TOPOGRAPHIC PROJECTION IN AMERICAN DESCRIPTIVE GEOMETRY WORKBOOKS

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Abstract: The term 'topographic projection' corresponding to Polish 'rzut cechowany', Russian 'проекция с числовой отметкой', German 'Kotierte Projektion', Italian 'proiezioni quotate' or French 'géométrie cotée' cannot be found in American workbooks. This paper discusses the American proposition of a lecture of the theory and application of the section, which is equivalent to the topographic projection and its application.

Keywords: topographic projection, bearing of line, slope of a line, contour lines

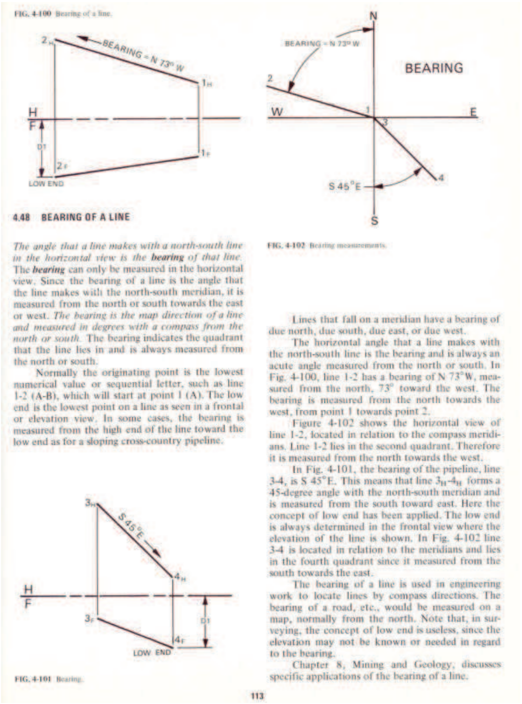
The paper is dedicated to the memory of Professor Marian Palej (1923-2001) in his 90th birthday anniversary.

1 Introduction

The term *topographic projection* corresponding to Polish *rzut cechowany*, Russian *проекция с числовой отметкой* [1], German *Kotierte Projektion* [7], Italian *proiezioni quotate* [3] or French *géométrie cotée* [2] cannot be found in American workbooks and in the internet. Formally, American authors do not introduce and distinguish the projection in question and its basic terminology. However, it is not completely true. Why? Some differences between American and Polish Descriptive Geometry workbooks was discussed at the article [4], but the author does not explain why American authors do not discuss separately the topographic projection.

2 Slope and bearing of line and other determinants of American viewpoint of lecture of Descriptive Geometry

The entity of topographic projection and its application in American workbooks is introduced at the beginning of the orthographic projection onto two projective planes (Monge projection). Luis G. Lamit [6] already introduces the terms *azimuth bearing of a line* and *slope of a line* (*grade of a line*) on page 113 of his 450-page monograph (cf. Fig. 1a and 1b). Steve M. Slaby [8] makes this reference even earlier, because these terms appear on page 29 of his 350-page workbook. Similarly, F.W. Warner and M. McNeary [9], apart from the basic types of line projection: *horizontal*, *frontal*, *profile*, use the terms: the mapping of *contour lines* of a surface and meaning of azimuth bearing of a line on page 20 of their 250-page monograph devoted to the application of Descriptive Geometry. However, the latter book is devoted to the application of Descriptive Geometry, but we do not find there the basic terminology concerning the topographic projection from the traditional European view point.



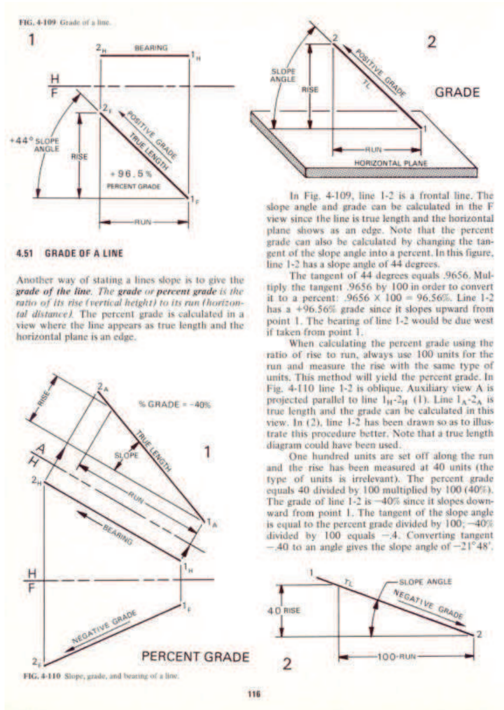


Figure 1a: The azimuth bearing of a line defined by the orthographic projection (two-sheet Monge method) explained on page113 of the Luis G. Lamit workbook [6]

Figure 1b: The slope of a line defined by the orthographic projection (two-sheet Monge method) explained on page 114 ([6])

In particular, the American authors in their workbooks do not mention the so called interval of a line and a plane. Such a term cannot be found. Searching for any equivalent of the interval we can find the term *run* (*horizontal distance*). Therefore the *grade* or *percent grade* of the line is the ratio of its *rise* (*vertical height*) to its *run*. The percent grade is calculated in a view where the line appears as true length and the horizontal plane is an edge (Fig. 1, p. 116, top, left side – third angle projection). If the line is in another position (not frontal), then the author [6] uses transformation into primary auxiliary view (Fig. 1, p. 116, bottom, left side – third angle projection).

This paper discusses the American proposition of a lecture of the theory and application of the section, which is equivalent to the topographic projection and its application. This is all preparation for the implementation of the topographic projection, which is the realization of an explicit begin when discussing the problems of mining and geology. So let's look at the introduction to the chapter devoted to this question.

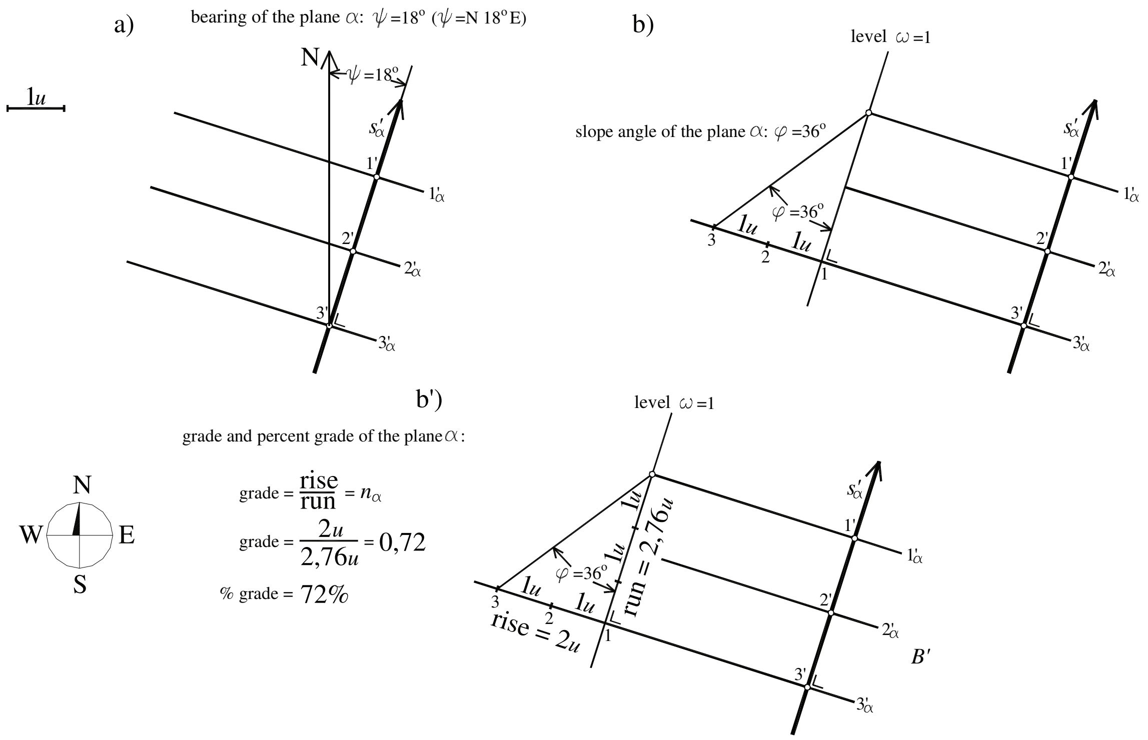


Figure 2: The description of the azimuth bearing and slope of a line defined in the author's lecture for the ERASMUS students [5]

On page 354, at the beginning of section 8 *Mining and geology*, in the subsection titled *Mining and topographic applications*, G. Lamit writes „The principles of orthographic projection are used continually in the real world of engineering construction and mining. Topographical and mining problems involving land contours, surface and subsurface earthwork and their specific applications in construction technologies utilize a variety of descriptive geometry principals, practices, and procedures in their solutions… [6]" and publishes the drawing represented in Figure 3. So in this section the first realizations of topographic projection disappear. Author introduces two notions: contour maps and plan-profiles based on a topographic map (obtained from a surveyor's topographical notes and calculations or an aerial photo survey) using the Monge's method. Contours are curves of intersection of a series of evenly spaced horizontal cutting planes and the ground surface (earth's surface). Therefore each contour line represents the horizontal projection of a line (usually curvilinear) on the earth's surface at a particular level. Note that this is the slice-based approach to the representation of the geometric solid (cf. [6]). This particular level is defined by height relative to sea level, and here is where the *cote* of a point (however, the author does not introduce the name "cote"). The frontal view is called a profile since it shows the „profile" of the ground's surface.

3 Why is there no topographic projection in American handbooks?

The answer comes as a result of the analysis of the approach discussing orthogonal projections (with two or more projection planes) based on continuous use of auxiliary projection planes, i.e. practicing geometry position relative to the projection planes (Fig. 4).

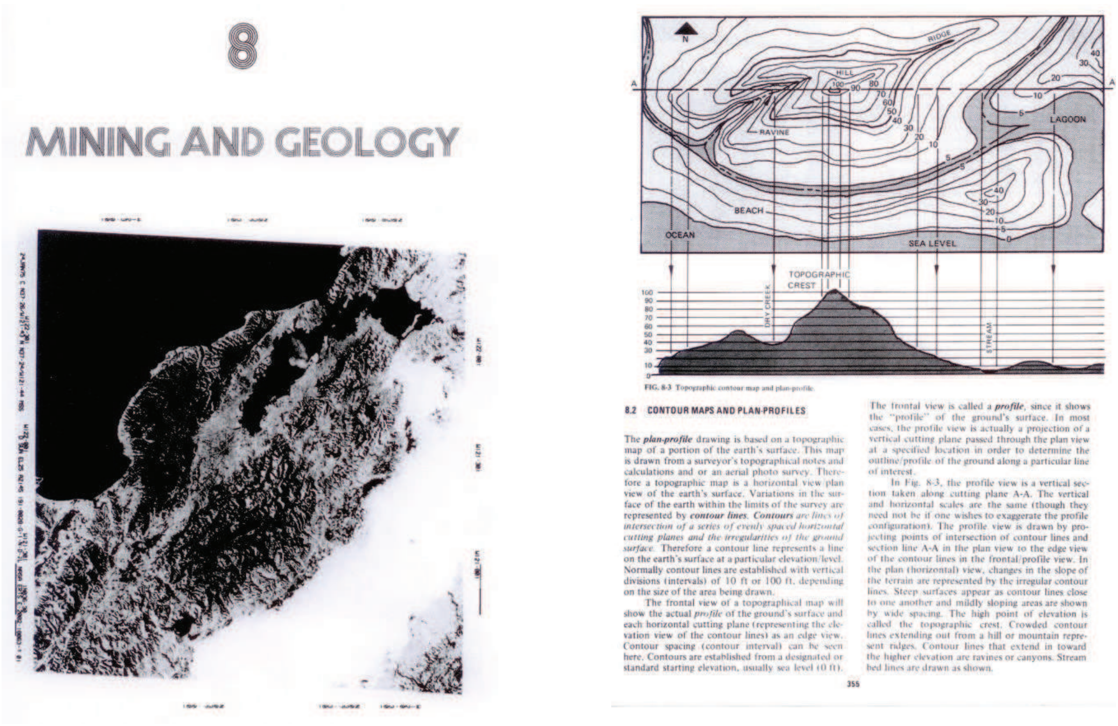
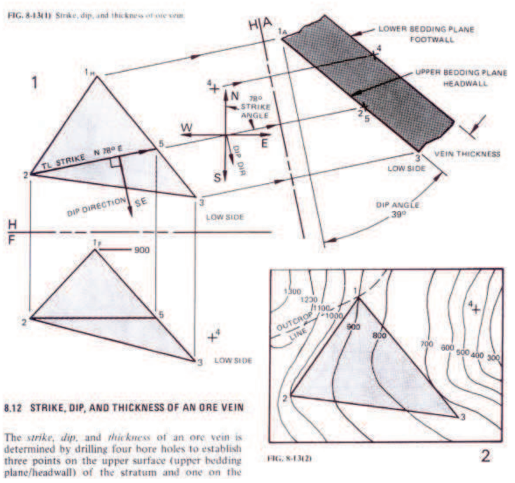


Figure 3: The beginning of the mining and geology section explained on pages 353 and 355 of the Luis G. Lamit workbook [6]

And that is the essence of topographic projection. In handbooks there is no concept of a revolved section, and all tasks are solved by the transformation of projection planes, and the problems in the context of topographic projection are related to the use of projections on the two projection planes. This point of view is not surprising if we accept the fact that the topographic projection is really a plan view of the two projection planes, where the elevation of a point is highlighted instead of the vertical projection (hence the distance from the horizontal projection plane), expressed as a measurement in the accepted unit.



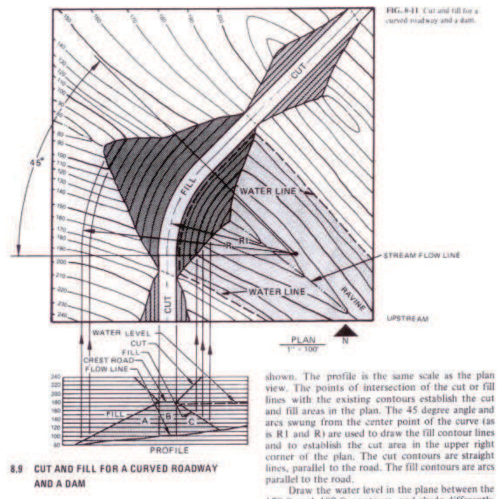


Figure 4: Strike, dip, and thickness of an ore vein is determined using auxiliary elevation views (transformation of projection planes methods in Polish terminology) ([6], p. 369)

Figure 5: Cut and fill for a curved roadway and a dam ([6], p. 364) is realized by the orthographic projection (the two-sheet Monge method)

4 Conclusions

The entity of topographic projection and its application in American workbooks is introduced at the beginning of the orthographic projection onto two projective planes (Monge projection) and this concept is included in the whole lecture of the orthogonal projection method. The tasks are solved by the transformation of projection planes, and the problems related to the topographic projection appear as examples of orthogonal projection (onto two projection planes) in the technique.

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RZUT CECHOWANY W AMERYKAŃSKICH PODRĘCZNIKACH Z GEOMETRII WYKREŚLNEJ

Próżno poszukiwać w amerykańskich podręcznikach geometrii, na stronach internetowych, terminu odpowiadającego naszemu 'rzut cechowany', rosyjskiemu 'проекция с числовой отметкой' niemieckiemu 'Kotierte Projektion', włoskiemu 'proiezioni quotate' czy francuskiemu 'géométrie cotée'. Amerykanie formalnie nie wprowadzają rzutu cechowanego i jego podstawowej terminologii jako oddzielnej klasy rzutowania, ale tylko pozornie nie mówią na ten temat. Dlaczego? Odpowiedź przychodzi w następstwie analizy przyjętej koncepcji omawiania rzutów prostokątnych na dwie (i więcej rzutni) polegającej na ciągłym posługiwaniu się rzutniami pomocniczymi, czyli uprawiania geometrii położenia w stosunku do rzutni. W podręcznikach nie występuje bowiem pojęcie kładu, a wszystkie zadania rozwiązywane są metodą transformacji, zaś problemy w rozumieniu rzutu cechowanego pojawiają się jako przykłady zastosowania rzutów na dwie rzutnie w technice.