# Technical Conditions and Norms for the Design of Tram Tracks

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**ABSTRACT**
*This article focuses on the design of the first tram track to be built in Samarkand, geodetic surveys, organization and installation of the project, as well as the organization of geodetic works and their accuracy, as well as the selection of the necessary geodetic tools.*

**Introduction.**

The essence of the ongoing reforms in the economy of the republic is to improve the welfare of the population, a radical improvement in the socio-economic situation.

During a visit to the Samarkand region on October 5, 2016, the Acting President of the Republic of Uzbekistan Shavkat Mirziyoyev, having familiarized himself with the road infrastructure of Samarkand, focusing on the need to improve the transport system of the city, he proposed to return the tram to Samarkand, which was in 1947-1973 in order to create amenities for the population and ensuring the ecological cleanliness of the environment.

In accordance with the Decree of the President of the Republic of Uzbekistan dated February 1, 2017 № DP-2748 “On measures to implement the project for the construction of tram lines in the city of Samarkand”, JSC “Uzbekiston temir yullari” in the city of Samarkand Tram tracks with a total length of 39.8 km are being built in stages / 33.32./.

The total length of the tram track under construction at the first stage of the project is 11.4 km, and to date, the construction of the first part of the tram track with a length of 7.2 km has been completed and serves the tram population.

The next part of the construction is the construction of a 5 km tram line from the railway station to the Siab market serving the population. A tram depot was built at the intersection of Rudaki and Gagarin streets.

On April 15, 2017, the President of the Republic of Uzbekistan Shavkat Mirziyoyev, among the first passengers, traveled by Samarkand tram and arrived by tram with regional activists from the Historical Museum station to the Railway Station station /33.34/.

**Aims and objectives of the article.** The purpose of the article is to organize and ensure the accuracy of geodetic work in the design of a tram track, geodetic surveys, design movements and installations, as well as the analysis of geodetic and cartographic materials when choosing the necessary geodetic tools and, based on this, the development of appropriate proposals and the scientific justification for their implementation.

Article objectives. Based on the main goal of the study, the following tasks were set in the dissertation:

1. Types and composition of geodetic works in the construction of tram tracks;

2. Accuracy of geodetic works in the construction of tram tracks and methods for their provision;

3. Types of geodetic instruments that provide geodetic work and appropriate accuracy in the construction of tram tracks.

**Main part**

The width of tram tracks is 10 m with stations, 7 m non-stop, 20 m from residential buildings, 2.8 m from non-residential buildings, 5 m from trees and 1.5 m from bushes. Tram tracks should be designed on a separate track /29/.

For this reason, the maximum slope and minimum turning radius of tram tracks are strictly observed.

Slopes with a small radius of curvature are minimized.

On tram tracks, this reduction is expressed as follows.

$\Delta i = (12.2\varphi^0) / k,$ (1)

where $\varphi^0$ and k – are the angle of rotation and the length of the rotation.

If $K=R\varphi_{pad} = R\varphi^0 / p^0$ , where R is the radius of curvature, $p^0$ – is the degree radian (57.30), then

$$\Delta i = (12.2\, p^0) / R = 700 / R. \quad (2)$$

for instance, $i_r = 20^0/_{00}$ va R= 700m if

$$i = i_r - \Delta I = 20 - (700/700) = 19^0/_{00}.$$

**Requirements for turning curves of tram tracks**

Straight sections are characterized by their length. Curves are represented by such parameters as angle of rotation φ, radius of rotation R, curve length K and tangent T (Figure 1).

These curve parameters are geometrically interconnected. The tangent and length of a curve can be easily found based on a given radius of curvature R and angle of rotation φ:

$$T = R\,tg\frac{\varphi}{2} \quad (3)$$

$$K = \frac{\pi R \varphi}{180} \quad (4)$$

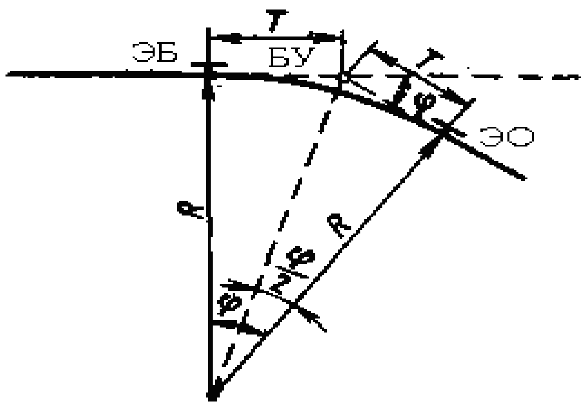


**Figure 1.**

The structure of the turning curve: BC - the beginning of the curve; EC - the end of the curve; TP - turning peak; R is the radius of curvature; φ - angle of rotation.

Turning on tight curves requires a reduction in speed, which causes the rails and wheels of the rolling stock to slide sideways, lengthening the path, increasing resistance to movement and obstructing visibility. The maximum guideline speed in curves depending on the radius of curvature can be found as follows:

$$V_{max} = 4{,}6\sqrt{R} \text{, km/s} \quad (5)$$

Such curves are combined with straight sections using a transition curve to ensure smooth movement of the rolling stock on the radius of curvature.

The radius of the transition curve decreases from infinity ∞ to the radius R of the circle. Adjacent curves are straight sections (taking into account the direction of the curves) with a minimum length of 30 m to 150 m, depending on the level of the road.

The longitudinal profile of the tram is characterized by the slope and length of the individual sections. The height difference between the start and end points of the inclined profile is measured by the ratio ***h*** to the distance ***l*** between these two points and is calculated in thousands. In other words, the slope of the road is the ratio of the angle of inclination of the road to the horizon, that is, the tangent of the angle ***ά***. As shown in Figure 2, the slope creates additional resistance to tram traffic when overcoming the rise:

$$W_i = Q \cdot \sin\alpha \approx Q \cdot tg\alpha = Q \cdot i \cdot 10^{-3}, \quad (6)$$

where

$Q$ – tram weight;

$i$ - thousandth of ascents

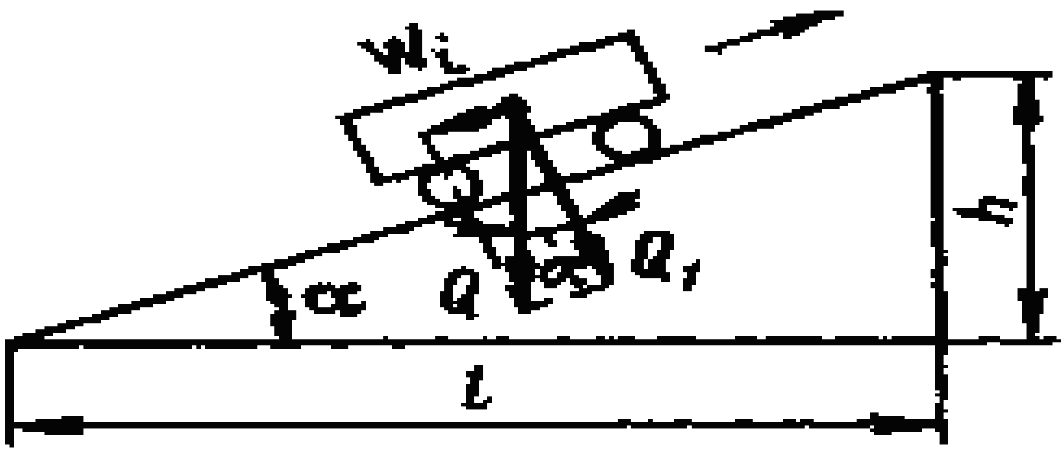


Figure 2. Slope calculation scheme

**Conclusion.**

This article is devoted to the organization and accuracy of geodetic work in the design of a tram under construction in the city of Samarkand, geodetic surveys, project relocation and installation, as well as surveying, on the basis of which the following conclusions can be drawn:

When designing and building a tram track, the following technical conditions and norms must be provided:

- The width of tram tracks is 10 m with stations, 7 m non-stop, 20 m from residential buildings, 2.8 m from non-residential buildings, 5 m from trees and 1.5 m from bushes;
- Calculation of tram tracks for a separate corridor, the slope of the carriageway with a cement-asphalt concrete pavement 15-200/00, for gravel roads 20-300/00, on roads with one-way traffic, the pavement width is 5.8 - .5 m and 10 m on roads with two-way traffic;

**References:**

1. Read more: https://sputniknews- uz.com/sociyety/20170416/5204869/ Mirziyoyev-Samarqand-tramvay.html.
2. On April 15, President of Uzbekistan Shavkat Mirziyoyev was among the first passengers to use the Samarkand tram. TASHKENT, April 16 - Sputnik. Tram traffic in Samarkand.
3. Dostmukhamedov M.Yu. "The engineering geodesy". Uzbekistan. 1998.
4. Muborakov X. “Geodeziya”. Toshkent. “Cho’lpon”. 2007.
5. Muborakov X. "Geodesy". Tashkent. "Cholpon". 2007.
6. www.literature.uz - literary site.
7. www.pedagog.uz - pedagogy website.