, culverts are arranged, which, depending on the topographic, hydrological, geological and other conditions, can be of various types.

Key words: Culverts, bridges, pipes, chutes, duckers, earthwork.

INTRODUCTION

The role of Railways in the development of the country's economy, the increase in export potential and the supply of goods to consumers is of great importance. It is not surprising that the railways are called the blood vessels of the country's economy. Therefore, great importance is attached to the development of railway networks and the maintenance of Railways in operation and the

Pipes under the embankment on the railways and make up half of all artificial structures, and these are the most common artificial structures. The scope of application of the pipes is mainly due to the fact that small running water flows from time to time, that is, when it rains and snow melts, ensure that the dressing waters pass without damaging the railway network[2].

maintenance of cargo capacity at the required level[1].

MATERIAL AND METHODS.

The main regulatory documents in the design of culverts are building codes and regulations. Culverts are designed to pass the maximum estimated costs of a certain probability of exceeding. The probability of exceeding is determined depending on the type of road (railway, automobile), the type of structure (bridge, pipe), the category of road (I, II...V). As a result of hydraulic calculations, culverts are the fundamental works of Russian scientists: V. A. Gritsenko, N. A. Krasin, L. I. Drugov, A. S. Alexandrov, O. N. Chernykh, L. I. Vysotsky, E. N. Petrov[2,3,4,5,6,7,8,9,10,11,12,13,14]. The following parameters should be established that determine the main dimensions of the structures [15]:

a) the greatest depth in front of the structure, which determines the height of the road embankment;

b) the depth of water at the entrance and in the structure, which determines the mode of flow and filling of the water pipe;

c) the depth of the water and the speed at the exit of the structure, according to which the size and type of fortifications at the exit are assigned;

d) the depth of erosion at the end of the fortifications, the size of which is assigned to the dimensions of the structural conditions can be met by different versions of culverts that differ in cost. The optimal construction option should be established by a technical and economic comparison of the options[16].

By hydraulic operation, culverts are classified:

1. According to the conditions of the flow entrance, flat and sloping pipes are distinguished.
2. By the nature of the roughness of the inner surface of the pipe:
- technical, smooth (concrete, reinforced concrete, cast iron, etc.);
- corrugated (metal, plastic, etc.).
3. By the effect of length on throughput:
- short, in which the length does not affect the throughput;
- long, in which the length affects the throughput (Figure 1).

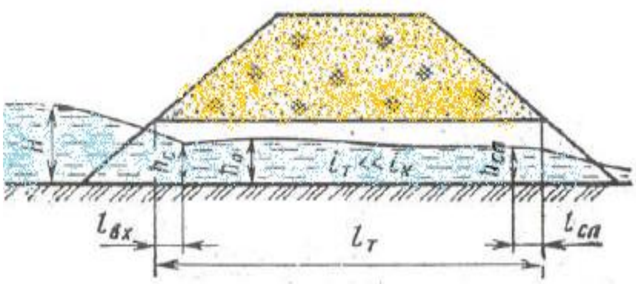


Fig. 1. Flow diagram of water in the pipe: H – head in front of the pipe; h_c – flow depth in the compressed section; h_0-normal water depth; h_{sl} – water depth at the beginning of the discharge section; l_{xx} – length of the inlet section;

structures of the water-breaking elements. The required hydraulic and

METHODS.

Culverts operate depending on the amount of water intake in front of the pipe in non-pressure mode, semi-pressure mode and in pressure mode. Non-pressure mode of operation is formed if the backstop is less than the height of the pipe at the inlet or exceeds it by no more than 20%. In the non-pressure mode, the free surface above the flow is preserved and calculated by the formula:

$$Q_c = \varphi_B * \omega_c * \sqrt{2 * g * (H - h_c}$$

Q_c – flow rate of water passing through the structure;

ω_c – the area of the compressed section in the pipe, calculated at h_c= 0.5H;

φ_B – speed coefficient in non-pressure mode, φ_B=0,82;

For rectangular pipes: Q_c=1.35bH$^{3|2}$.

L_T – the length of the pipe; l_{sl} – the length of the drain section; i_T – the slope of the pipe; i_k-the critical slope[17].

Semi-pressure mode is unstable, it can break down to non-pressure or pressure mode.

$$Q_c = \varphi_B * \omega_T * \varepsilon * \sqrt{2 * g * (H - h_c)}$$

h_c=0.6h_T

h_T – pipe inlet height;

φ_p – speed coefficient of the semi-pressure mode φ_p=0,85

ω_T – total cross-sectional area of the entrance;

ε – the coefficient of lateral compression; ω_T it is easy to calculate for both circular and rectangular cross-sections.

The pressure mode is formed at H>1.4h_T. At the beginning of the pipe, a vacuum zone is formed at the entrances of the head, which can lead to the destruction of the embankment above the pipe. In order to eliminate the vacuum zone, the inlet head is arranged with a curved outline so that the flow smoothly enters the curve.

The semi-pressure mode is formed when $1,2h_T<H<1.4h_T$
In the semi-pressure mode, the free surface above the flow is preserved. A funnel is formed in front of the pipe, in which all floating objects that can clog the holes of the pipe can be tightened.

l и i – the length and slope of the pipe;

i_W – the slope of the friction;

$i_W=Q_0^2/K_0$

K_0 – flow characteristics of a fully filled pipe[18].

RESULTS AND DISCUSSION.

During the study period, Tashkent-Sirdarya direction was chosen as the experimental site. This is because the uchachtka direction is characterized by high-speed and high-speed trains. For this reason, the technical case of the road in such networks is of great importance.

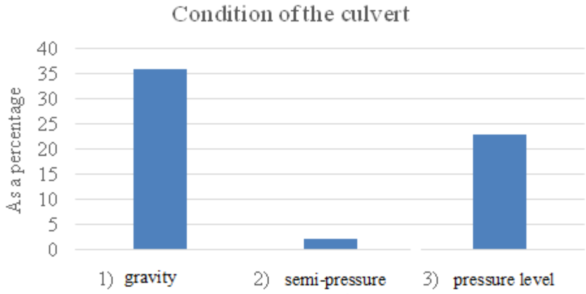
$$Q_c = \varphi_B * \omega_c * \sqrt{2 * g * (H - h_c) - (i_w - i)}$$

Φ_H=0,95 – the speed ratio of the pressure mode;

We can see the case of artificial structures in the railway network from the tables presented below[19,20].

Table-1

№	Pipe states	Quantity KM3367-3436 pieces	%
1)	gravity	36	59
2)	semi-pressure	2	3
3)	pressure level	23	38



CONCLUSIONS based on the results of studies of culverts can be made as follows it is necessary to study the state of the water-conducting pipes located on high-speed and high-speed lines and its effect on the structure of the movement. It is necessary to conduct detailed surveys of the condition of culverts for high-speed sections, because pipe failures negatively affect the condition of the track structure and rolling stock.

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