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CLASSIFICATION OF THE GEOMETRY OF ROADWAYS AND RAILWAYS

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Key words: *road geometry, cubic parabola, clothoid, curve, roadways and railways*
Abstract: *In transportation civil engineering a variety of transition curves are used-cubic parabola, clothoid, Bloss, sinusoidal curve, etc. Knowing different geometry of the roadways and railways is from great importance for their design and reconstruction. When reconstructing roadways and railways it is necessary to carry out measurements to determine the length of straight sections and the radius of curves, etc. The results obtained from measurements can be filtered with digital filters and interpolated using splines. This work presents full classification of existing road and railway geometry.*

1. GEOMETRY OF ROADWAYS AND RAILWAYS

The reconstruction of the railways and roadways is impossible without the creation of a geodetic network close to them. The construction of the geodetic network can be carried out only by GPS, or only with a total station. From this network geodetic surveys are measurements of the railway axis with angle and distance from the nearest station of the geodetic network to the points of the roadway (railway). During construction works of roadways and railways is necessary to monitor the deformation of unstable terrain and control of alignment geometry. The deformation of roadways and railways are most often associated with landslides, mining, salt deposits near them, etc. Changes in the straight part and curves can be detected by the GNSS method. Mobile measurement platforms are the most used methods and applied measurement techniques are mobile satellite measurements [1]. The track geometry components as alignment, cant and gauge are measured directly with trolleys and recorded in real-time. GPS measurements of the railway are usually carried out using the RTK method. The deviation between the design and the measured position of the railway makes it possible to assess the quality of the geometry of the route. For the roadway and railway measurements and quality assessment are using different methods, models and instrumentation [2,3].When reconstructing roadways it's necessary to perform measurements to determine the length of straight sections and the radius of the horizontal curves of the road, degree of curvature, etc. The use of GNSS receivers is able to give automatically centimeter and higher accuracy in determining the geometry of the roadway. This technology opens up new possibilities for control measurements not only of the roadways, but also of the railways. High absolute GPS accuracy can be combined with high relative INS in times of system outages and thus to enhance navigation systems applicability. In addition to GNSS receivers,

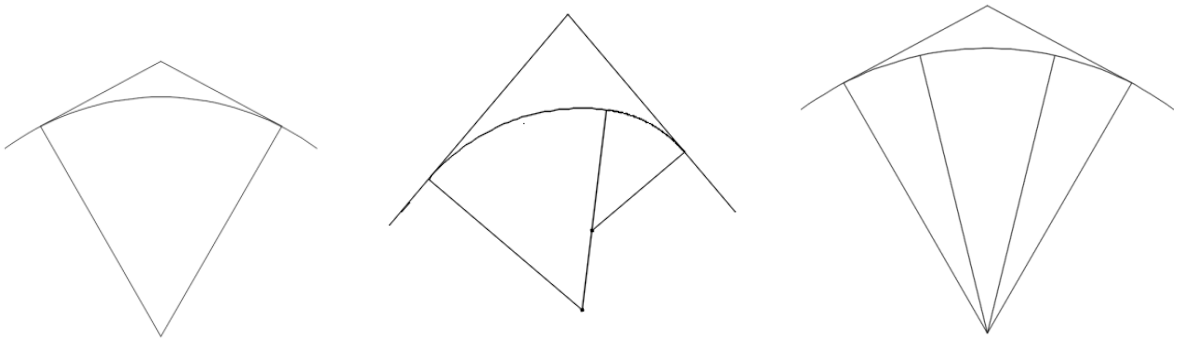
inertial navigation systems (INS) are often used to determine the geometry of the roadway. They guarantee the continuity of the data received. Photogrammetric, barometric, inclinometric measurements, etc., are performed together with the satellite measurements. Laser scanners are applied intensively for geodetic surveys [4,5,6]. The used mathematical methods allow besides the radius of the curves (horizontal and vertical) to determine also the radius of curvature, the longitudinal and transverse slope, the existing road signs in the measured road section, visibility in a curve, width of the roadway, etc. Integrated measuring systems use electronic sensors to obtain the information necessary to determine the geometrical characteristics of the roads–horizontal and vertical radius, grade, etc., derived from sensors (GPS, accelerometers, gyros, odometer, laser scanners, etc.). The appropriate inertial measurement systems and hardware implementation are presented in [7]. The combination of the different sensors is accomplished with a Kalman filter algorithm.

2. CLASSIFICATION OF THE GEOMETRY OF ROADWAYS AND RAILWAYS

Horizontal alignment, vertical alignment and cross-section are the three fundamental components of the roadway and railway geometry. The horizontal alignment of the roads consists of straight lines, transition curves, circular arcs, etc. In transportation civil engineering, a variety of transition curves are used. The different types of transition curves are cubic spiral, clothoid, Bloss, sinusoidal curve, etc., [8]. Knowing different geometry of the roadways and railways is from great importance for their design and reconstruction and improve their transportation and operational performance. Horizontal curves may be: reverse, spiral, circular, compound, broken back, deviation, etc. The elements of a circular curve are straight lines and arc between them. Compound curves consist of two or more circular curves with different radii (Fig.1). The reverse curves are two circular curves in opposite directions with a straight in placed (or not placed) between them (Fig.2). The Broken Back Circular curves are two circular curves with different radii with a straight placed (or not placed) between them (Fig.3). A deviation curve is a combination of two reverse curves (Fig.4). Deviation curve is used to avoid obstructions along the route of the road. The geometry of the roadway can be of different types–horizontal and vertical curves. An artificial neural network (ANN) can be used to classify the road data into different road geometries [9]. Additional information for the assessment of the railway and road accidents e.g. place of derails in straight line, curve, ets., is necessary for the expertise [10,11].

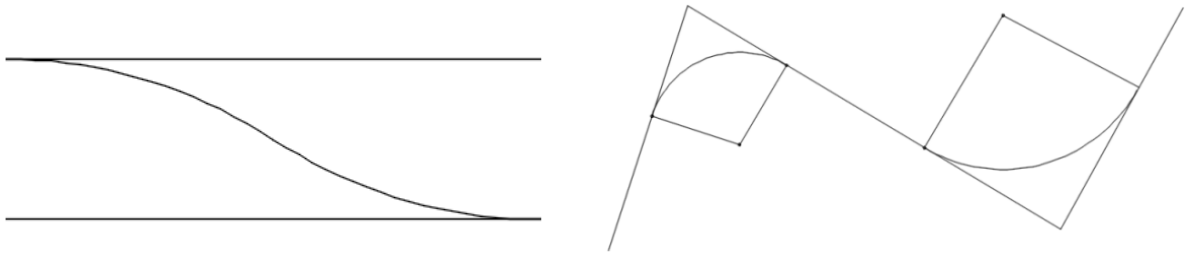
In the practice, the geometry of roadways and railways is often a combination of different types of curves used in roundabouts and railway station tracks [12,13,14]. The full classification of existing road and railway geometry is:

a.) Horizontal curves



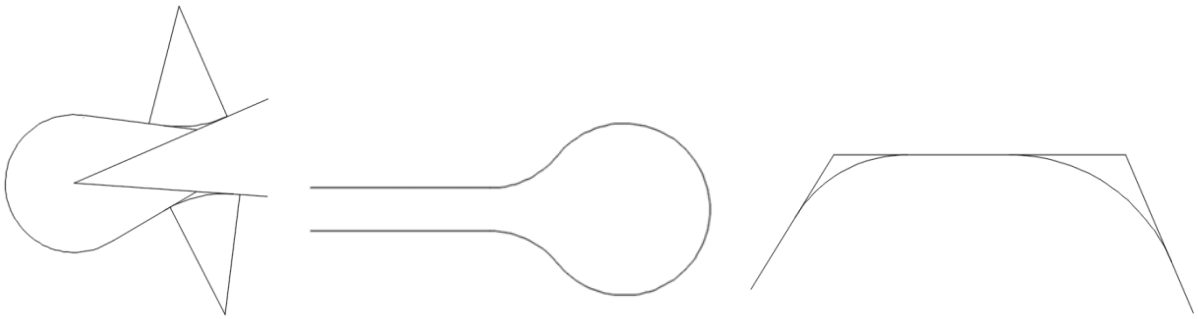
Simple (circular) curve Compound curve Transition (spiral) curve

Fig.1



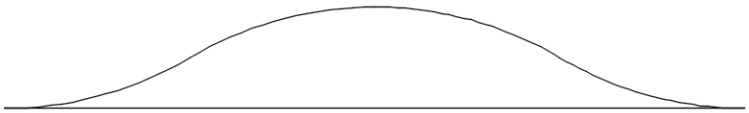
Reverse curves

Fig.2



Serpentine curve Cul de sac Broken–back curve

Fig.3



Deviation curve

Fig.4

b.) Vertical curves

Vertical curves are used to ensure smooth transition between tangents of the vertical alignment of roadways and railways. They are crest or sag curves (Fig.5).

Fig.5

c.) Cross sections

Typical cross sections are standard and they are fill, cut and cut/fill (Fig.6).

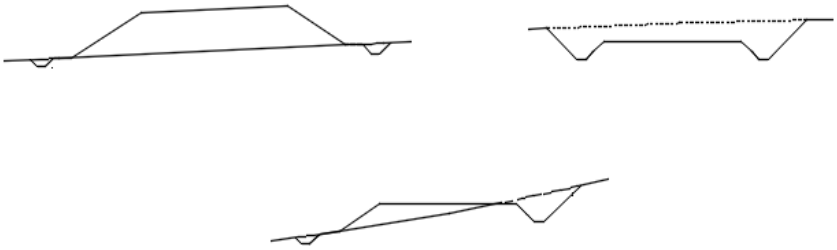


Fig.6

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