Project Solution in Designing Communications and Routes for Fieldwork

Rješenje projekta kod dizajniranja komunikacija i ruta za rad na terenu

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Summary

This paper is focused on the application of descriptive geometry methods on the construction of several types of communications. Project solution in designing communications and routes for fieldwork is illustrated on examples. The examples are presented by figures and description of procedure. In the paper there is presented construction of horizontal, straight rising communication, horizontal curved communication, direct evenly ascending communication, direct disproportionately ascending communication and disproportionately ascending curved communication.

KEY WORDS
excavation
embarkments
communication

Sažetak

Ovaj članak se fokusira na primjenu metoda opisne geometrije na konstrukciju različitih tipova komunikacija. Rješenje problema kod dizajniranja komunikacija i ruta za rad na terenu ilustrira se na primjerima. Primjeri su prikazani brojevima i opisom procedure. U članku je prikazana konstrukcija horizontalne izravne rastuće komunikacije, horizontalno zakrivljene komunikacije, izravne ravnomjerno rastuće komunikacije, izravne neproporcionalno rastuće komunikacije i neproporcionalno rastuće zakrivljene komunikacije.

KLJUČNE RIJEČI
iskopavanje
ukrcavanje
komunikacija

1. INTRODUCTION

One of the most well-known logistical problems is planning and construction of routes. From time immemorial. the roads were planned as a connection of great human settlements. In terms of human history of routes construction (from Latin: *viae*; singular: *via* meaning way) it occurred at the time of the ancient Roman Empire massively in all parts of the empire. For more details about ancient roman roads. we recommend [1].

Roman roads were physical infrastructure crucial to the development and maintenance of the large area of the Roman Empire. They provided efficient means for the overland movement of armies (to bordering territories), officials, civilians and the inland carriage of official communication and trade goods. Roman roads were of several kinds, ranging from small routes of local character to broad, long-distance "highways" built to connect great settlements (cities, major towns), military bases and ports. Well-known Via Appia leads from Rome to the port of Brindisi. A lot of ancient roman *viae* pass through coastal cities (Genua, Ariminum, Ancona, Messana, Syracusae, Marseille etc.).

These major roads were often stone-paved and metaled. The ancient roads were built so well that many of them persist to the present day.

Note that: "At the peak of Rome's development, no fewer than 29 great military highways radiated from the capital, and the late Empire's 113 provinces were interconnected by 372 great roads. The whole comprised more than 400,000 km of roads, of which over 80,500 kilometres (50,000 mi) were stone-paved. In Gaul alone, no less than 21 000 kilometres (13 000 mi) of roadways are said to have been improved, and in Britain at least 4,000 kilometres (2,500 mi). The courses (and sometimes the surfaces) of many Roman roads survived for millennia. Some are overlaid by modern roads" [1].

Nowadays. the logistic problems do not comprise only planning of the routes and communications. The current logistic problems are more variable [2-7].

In this paper we study how to project some types of communications and routes. Now to clarify some terms. The *slope of the line* is tangent of deviation from a straight line to projection plane. The *slope of the incline plane* is slope of the slope line of a plane of projection. The *slope line of the incline plane* is a straight line lying in the incline plane with maximal deviation to the projected line. It is perpendicular to the contour lines of the incline plane. This angle is projected as a right. The *zero line* is the intersection of the surface topography and surface of communication. Boundaries of the excavations and the embankments are based on the intersection of the zero line of communication with the road verges. *Interval of the line* is the distance between two points diameter line with a difference equal to one dimension. The interval of the line is equal to the reciprocal number of the slope of the line. For more details about descriptive geometry. we recommend [8], [9].

2. HORIZONTAL STRAIGHT RISING COMMUNICATION

Figure 1 shows how to make excavations and embankments of horizontal straight rising communication. The communication has level 202 and width 5 metres in the topography surface. The axis of given communication is plotted in a dot-dashes line. The slope of the embankment is and the slope of the . The scale of the plane is *1:500*. Calculation: the width of the communication in given scale , interval of the embankment , in given scale , interval of the excavation , in given scale .

The zero line (see Figure 1) is created by a contour of topography surface in the same dimension as a proposed communication (i.e. dimension 202 m). As we can see in the Figure 1 there is an embankment under the zero line and an excavation above the zero line.

The contour lines of the embankments and the excavations are parallel with the road verge with the dimension of 208. The distance between bordering contour lines is 7.5 mm, resp. 5 mm. The slope scale of the embankments and the excavations are drawn as a double line. The arrow shows the direction of an ascending plane of the embankment and the excavation. A border of the embankment and the excavation creates a line which connects intersection points of the contour lines of the embankment or the excavation with contour lines of a topography surface in the same dimension.

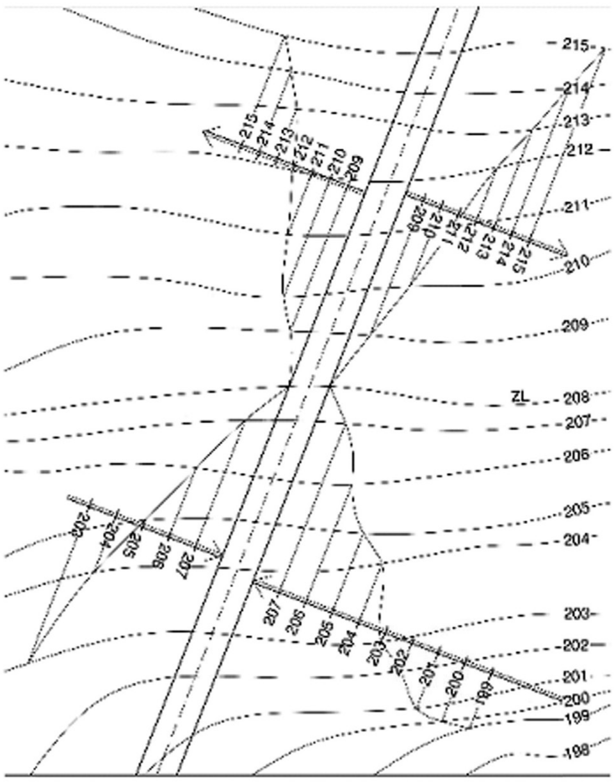

Figure 1 Horizontal straight rising communication

There is a special case when the dimension of the communication differs from the dimension of all contour lines. We must construct zero line by the method of linear interpolation (see next chapter). We suppose that the terrain between the nearest two contour lines is linear. We use this method often in case of linear interpolation if the intersection points of the embankment contour lines or the excavation with topography surface contour lines are very distant from each other.

3. LINEAR INTERPOLATION

Let us demonstrate in this chapter linear interpolation on a concrete example: linear interpolation between the contour lines with dimensions 208 and 209 in a topography surface. We construct segment lines which are almost perpendicular to both contour lines. For the construction of the perpendicular line to two parallel lines we use compasses and a scale (see Figure 2a). On the line with dimension 209, there is a point S which is a centre of the circle. The circle has a radius greater than the distance of the parallel lines. Points 1 and 2 (Figure 2a) represent intersections of the circle and the line with dimension 208. On line 209, there is a point 3 with the same distance to points 1 and 2. Then the line, which contains the points S and 3, is perpendicular to lines 208 and 209.

In Figure 2b, there is a construction of the contour line of dimension 208,5. We make bisection of the above lines only by scale. Precise construction is not necessary. Note that we suppose that the terrain is linear.

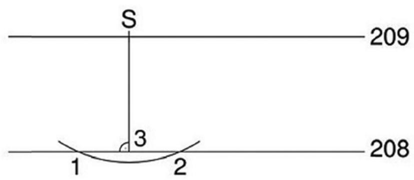

Figure 2a Linear interpolation

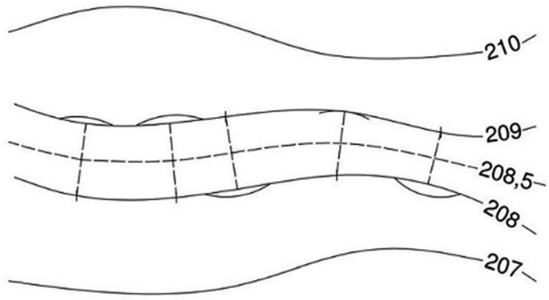

Figure 2b Linear interpolation

4. HORIZONTAL CURVED COMMUNICATION

We project horizontal curved communication of dimension 208 with the same scale as in the previous situation. The planes of the embankment and the excavation change to cone surface and the distances of contour lines are not altered. For better understanding, the cross-sections are drawn. In Figure 3, there are cross-sections by planes ρ and σ. The planes are downcast to the dimension 208.

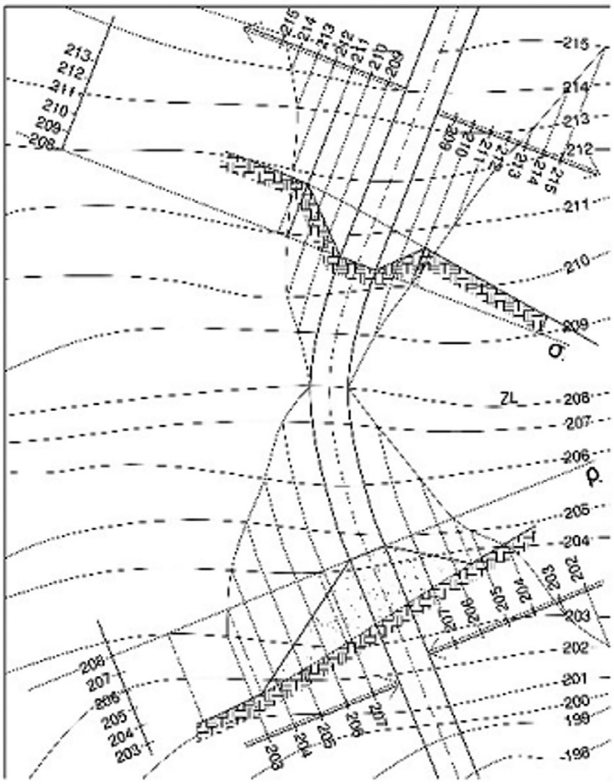

Figure 3 Horizontal curved communication

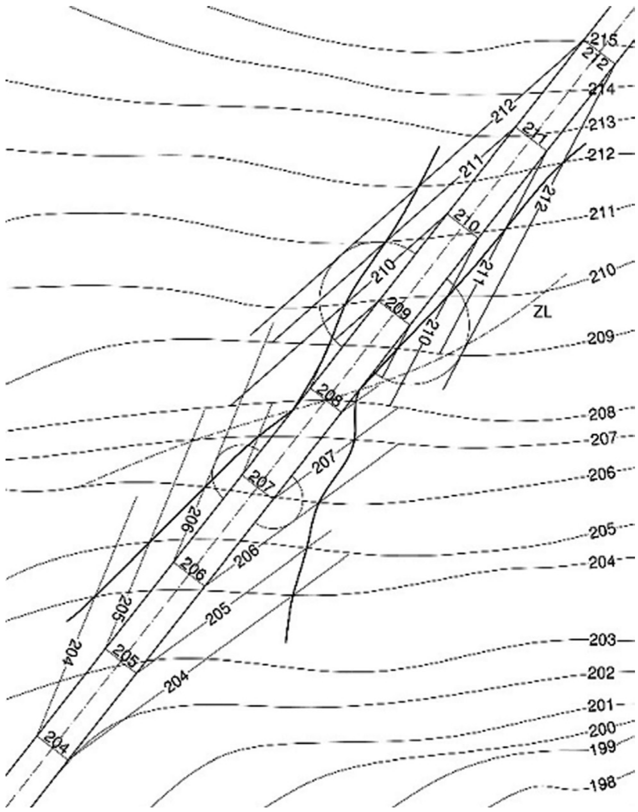

Figure 4 Direct evenly ascending communications

5. DIRECT EVENLY ASCENDING COMMUNICATION

In Figure 4, we project direct evenly ascending communication with the same width and scale as in the previous situations.

We create the Zero line (noted ZL) as the intersection of the communication (plane of the road) and the terrain. In the place of intersection of zero line with the road verges, the border of the embankment and the excavation can be easily seen. In Figure 4 there are embankments under the zero line and excavation above the zero line (dimension of contour lines).

The direction of contour lines of the embankment is constructed as follows: on road verges with dimension 207 there we draw half-circles with radius of the interval of the embarkment (7.5 mm), on the road verges with next dimension 206 we draw perpendicular lines (it is not necessary to use the Thalet´s circle because topographic surface is only an approximate image of the Earth´s surface). The parallels are passing through the points on the road verges with dimensions 204, 205 and 207, and the distance between nearby parallels is 7.5 mm.

In similar way, we can draw a contour line of the excavation but the distance must be changed to 5 mm. But the designation of the contour lines direction of the excavation is made by constructing half-circles with the radius of 15 mm (3 times the interval of the excavation) on the road verges with dimension 209. The perpendicular lines come from the road verges with dimension plus 3 (i.e. 212). At points on the road verges with dimensions 211, 210 and 209, parallel lines with distance 5 mm are drawn.

6. DIRECT DISPROPORTIONATELY ASCENDING COMMUNICATION

In Figure 5, we construct a direct disproportionately ascending communication with the same width and scale as in previous situations. Zero line (noted ZL) is again constructed as the intersection of the communication and the terrain. In Figure 5, there is an embankment under the zero line and an excavation above the zero line as in the previous situations.

The contour lines of the embankment and the excavation are constructed as envelope curve of the circles with radiuses of one times, two times, three times, … the interval of the embankment or the excavation. For example: the contour line of the embankment with dimension 204 is envelope curve of circles with radiuses 7.5 mm (in 205); 15 mm (in 206); 22.5 mm (in 207). The contour line of the excavation with dimension 211 is envelope curve of circles with radiuses 5 mm (in 210); 10 mm (in 209).

7. DISPROPORTIONATELY ASCENDING CURVED COMMUNICATION

In Figure 6, we present disproportionately ascending curved communication with the same width and scale as in previous situations. Zero line is missing because the whole road is above the terrain. In Figure 6, there is the embankment only. The construction is executed in similar way as in the previous part. We find contour lines by application of the envelope curve. The contour line of the embankment with dimension 207 is envelope curve of circles with radiuses 7.5 mm (in 208); 15 mm (in 209); 22.5 mm (in 210).

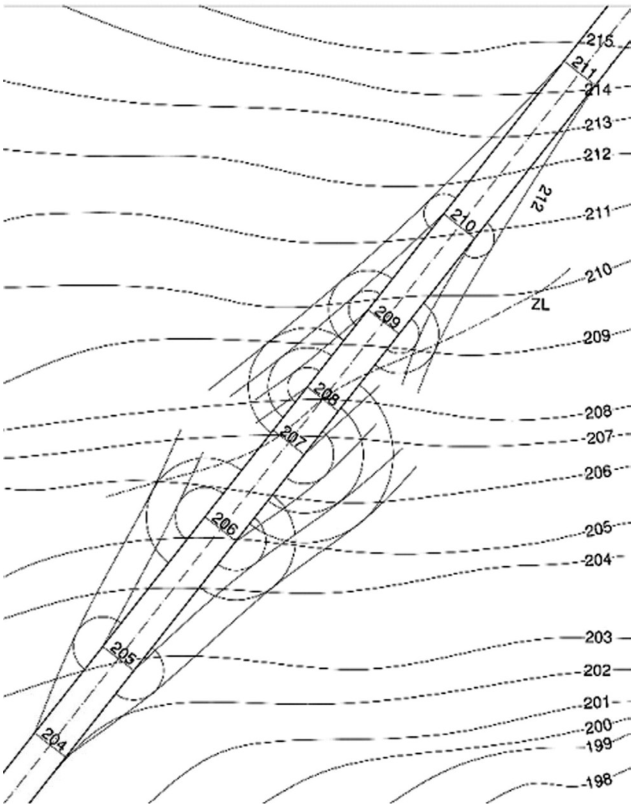

Figure 5 Direct disproportionately ascending communications

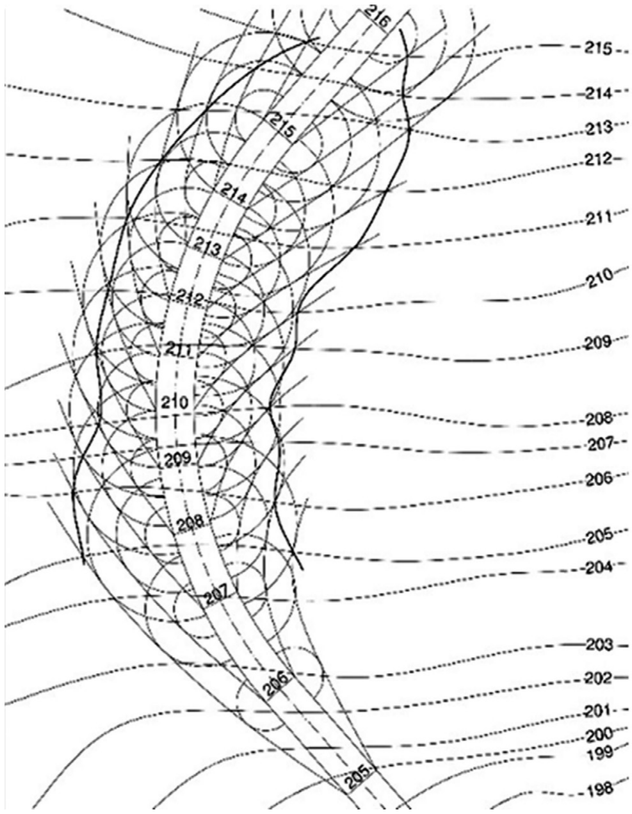

Figure 6 Disproportionately ascending curved communication

8. CONCLUSION

In planning and construction of communications and routes, we utilize methods of descriptive geometry [8], [9]. The methods are applied to several types of communications.

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