The Foundations of Constructions in Dobrogea—Romania, on Water Sensitive Soils, Loess

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Abstract
This article presents the geotechnical characteristics of loess, wetting sensitive soil in Dobrogea. These lands are of Quaternary age, are found just below the topsoil and most buildings are founded on it. Problems can arise when the foundation on these lands is due to any softening of foundation soil with water from different sources, permanent or casual. It will present the parameters of geotechnical solutions for improvement when appropriate.

Keywords
Loess • Foundation • Dobrogea • Sensitive soil

11.1 Introduction

The loess is a category featured among continental, Quaternary, sedimentary formations.

The name loess was introduced in 1834 by C. Lyell, coming from the German *lose* or *loss,* used in Rhineland, with the meaning of loose, porous, brittle. Loess lands occupy about 10 % of the entire surface of the continents, a spread of loess in the world is shown in Fig. 11.1a, b, North America and China, and in Fig. 11.2 in Europe.

Loess deposits in Romania occupies an area representing 17 % of the entire country. In Dobrogea there are areas where loess thickness is up to 60 m.

11.2 Properties of Loess

Most buildings in Dobrogea are founded on loess and loess soils, hence the need to understand the behavior of these soils and changes in terms of land and loads on which the construction transmits it.

The minimum and maximum values of geotechnical parameters of loess, in the natural state, in the Dobrogea area are listed in Table 11.1.

11.3 The Collapse Risk of the Loess

Problems can arise when the foundation on these regions is due to any softening of foundation soil with water from different sources, permanent or casual.

Because of the extra moisture, the loess can become collapsible.

Depending on the behavior of the loess, increasing of moisture content it has been classified in two categories:

(A) lands which not settles under the geological load, but of deformation under the influence of the loads transmitted by the construction, are not in risk of collapsing.

(B) lands which settles in geological load, they may be in risk of collapsing.

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G. Lollino et al. (eds.), *Engineering Geology for Society and Territory – Volume 6*,
DOI: 10.1007/978-3-319-09060-3_11,

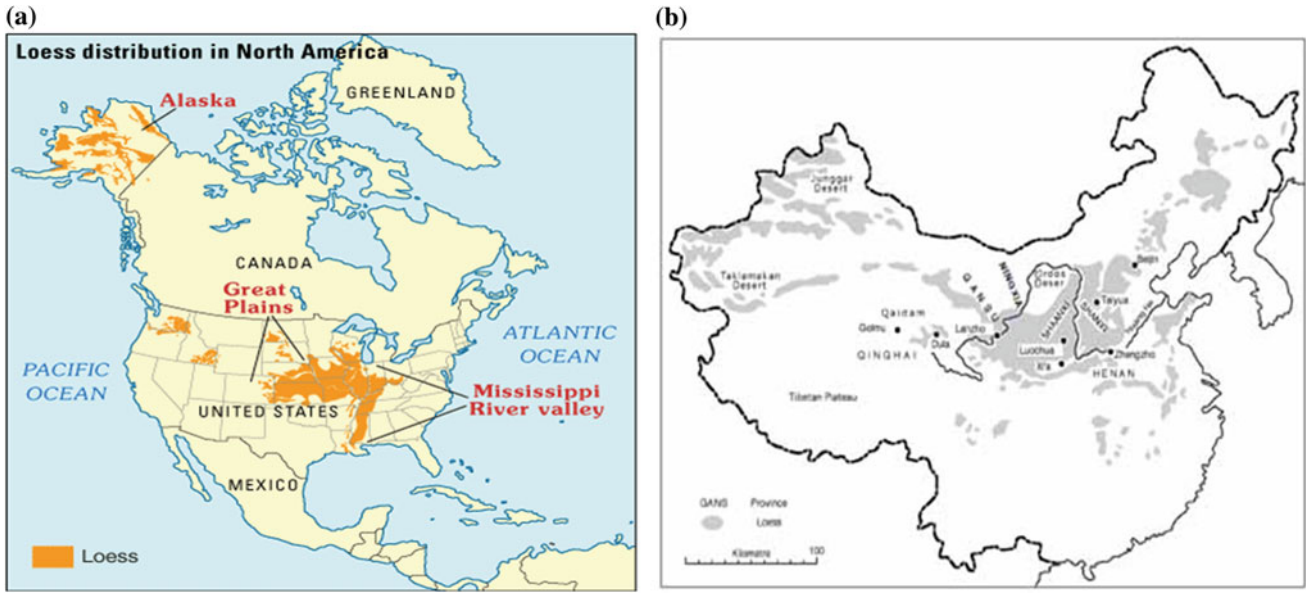

Fig. 11.1 Loess distribution. **a** In America de Nord. **b** China (*source* http://gec.cr.usgs.gov)

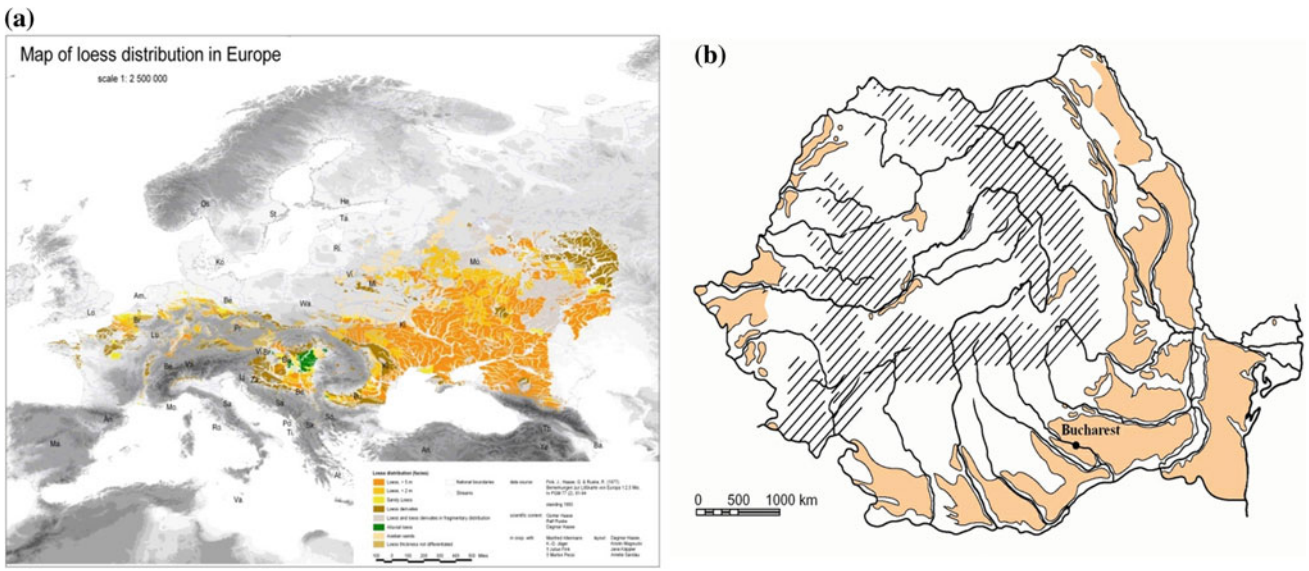

Fig. 11.2 Loess distribution (*source* Dagmar Haase/UFZ). **a** Europe. **b** Romania

Table 11.1 The minimum and maximum values of geotechnical parameters

Param	Clay (%)	Silt (%)	Sand (%)	w_L (%)	w_P (%)	w (%)	n (%)	Sr (%)	M2-3 (daN/cmp)	im3 (cm/m)	ϕ (grade)	c (kPa)
Min	14	50	3	32	12	7.8	46	0.4	18.7	0.6	5	5
Max	29	80	18	40	17	28.5	54	1	107	15	30	48

In order to make a correct classification of a soil, a comprehensive analysis of all the following parameters are required:

- parameters defining its composition and physical properties (granulometry, porosity);
- mechanical parameters: values of the index of the specific subsidence by wetting below the mark of 300 kPa and the structural strength obtained from endometrium testing;
- the thickness of loess, found in the history of the works from the area.

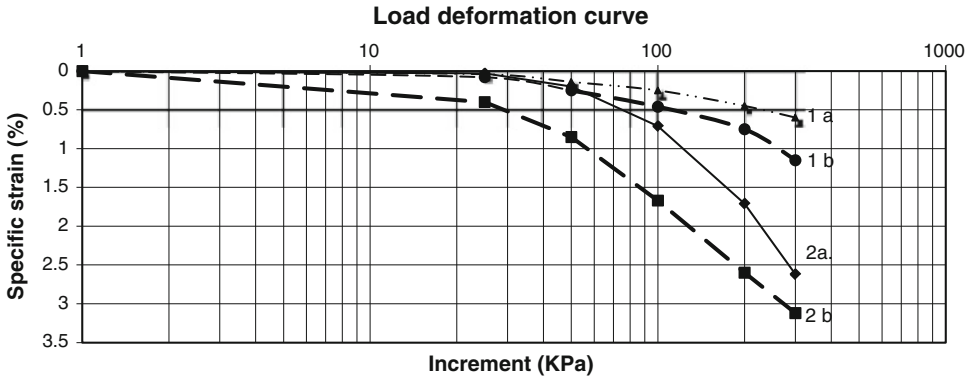

Fig. 11.3 Diagrams of compression subsidence

In the Dobrogea region loess of both categories occur, and their structural strength is based on the category they fall into: for 25–60 kPa is loess of category B and for 80–100 kPa is loess of category A.

In Fig. 11.3 are presented the diagrams of compression subsidence for the loesses with a low porosity, soil denoted by 1 and loesses with a high porosity, denoted by 2; (a) samples with natural moisture and (b) samples that were previously flooded.

11.4 Foundation Solutions

To ensure the normal behavior of buildings founded on land susceptible to wetting, there is a need for rational foundation systems and appropriate measures to avoid flooding of the foundation soil, both during and after construction. The humidity action on soils susceptible to wetting must be viewed from two perspectives, namely: the reduction in the bearing capacity and the growth of settlements under construction load transmitted (additional subsidence due to moisture). The foundation solutions are adopted according to the nature of the soil foundation, the hydrostatic level and construction characteristics:

- direct foundation on loess;
- foundation reinforced trough layers of cohesive soils (loess, loess lined with various waterproofing solutions, loess mixed with cement or lime);
- loess consolidation by intensive compaction (hard mallet and super hard) or with different injection solutions, heat treatment;
- adopting a foundation system that exceed sensitive soil layer wetting (deep foundations, piles, columns, etc.) and that are embedded in the insensitive wetting layer.

11.5 Conclusions

The infrastructure and construction on land susceptible to collapse under wetting have created problems. Their stability is not problematic under natural field conditions, but problems can arise if there are additional moistening that can cause deformations of buildings located on these moisted lands.

The special character of these lands is reflected in the fact that for them has been developed a normative—NP 125:2010 "Normative for foundation of construction on land susceptible to wetting". This legislation provides elements for identification, classification, conditions that have to be taken into account in designing, the recommended constructive and operation measures, maintenance and monitoring of buildings and facilities located on such lands.

References

Andrei S et al. La systematisation, le stockage et la reutilisation de informations geotechniques. Principe d' organisation d'une banque des donnees geotechniq

Andrei S et al (2006) The systematization and storing methods of information concerning the geotechnical parameters. XIII Danube European conference on geotechnical engineering, Ljubljana

Cazacu GB Contributions concerning the methods of establishing of geotechnical parameters of soils moisture sensitivity, Ph.D. thesis

Dianu VD (1982) Loess deposits as founding soils. Editura Tehnica

Ferreira RC, Monteiro LB (1985) Identification and evaluation of collapsibility of colluvial soils that occur in the Sao Paulo State. First international conference on geomechanics in tropical lateritic and saprolitic soils, vol I, Brazilia, pp 269–280

Muhs DR (2006) Late quaternary loess in northeastern Colorado: part I-age and paleoclimatic significance. Geol Soc Am Bull 111:1861–1875

Andrei S, Cazacu GB, Zarojanu D The systematization and storing methods of information concerning the geotechnical parameters. XIII Danube European conference on geotechnical engineering, Ljubljana