Workshop on the Role of Mineral Aerosols in Quaternary Climate Cycles: Models & Data: Jena, Germany, 7-11 October 2000
LOESS LETTER LL 44: October 2000

LL44 is a special issue supporting the GeoEng 2000 conference in Melbourne, Australia 2-12 November 2000, and the Dirtmap project workshop in Jena, Germany 7-11 October 2000. GeoEng 2000 is a joint meeting of the IAEG, ISSMGE and ISRM. Dirtmap is the "Dust Indicators and Records of Terrestrial and Marine Palaeoenvironments" project. The October workshop is on "The Role of Mineral Aerosols in Quaternary Climate Cycles: Models & Data" and more details are available on the website www.bgc-jena.mpg.de/bgc_prentice/start1.html or from organiser Karen Kohfeld (kkk@bgc-jena.mpg.de).

LL is a newsletter (just a newsletter, nothing more ambitious) produced by the GeoHazards Group at Nottingham Trent University for the INQUA Loess Commission and the IAEG Collapsing Soils Commission. It comes out twice a year, nominally in April and October, and is augmented by LLO-Loess Letter Online at www.loanletter.com. The way things are going it will soon be LLO augmented by LL, but at the moment we are in a transition zone.

LL44 features (inter alia): a paper by V.T.Trofimov, bits of a book by T.A.Dijkstra, some thoughts by Dan Yaalon, cartoons by Simon Bond, a picture of an editor all dressed up, our usual extract from 'Arid Land Geography' etc. The map on the front cover is Australia via the USDA Soil Taxonomy system- note the placing of the Alfisols(good soils) exactly where you would expect them (A Alfisols, U Ultisols, V Vertisols, D Aridisols, X mountain soils etc).

Loess InForm- the loess journal published by the Geographical Institute of the Hungarian Academy of Sciences welcomes submissions. LL has been appearing sporadically since 1987 but now more regular publication is intended. LoessFest publications: special issues of Quaternary International and Earth Science Reviews are more or less ready to appear; QI rather in advance of ESR. Selected recent loess publications are listed on LLO.
塔里木盆地边缘山地的黄土沉积

杨小平

干旱区地理

中国科学院地质与地球物理研究所，北京 100029

提 要 　 依稀在昆仑山北麓若羌，于田和昆仑山西缘库车阿克陶县境内的野外工作，分析研究了新旧黄土的分布规律，形态特征，物质成分，沉积环境和沉积区的环境变化。在新旧黄土的北高南低的趋势，黄土的年龄各相差龄大，低值区域的分布保存有“新黄土”，实际新和现代黄土。本区黄土经地质演化，但黄土层的沉积和沉积条件相近相似。在昆仑山北坡高海拔地区现代的黄土层在当地的地质因素控制的时期沉积的。

主题词 黄土 坎儿井 干旱区 昆仑山 坎儿井

中国分类号 P55:245 文献标识码 A

1 引 言

中国黄土的地理分布可划分为三个大区，即西部干燥内陆盆地、中部高原和东部平原。在塔里木盆地和准噶尔盆地黄土分布的总面积分别为34.400km²和15.800km²。在甘肃省和青海省黄土的分布面积分别为1.200km²和16.000km²。换句话说，我国黄土的面积仅为总面积的17.35%。分布于西部干燥内陆盆地中的黄土，其分布范围从岩石层薄，到全国总面积的65.67%分布于西部地区。并且在中部亚干旱地区其它国家及蒙古、哈萨克等地都有黄土和黄土岩石层分布。所以研究新疆的黄土不仅对于认识黄土的地理环境特征而且对于探讨全球黄土的总特点和研究现代生灾害都有重要意义。

2 黄土分布特征

塔里木盆地南侧的黄土主要分布在昆仑山北侧。西段和西段的南侧也有一些分布。在昆仑山中部分区分布较广。在阿克苏地区也有黄土分布。在阿尔金山当金山口以北，克里雅河上游的普鲁村等地区可观察到大面积连续分布的黄土。这些地区的黄土堆积过程仍在进行。白天因地形落差大，风由北向南吹向昆仑山，把大量的粉砂和细砂搬运至山地沉积。在野外工作期间经常体验到，中午时风力变强，所携带的粉砂和细砂沉积于山地沉积。在干旱地区的暴雨后河流泥沙的悬浮物含量可高达6000ppm。河流在出山口因坡度减小小，流速减小，所带泥沙塌积在山地沉积。其中的粉砂部分在风力作用下又被搬运到山地或其它地区。所以在塔里木盆地的周围山地常出现两个黄土带，即在山地沉积为黄土状沉积的堆积。
LOESS DEPOSITS IN THE SURROUNDING MOUNTAINS
OF TARIM BASIN, NORTHWESTERN CHINA

Yang Xiaoping
(Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029)

Abstract

Loess and loess-like sediments are vasty spread over the marginal mountains of the Tarim Basin and Zhanjier Basin in Xinjiang of northwestern China. Around the basins there are often two different aeolian sedimentation belts, which are separately covered by loess and loess-like deposits. Generally speaking, the loess is more intensively developed in the southern margin of the basin than in the northern. On the northern flank of Kunlun Mountains, loess is mainly distributed between 2500 m and 3400 m a.s.l. (above see level), and its thickness is seldom over two dozen meters. Small loess patches with a thickness of about 1 m may occur even at the elevation over 5000 m a.s.l. But in the Tienshan Mountains, the loess is considerably restricted to 950 m and 2400 m a.s.l. on the southern flank, and 800 m and 2000 m on the northern side.

The samples taken from Tashkuitergan to Yitian of the northern flank of Kunlun Mountains show the grain size of loess tends to increase from West to East. Compared with Loess Plateau, the loess in Xinjiang is generally finer probably owing to its shorter transport distance. The samples from Culu in the upper reaches of Keriya River indicate that the percentage of heavy minerals in the loess is 5.5% on average. The content of stable minerals is only some 20%. One third of the heavy minerals is hornblende. Besides, the content of feldite, iron minerals and black mica is relatively high also.

From the field investigation and laboratory analysis, it concludes that the preserved loess in the surrounding mountains of the Tarim Basin has been deposited mainly in Holocene. There the loess accumulation takes place mainly during the interglacial periods. Under the more severe climatic conditions of glacial times, the vegetation in the present loess zone would deteriorate considerably, and a stronger deflation and sand accumulation would replace the process of loess sedimentation. But in the northern flank of Tienshan Mountains, several layers of palaeosol are present in the loess section, and both Holocene and late Pleistocene loess is observed.

Key words: Loess, environmental change, arid zone, Kunlun Mountains, Xinjiang

Reno 2003. As this editorial is being composed the next major INQUA meeting is 3 years away. This may seem like a long time but the months click by very rapidly, and we should start thinking about possible loess symposia or workshops for the Reno '03 meeting. Do we discuss the cutting edge of loess research, or take a geographical approach and consider loess deposits associated with deserts, or a continental approach and focus on loess in North America? Suggestions please.
Damage function and a masonry model for Loess

Z.J. Shen
Nanjing Hydraulic Research Institute, People’s Republic of China
Z.Q. Hu
Xiao University of Technology, People’s Republic of China

ABSTRACT: Natural soils usually have their peculiar structure and their behavior cannot be properly modeled by traditional elasto-plastic theory. In this paper, a so-called masonry model is proposed in which a damage function is defined and used in parallel with the yield function to predict the deformation of natural loess during loading and wetting.

1 INTRODUCTION

By introducing suction as a new variable, the Cambridge critical state model has been generalized to model the behavior of unsaturated soils. According to Alonso et al. (1990), a so-called LC (loading and collapse) locus is assumed for predicting the plastic behavior of unsaturated soils due to an increase of load and a decrease of suction. This kind of plastic model seems satisfactory for many compacted soils, but trouble will be encountered when one deals with some natural soils with open macro pores such as loess which usually has a peak deformation at a definite pressure when wetted under different vertical pressures (Figure 1).

Many natural soils have their structure and exhibit quite different behavior before and after the damage of the structure. A new kind of constitutive model which takes account of the damage of the soil structure during loading and other mechanical effects has been proposed by the first author as a structural model (Shen, 1998). In the following sections, such a model will be developed for loess.

2 DAMAGE FUNCTION

In classic plasticity theory, the yield function is the key variable in characterizing the evolution of plastic deformation during loading. Usually the yield function is expressed as

\[ f(\sigma) = \mathcal{F}(\sigma) + \kappa(h) = 0 \]  

where \( \kappa \) is a hardening parameter. Damage function

\[ G(\sigma^*) = g(\sigma^*) \cdot \eta^* = 0 \]  

is the generalization of yield function to describe the evolution of the damage of soil structure. In accordance with the two variable approach, the damage function must be a function of both net stress and suction, and its general form can be expressed as

\[ G(\sigma^*) = g(\sigma^*) \cdot \eta \cdot \phi(\eta) = 0 \]  

where \( \{ \sigma^* \} = \{ \sigma \} - \omega_0 \{ \sigma \} \) is net stress, \( \{ \sigma \} \) is total stress vector, \( d \) is the damage parameter, \( \phi \) can be regarded as an equivalent stress which causes the structure to be damaged. If an elliptic function for net stress is used as in the Cambridge model, the following expression for \( g \) can be suggested:

\[ g = \frac{\sigma^*}{M} \left[ 1 + \frac{\sigma^*}{\alpha^*} \right]^{2} \]  

where \( \alpha^* = \alpha + \alpha^* \). \( \alpha \) is a constant, and \( p_0 \) is atmospheric pressure. However for better fitting the available experimental data both in the \( \eta \) plane and in the meridian plane, the following new expression will be used:

\[ g = \frac{\sigma^*}{M} \left[ 1 + \frac{\sigma^*}{\alpha^*} \right]^{2} \]  

where

\[ \eta^* = \frac{1}{\sqrt{2}} \left( \frac{\sigma^*}{\sigma^*} + \frac{\sigma^*}{\sigma^*} \right)^{2} \]

(4)

The curve for \( n=\eta=\phi(\eta) \) is shown in Figure 2 (Shen, 1989). A damage surface in \( \sigma_0 - \sigma - s \) space for \( n=1 \) and \( n=2 \) is shown in Figure 3. Equation 4 explains that either increase of \( \sigma^* \) and \( \eta^* \) or decrease of \( s \) will result in the damage of the soil structure.

The damage parameter \( d \) is a measure of damage. A common definition of \( d \) is damage ratio, i.e., the ratio of volume occupied by the damaged part to the total volume of the examined element. However, this ratio is unable to be measured, and in the following another definition will be given.

3 A MASONRY MODEL

3.1 Basic assumption

Many natural soils exhibit essentially elastic behavior when loaded at low stress levels. Therefore we can regard the natural soil sample as an elastic body intersected by randomly distributed joints, i.e., like a masonry. When the load reaches a threshold value the weakest joints will break down first making the sample like an assembly of several lamps. When the load increases further, the lamps are crushed again and their size get smaller and smaller. Finally, when all the soil aggregates have been destroyed, a sample with dispersed particles is obtained. Figure 4 demonstrates the process of shear band formation of a masonry sample.

Accordingly, the behavior of soil after the threshold of loading has been exceeded can be characterized by an assembly of stone-like lamps.

Figure 1 Wetting deformation

\[ \gamma = \frac{1}{1+c_0} \]  

Figure 2 Yield locus

where \( c_0 \) is a reference pressure when \( c=0, \), 1 and \( k \) is the slope of \( e-Np \) curve for virgin compression and rebound, respectively. The incremental form of this equation will be

\[ \delta \gamma = \frac{k \delta p}{1+c_0} \]  

In the case of isotropic compression, \( \delta \gamma = \delta p \),

\[ \frac{\delta g(\gamma)}{\delta \gamma} = \frac{\delta f(\sigma)}{\delta \gamma} \]

Comparison of Equation 8 with the second term of Equation 5 yields the following expression for the plastic coefficient \( A_p \).
Figure 5 Stable void ratio

the following expression for $A_2$ is obtained from Equation 5

$$A_2 = \frac{(e-e)\Delta \gamma + (d \Delta \gamma + \lambda)}{1 + e}$$

(12)

3.3 Plastic deformation due to damage

For determining plastic coefficient $A_2$, we must choose the damage parameter $d$ first. As mentioned above, the damage ratio commonly used in the classical damage mechanics will be abandoned here. A reasonable way is taking the size of stone-like lumps as the damage parameter which reduces progressively in the process of damage. But this quantity also cannot be measured. In the following we shall define the parameter as

$$d = \frac{e_{\min} - e}{e_{\min}}$$

(10)

where $e$ is current void ratio, $e_{\min}$ is its initial value, and $e_{\min}$ is the stable void ratio obtained from compression test of a saturated reconstituted sample of the same soil (Shen, 1986, Figure 5). This definition gives a complete damage ($d=1$) when $e=e_{\min}$ and no damage at all ($d=0$) when $e=e_{\min}$.

Now a damage law will be postulated as follows:

$$q = q_0 + (d - 1)$$

(11)

where $d$ is the initial slope of $Q$-$d$ curve. This equation satisfies the following condition: $q = q_0$, $d = 0$ and $q = \infty$, $d = 1$. From Equation 10, $d = \frac{(e-e)\Delta \gamma + (d \Delta \gamma + \lambda)}{1 + e}$, and accounting for $d = \frac{\Delta \gamma + \lambda}{1 + e}$, $d = \frac{\Delta \gamma}{1 + e}$, and $d = \frac{(e-e)\Delta \gamma + (d \Delta \gamma + \lambda)}{1 + e}$. This gives for isotropic compression $\Delta \gamma = \frac{\Delta \gamma}{1 + e}$, and $\frac{d}{\Delta \gamma} = \frac{\Delta \gamma}{1 + e}$.

Figure 6 Shear strength envelop

$$M = \sqrt{1 + \sin \phi}$$

(15)

If $\phi_0$ and $\phi_1$ are the friction angle for undamaged ($d=0$) and completely damaged ($d=1$) sample respectively, the following linear interpolation formula will be used to get $\phi$ at an intermediate value of $d$

$$\phi = \phi_0 + d(\phi_1 - \phi_0)$$

(16)

$\phi_0$ and $\phi_1$ can be obtained from the result of triaxial test of natural samples under low and high confining pressures, (see Figure 6). A similar interpolation formula will be used for parameter $\lambda$

$$\lambda = \lambda_0 + d(\lambda_1 - \lambda_0)$$

(17)

$\lambda_0$ and $\lambda_1$ can be determined from the slope of $\gamma_{m}$-$\ln \gamma_{m}$ at small and high stress level respectively as shown in Figure 7. From this figure we can obtain another pair of parameters $p$, $p_1$ for saturated and unsaturated sample respectively, from which the $q_0$ in Equation 11 and $a$ in Equation 4 can be deduced under assumption that $a_{1,2} = 1.2$ and $m = 2$. Finally, the value of $a$ in Equation 11 is obtained by trial and error to obtain a best fit to the experimental data.

5 COMPUTED EXAMPLES

A series of test with artificially prepared loess samples having similar structure with natural loess has been tested in order to determine the model constants and to verify the model behaviour. The obtained constants are: $q = 0.01, a = 0.035$, $\phi_0 = 0.04$, $\phi_1 = 0.52$, $q_0 = 0.03$, $a = 0.4$, $\phi_1 = 1.4$. In addition $\lambda_0$ is assumed and $\eta = q_0\lambda_0$ and $r = 3.3$ are used for the elastic behaviour of the samples before the threshold value $q_0$ has been exceeded. The computed results are also shown in Figure 1 and Figure 7.

6 CONCLUSIONS

1. Natural loess has a peculiar structure with open macropores, and its deformation behaviour during loading and wetting cannot be properly modeled by simple extension of existing soil plasticity and introducing only an additional term to take account of suction.

2. The masonry model proposed in this paper regards the soil sample as an assembly of lumps connected with weak bonds which can be destroyed during loading and wetting.

3. According to this model the deformation of a sample consists of 3 parts: (a) elastic deformation of lumps, (b) plastic deformation due to sliding between lumps and (c) irreversible deformation due to crushing of lumps which can be described by a damage function.

4. The damage function can be defined similar to the yield function, but an extra term with suction as an independent variable must be added to reflect the action of wetting.

5. The preliminary verification shows that the new model might offer an effective way in modeling many natural soils.

REFERENCES

Collapsibility of Egyptian loess soil

E.M. Abdurro, R.M. El-Hansy & K.M. Hamed
Structural Engineering Department, Faculty of Engineering, Alexandria University, Egypt

Abstract: The work presented is dealing with experimental research project on the response of circular footing resting on collapsible soil. A special apparatus was prepared in laboratory to measure the collapse settlement of a footing model under the effect of several parameters. Most of the previous researches are dealing with the inundation of collapsible soil starting from the top surface which represents the case of rainfall, or similar. In this research the inundation starts from bottom of the soil toward the surface which is representing the case of the breakdown of sewage pipes and/or rise of ground water table. The used system for inundation enabled to study the effect of dry soil thickness beneath the footing on the value of collapse settlement. The effects of load ratio, initial dry unit weight and the molding moisture content are also studied. Sun-dried soil is placed beneath the footing as a stabilization method to improve the response of footing and to minimize the collapse potential of soil upon wetting. Comparison between the measured and the predicted collapse settlement using the collapse predictive model developed by Basma & Tuncer (1992) are made.

1 Introduction

The collapsible soils are covering vast areas of several countries. Particularly in Egypt, they are widely spread throughout the Egyptian western desert area, specifically at Sidi Barani, New El-Ameria city, El-Boustan, Borg El-Arab city, the 6th of October city, etc. Some collapsible soils are deposited in such a way that they exist in a loose honeycomb-type structure at a relatively low density. At their natural low moisture content they possess high apparent strength, but are susceptible to a large reduction in void ratio upon wetting. Some other collapsible soils are generally composed of uniform, silt-sized particles which are loosely deposited and are bonded together with relatively small fraction of clay forming the typical loess structure. Normally, soils have high shear resistance and withstands high stresses without great settlement, when natural moisture content is low. However, upon wetting, the clay tends to soften and cause collapse of the soil structure inducing large settlement under low level of stresses. Therefore, it is dangerous to construct on these soils without improving their characteristics.

In Egypt, the formation is very dense; SPT values in the range of 250-300 blows were recorded. Extensive work on Egyptian western desert collapsible soil was carried out (Abdourro & Mahmoud 1988). The authors found that the angle of shearing resistance measured from shear box apparatus, decreases as the molding water content increases, whereas the cohesion increases with the increase of the molding water content up to the value of water content corresponding to optimum dry density, then decreases again. The authors also found that the western desert soil exhibits collapse potential at initial void ratio bigger than 0.45.

Modified procedure of double oedometer test developed by Jennings & Knight (1975) to estimate the magnitude of collapse settlement by conducting only one oedometer test. Many researchers made comparison between the output results of the double and single oedometer tests in calculating the collapse settlement of a foundation. General agreement was found (Israel 1988, Lawton et al. 1992) and (Basma & Tuncer 1992). Houston et al. (1995) introduced an in-situ collapse test, which is called down-hole collapse test. The test results were used to develop stress-strain relationship of soil. Basma & Tuncer (1992) developed the following equation to predict the collapse potential ($S_c$) as:

$$S_c = 4.8496 + 0.102 C_1 - 0.457 W_1 - 3.53 y_0 + 2.18 P_e$$

where $C_1$ = coefficient of uniformity of the soil; $W_1$ = initial moisture content, $y_0$ = dry unit weight in kN/m$^3$; and $P_e$ = pressure at wetting in kN/m$^2$.

2 Testing Equipment and Materials

A soil bin, used to contain the soil, was made of transparent plastic (plexiglas) plates; 345 mm side length, 400 mm depth and 10 mm thickness connected together using a mixture of plexiglas powder and chloroform and tied together using steel ties at two levels as shown in Figure 1. The base of the bin was made of a square plexiglas plate; 365 mm side length and 20 mm thickness. The soil bin was placed on a square steel plate; 340 mm side length, 12mm thickness, which rests on two steel rings; 300 mm diameter, 400 mm height filled with compacted sand. The two rings were placed inside a cylindrical steel rigid container; 750 mm diameter and 600 mm height filled with compacted sand, in order to insure the stability of soil bin during running the test.

A calibrated proving ring; 49 N accuracy, recorded the load applied using a frictionless lever and guiding system. The displacement of the footing was recorded by two dial gauges; 0.01 mm accuracy fixed rigidly to reference beams using magnetic bases. During loading tests, the difference between readings of the two dial gauges, were kept to be within 1% of the mean value, to accept the test results. The model footing 100 mm in diameter was machined from a steel plate 10 mm thickness. The loads transferred from the lever to the footing, were checked by the principles of static using the lever arm ratio. No appreciable difference what so ever were observed between the calculated and the measured values. A circular water tank of 200 mm diameter was used to supply the soil bin with water through four plastic pipes. The water was controlled using four water valves, each of 10mm diameter, made from brass, and connected to the bottom side of soil bin symmetrically at equal distance.

The collapsible soil was obtained from New Borg El-Arab E.B. 800 km to the west of Alexandria city. The soil was dried in an electrical oven at 110°C for 24 hours then, sieved on 0.425 mm B.S. sieve, the passing material was used. The main characteristics of soil shown in Table 1. The laboratory tests on soil are carried out in accordance with ASTM T.

The soil bin, Figure 2 was placed and centered at its position with respect to the loading system. Fine gravel layer; 50 mm thickness acts as a filter, was placed and compacted to reach a dry unit weight of 17.56 kN/m$^3$ and then, covered with a sheet of felt to separate between collapsible soil deposit and the filter layer. The collapsible soil was prepared in six layers, each layer 50 mm thick. The weight of dry soil was determined for each layer and compacted to achieve the desired predetermined dry unit weight. After placing and forming the soil, the footing was placed accurately on the top of soil surface and loaded incrementally up to a predetermined percentage of the failure load. The load was held constant, and the water allowed to flow to the soil via the four water valves. After water had reached the required level, the water valves were turned off. The water level in the water tank was held constant during the inundation process. The rise of water through the soil was recorded with time, if possible, before and after turning off the water valves. The collapse settlement due to wetting was also, recorded with time during this stage. The load was held constant for 24 hours until full collapse settlement takes place.

The vertical load was then increased incrementally using the same procedure in the slope of the load-settlement relationship, presented in logarithmic drawings.

Table 1: Main characteristics of collapsible soil

<table>
<thead>
<tr>
<th>Percentage passing no.200 sieve</th>
<th>76%</th>
</tr>
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<tbody>
<tr>
<td>Uniformity coefficient, $C_u$</td>
<td>0.088 mm</td>
</tr>
<tr>
<td>Coefficient of curvature, $C_w$</td>
<td>2.23</td>
</tr>
<tr>
<td>Liquid limit, $W_L$</td>
<td>50%</td>
</tr>
<tr>
<td>Plastic limit, $W_p$</td>
<td>21%</td>
</tr>
<tr>
<td>Plasticity index, $I_p$</td>
<td>9%</td>
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<tr>
<td>Specific gravity, $G_s$</td>
<td>2.29</td>
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<tr>
<td>Maximum dry unit weight, $w_{dry}$</td>
<td>16.76 kN/m$^3$</td>
</tr>
<tr>
<td>Optimum moisture content, $w_{opt}$</td>
<td>21%</td>
</tr>
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</table>
A comparison between the measured values of collapse settlement from footing models, and the predicted values using the collapse predictive model, developed by Basma & Tuncer (1992) was conducted. The results of this comparison are shown in Table 4. The relationship between R (the ratio of measured collapse settlement/predicted collapse settlement using Equation 1) and (h/B) is shown in Figure 8. From this figure, it was found that, the measured collapse settlement is, in general, less than the predicted collapse settlement. But, this ratio increases with the decrease in the dry depth under the footing, and is closer to the measured values when h/B = 0, i.e. the collapse predictive model developed by Basma & Tuncer is more applicable when the inundation of collapsible soil starting from top surface of soil.

<table>
<thead>
<tr>
<th>Table 4. Measured and predicted values of collapse settlement</th>
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<tr>
<td>h/B</td>
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<tr>
<td>1.80</td>
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<td>1.20</td>
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<td>0.70</td>
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<td>0.50</td>
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Figure 8. Variation of ratio (R) with (h/B)

6 CONCLUSIONS

The following conclusions were drawn from the course of investigation:

1. The collapse settlement increases as the thickness of inundated collapsible soil increases, the load ratio increases and the initial dry unit weight decreases.

2. The collapse settlement at load ratios 0.25 and 0.50 is equal to inappreciable value when the depth of dry soil under the footing is equal nearly to two and half times the footing diameter.

3. Using a sand cushion with thickness equal to twice the footing diameter decreases the collapse settlement significantly.

4. Basma & Tuncer predictive model over estimates the collapse settlement of circular footing resting on collapsible soil and inundated far from foundation level.

REFERENCES


LOESS SLOPE INSTABILITY IN THE LANZHOU REGION, CHINA

INSTABILITEIT VAN LOESS HELLINGEN IN DE LANZHOU REGIO, CHINA

(MET EEN SAMENVATTING IN HET NEDERLANDS)

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DOOR

TOM ANE DIJKSTRA

GEBORON OP 12 DECEMBER 1962, TE DIEREN (GEM. RHEDEN)
Structure of the thesis

The research project was carried out as part of a larger team endeavour and dissemination of the results has therefore led to the publication of multi-authored papers. A selection of these has been used to form the main textual body of this Thesis.

In Section 1 the location, research framework and geomorphological problems encountered in the Lanzhou region are introduced. In Section 2 the first group of publications focuses on loess as a material with a meta-stable structure and its position among the range of other soil types distinguished by pedologists and engineers. This is illustrated by a short publication that formed one of three presentations at the First International Symposium on Engineering Characteristics of Arid Soils, held in London in July 1993.


The two following papers approach the meta-stable nature of loess deposits from a packing perspective. The first of these forms a literature review on loess collapse, discussing in detail the most influential contributions and identifying the major problems and research strategies that are associated with collapse mechanisms of loess deposits. In a second paper the concept of open packing formation is presented and the transitions to random loose to close particle packings are emphasised.


Section 3 comprises a short introduction and three research publications that deal with a broad geomorphological framework, paying attention to geomorphological thresholds, landslide distribution and classification, and neotectonic influences. The first was presented at a meeting of the British Geomorphological Research Group at the Annual Conference of the Institute of British Geographers at the University of Sheffield in 1991. It serves as an introduction into the physical geography of the loess region of Central China and the range of loess mass movements and their effect on human activities.


The second paper of this section was recently presented at a conference in Xi'an on landslide hazard mapping and analysis and has a section that deals with landslide classification and distribution. It is only this particular section (pages 44-55) that has been reproduced here.


In the final paper of this Section the geological framework of the Lanzhou region is discussed and a series of examples is given of major loess mass movements triggered by earthquakes. This paper was presented at a Quaternary Research Association meeting at the Geological Society in London in 1992.


In Section 4 the three selected papers discuss in greater detail the geotechnical properties of the Lanzhou loess as determined through both in situ and laboratory tests. The first contribution is adapted from two chapters (5 and 7) from a book, only very recently published, that provides a comprehensive overview of the results obtained during the European - Chinese joint research project. Together with the Engineering Geology publication, these two publications discuss in detail the results of the geotechnical testing programme providing some evaluations of the importance of these findings for the analysis of loess slope instability. The Section concludes with a paper on the analysis of particularly common types of mass movement in the Lanzhou region: cut-slopes and terrace edge failures.


Finally, Section 5 concludes with summaries of the thesis in English and in Dutch.
SOIL AND ROCK ENGINEERING

The Maximum Thickness of Collapsible Loess Rocks

V. T. Trofimov

Faculty of Geology, Moscow State University, Vorob'evy gory, Moscow, 119899 Russia
Received December 5, 1996

Abstract—The analysis of new experimental data indicates that the maximum thickness of collapsible loess rocks reaches 50–55 m. The upper five or six cycles of loess massifs can show collapsible properties. Loess horizons, buried soils, and pedocomplexes are collapsible in this massif section.

INTRODUCTION

Collapsibility is the characteristic engineering-geological property of loesses, defined as their deformability on wetting under load when affected by natural or engineering factors. The present-day concept implies that rocks of various genesis may acquire this property either immediately during accumulation and recent subaerial diagenesis of silts under arid conditions (syngenetic collapsibility) or in the course of progressive lithogenesis of young deposits under subaerial conditions and hypergene (including cryoeluvial) decomaption of rocks of different age and origin (epigenetic collapsibility) [13, 14].

As is noted in a number of reviews [3, 6, 8, 10, 12], the thickness of collapsible loess massifs does not usually exceed 10–30 m in Northern Eurasia. In the great bulk of the regions in Russia, Ukraine, and Kazakhstan, it reaches 10–15 m. The massifs with thicker collapsible zones (up to 35–40 m) are found in a number of areas in Central Asia and Ciscaucasia.

Kriger, who generalized the data on the loess collapsibility and the cyclic structure of loess massifs, noted that “in Central Asia, Ciscaucasia, the Russian Plain, and southern Western Siberia, C is observed in rock not deeper than the first fossil-soil horizon (20–25 ka old, the roof mainly occurring at a depth of 10–20 m) and, more rarely, not deeper than the second fossil soil (80–100 ka old, the roof lying mainly at a depth of 20–35 m)” [7].

The most comprehensive data on the spatial distribution of collapsible loess thickness are presented on Prediction Map of Collapsibility in the Areas Covered with Loess in the USSR of a scale 1 : 2,500,000 [6, 10]. However, this map does not subdivide further the collapsible sediments with thickness exceeding 20 m, although these are the massifs of the greatest interest in respect to this discussion.

LITERATURE DATA ON THE MAXIMUM THICKNESS OF COLLAPSIBLE LOESSES

In the European part of Northern Eurasia, the maximum thickness of collapsible loess massifs is noted in southern Ukraine and Ciscaucasia. In particular, Bykov et al. wrote in comments on the above-mentioned map: “However, it should be pointed out that the thickness of collapsible loess can reach 30–40 m and more in many regions, for example, in eastern Ciscaucasia (near Georgievsk and in the Alkhanchurt valley), southern Tajikistan (within the leveled mountain peninsulas), and in the southern periglacial plains of European Russia (in the vicinity of Zaporozhe, Dnepropetrovsk, etc.)” [10].

Galai points to even greater collapsible loess thickness in eastern Ciscaucasia [3]. According to his assessments, the thickness of the collapsible massiff ranges from 20 to 60 m within the interfluvial plains of the eastern and northeastern Stavropol region (Budennovsk, Stepnoe, Novozavodennoe, and Otkaznoe).

More comprehensive data have been published on the very thick collapsible part of the loess massifs in Central Asia. Specifically, a great thickness (40 m) is noted within the Gyrur massif [1].

The areas with highly collapsible thick loess have been discovered in the northeastern and eastern Karsh steppe. These areas are described as the “proluvian, rolling, dissected plain composed of the Karanb proluvian loesses.” This region includes mainly separate interfluval zones between the valleys of the Kashkardarya River and the dry channel of the Kumdarya River. The collapsible massiff thickness reaches 35–40 m” [9].

Kadyrov published interesting data on the thick loess sediments in the Tashkent region [5]. According to his assessment, the maximum thickness of loesses collapsible under natural load is more than 50 m. “The relative collapsibility coefficient of some samples, taken from a depth of 31–33 m in Tashkent region, was 0.07–7.1…. “According to the data of Shermatov (1971), the relative collapsibility coefficient of loess-

1 C stands for “genuine collapsibility,” defined by Kriger as the capacity of rock to compact on wetting in the natural stress state [7].

2 These sediments are of Middle Quaternary age.
like sediments occurring near Tarazken (Tashkent region) at a depth of 41 m was 0.0572% [5].

Thick collapsible massifs are also found in the Gissar–Surkhandarya depression. According to the data of Zhermangulov, the Imak, Middle Quaternary, proluvial, and loess sediments, collapsible to a depth of 40 m, occur in the adyrs (low foothills bordering the Fergana depression) and high terraces dissected by deep ravines and gullies [4].

Skvaliesskii provides more comprehensive and specific data on the thick collapsible loess [11, 12] found in Tajikistan. He proves that the upper three cycles (up to the third buried soil horizon) of the Dushanbe loess sediments (the upper Pleistocene) are collapsible under the natural load. These sediments are 39–41 m thick at the piedmont terrains and high terraces. These collapsible massifs are found in the Yavan valley and on the Alim, Uraltalov, and Tashkabad plateaus.

Kriger et al. present somewhat higher figures of collapsible-massif thickness in the Yavan valley: “The studies performed in the Yavan valley show that the collapsible massif thickness may reach 40–45 m at a moisture of the stable paragenetic complex” [8].

THE NEW DATA ON THE MAXIMUM THICKNESS OF COLLAPSEABLE LOESS SEDIMENTS OBTAINED FROM THE STUDY OF KEY ENGINEERING GEOLOGICAL SECTIONS

Between 1986 and 1990, the Production and Research Institute for Engineering Survey in Construction (PMNII), the USSR State Construction Committee, the Geological Department of Moscow State University, institutes of academies of sciences of the Soviet Union and several republics, many higher institutes of learning, and regional geological organizations in seven republics of the Soviet Union, worked on “Rational economic development (use) of areas covered by collapsible sediments.” The engineering geological investigations of the key sections of collapsible loess in the Soviet Union appeared to be the most significant part of this problem [16].

The new evidence on the thickness of both loess massifs and their collapsible sections was obtained in the course of these studies. The greatest thickness was established for the key sites in the Northern Caucasus, Tashkent, and southern Tajik regions. The maximum thickness of loesses exceeded 100 and 200 m in single sections of the Northern Caucasus (the Okhtaznkey site) and in the Southern Tajik Depression, respectively. The thickness of collapsible loess massifs also turned out to be higher than earlier believed. For example, its maximum value far exceeded 40 m under the natural load in the Okhtaznkey site. The collapsible sediments of similar thicknesses are observed in the Adyr key site in the Southern Tajik Depression. As was mentioned earlier [16], we consider this fact to be a discovery in engineering geology of loess formations. However, it is not yet elaborated in the literature. Let us compensate for this gap

The Okhtaznkey key site is located close to Okhtaznkey in the Stavropol region. It partially occupies the Kuma River valley and the watershed plateau between this river and the Mokryi Karanuk and Karakaya Balka rivers. The altitudes range from 246 to 156 m. This area belongs to the Terek–Kuma Plain between two major geological structures of Caucasia: the Stavropol Uplift in the west and the Caspian Depression in the east.

The studies performed by Botmikov, Galai, Fainer, Udarev, and other geologists between 1986 and 1989 proved that the maximum thickness of loesses in this region reaches nearly 140 m. These sediments consist of the Akhchayl marine sediments with erosional unconformities. Two complexes are distinguished within this massif. The lower complex (45 m thick) includes three cycles, each consisting of silty loam and brown buried soil horizons. Udarev considers that this loess massif section, which shows the inverse magnetization to the Matuyam rocks, is composed of the Pleistocene sediments. These sediments are currently water-saturated and in terms of engineering geology should be regarded as clays rather than loesses [15].

The 90-m-thick upper complex consists of nine Pleistocene and Holocene cycles, containing 26 loesses and soil horizons, according to Udarev. They are composed of silty sandy loams and loesses (loesses and loess-like loams according to Moscow). The paleo-magnetic studies proved that almost the entire complex (the upper 80 m) is characterized by the direct magnetization of the Brunese cycle. The data obtained from 72-m-deep C-1 Borehole drilled by the Stavropol TISIZ (Trust for Engineering and Construction Survey) at the watershed plateau on the right bank of the Kuma River (at an altitude of 245.5 m) appear to be of primary interest to engineering geologists. This borehole reveals five loess cycles occurring to a depth of 50 m (Fig. 1). The upper cycle is composed by the recent soil, and the underlying cycles are overlain by the buried soil horizons (pedocomplexes, as a rule). The first (upper) cycle (of thickness 13.8 m) is composed of the Holocene–Upper Pleistocene sediments. The second (9.5 m), third (9.8 m), fourth (9.9 m), and fifth (above 9 m) cycles are dated as the Upper, Upper-Middle, and Middle Pleistocene respectively. According to Udarev, these cycles are crowned by the Holocene pedocomplex, the indistinctly pronounced Bryansk buried soil, and the Mezen, Ramensk, and Kamens pedocomplexes, respectively.

The loesses in this section are predominated by the dry, dusty, heavy sandy loams, and loess-dry, silty, light loams, loesses, and loess-like loams. Their study shows that the collapsibility is typical of all elements in the upper five loess cycles, including the buried soils (Fig. 1a, Table 1). The collapsible loess massif is extraordinarily thick: loesses and palaeosols are formally collapsible under the natural load and a load of 0.3 MPa to a depth of 44 (the relative collapsibility coefficient is 0.057) and 30.5 m, respectively; the rated total collapse under natural load is 225 cm.

To a depth of 41 m, the relative collapsibility coefficient under the natural load is 0.021–0.0112 and 0.029–0.112 for the loesses and palaeosols, respectively. Under this load, the maximum collapsibility is typical of the sediments in the first, second, and third cycles. The collapsibility is a maximum (0.05–0.112) in the lower part of the second cycle and in the upper part of the third cycle (the Mezen pedocomplex). It decreases gradually to 0.021, 0.015, and 0 at depths of 44, 41, and 39.75 m, respectively (Fig. 1a, Table 1).

It is worth noting that Galai also studied the collapsibility of this loess massif to a depth of 62.5 m (at greater depths, the sediments become considerably compacted and moistened). Judging from the unpublished data, which were kindly submitted by Galai, we obtained values of the relative collapsibility coefficient that were virtually the same as those presented in Table 1. The maximum values (0.095–0.112) were obtained at the same depths and for the same structural elements. However, the following significant discrepancy was noted: the collapsible loess sediments allegedly occurred to a depth of 42 m, where the relative collapsibility coefficient was equal to 0.01. According to these data, this parameter was 0.98 and 0.02–0.034 at depths of 44 and 49 m, respectively. As Table 1, it was equal to zero at a depth of 49.5 m. This value ranged from 0.001 to 0.003 in the interval from 30 to 62.5 m.

The results obtained by Galai for the collapsibility of the 100-thick loess massif in the vicinity of Budennovskoye (the key stratigraphic section [2]) appear to be similarly timely. As follows from Table 1 and Fig. 1b, the loess is formally collapsible under the natural load to a depth of 55 m (almost to the bottom of the third cycle). At greater depths, in the fourth and fifth cycles, the relative collapsibility coefficient varies from 0.01 to 0.009.

The thick collapsible loess massifs are also found in the Tashkent region (Uzbekistan). There, the experts of...
The maximum thickness of collapsible loess rocks includes up to 12-13 loess cycles of the Pleistocene and Pleistocene-Holocene age, each (except for the uppermost cycle) including both loess horizon and overlying buried pedocloths (or buried soil). Borehole C-2KU (with the initial and final drilling diameters of 426 and 219 mm, respectively), drilled at this key site within the watershed plateau (at an altitude of 1020 m), reveals 12 loess cycles (dated as the Middle-Late Pleistocene) and crowned by the Holocene soil. The geologists from TajikGIINTIZ refer cycle 1 to the Holocene and Upper Pleistocene, cycles 2-5 to the Upper Pleistocene, and cycles 6-11 to the Middle Pleistocene. The underlying loess sediments are dated as the Early Pleistocene. These loess sediments are chiefly of proluvial or alluvial-proluvial genesis.

A lithologically, all cycles are represented by silty sandy loess, loess-silt, and light or ordinary loess-like loams. The buried-soil horizons are mainly composed of brown silty loams.

The engineering geologists from TajikGIINTIZ studied the collapsibility of these sediments and discovered that the thickness of the upper five cycles are collapsible according to the natural load. The lower boundary of the collapsible mass is conventionally positioned at a depth of 43 m (with the natural load of 0.73 MPa) and the relative collapsibility coefficient of 0.012, although the soils with the relative collapsibility coefficient varying from 0.005 to 0.008 occur below this boundary to a depth of 55.5 m (Table 2, Table 2). Under the additional load, the thickness of collapsible sediments would reach this amazing value.

The relative collapsibility coefficient varies significantly across the section (from 0.001-0.005 to 0.03-0.076) (Table 2). It attains a maximum (up to 0.045-0.076) at depths of 6.5-10.5 and decreases to 0.018, 0.029, and 0.032-0.039 at depths of 16.5, 26.5, and 37.5-41.5 m, respectively. Under the combined impact of natural and additional (0.3 MPa) loads, the relative collapsibility coefficient amounts to 0.012-0.134 in the upper 25 m of the mass.

It is worth noting that Borehole C-4* of depth 130 m, drilled previously by TajikGIINTIZ at altitudes of 330.0 m within the same key site, also revealed the thickness of the Upper Pleistocene collapsible sediments. At a depth of 36 m, the relative collapsibility coefficient was found to be equal to 0.01 under the natural load, and it varied within 0.003-0.007 to a depth of 40 m. Its maximum values (0.011-0.046) were confined to the upper 20-m-thick horizon.

CONCLUSIONS

The results obtained allow us to draw the following significant conclusions:

1) The maximum thickness of the collapsible loess masses may be much greater (up to 50-55 m) than considered previously. This fact appears to constitute a discovery in the engineering geology of loess.

REFERENCES


Loess field trip II

ПОЧВОВЕДЕНИЕ

On the Importance of International Communication in Soil Science
D. H. Yaalon

This article is dedicated to the celebration of the 100th anniversary of the founding of Pochvozvedenie, the first scientific journal entirely devoted to soil science. The year 1899 is also significant for the appearance of the first edition of the textbook Pochvozvedenie (Soil Science) by N.M. Shurzhev, presenting details of Dokuchayev’s concept of the genetic soil types and an outline of their classification in Russia. In the United States of America, 1899 marks the beginning of the federally supported systematic soil survey at a detailed scale. A comparison with the current situation is made and the need for better international communication in soil science is stressed.

Introduction

Soil science and the study of soils had a relatively uncomplicated history without great controversies. It had only a few significant paradigm shifts and was not much in the public’s eye, which some recent books attempt to remedy [1, 3, 14]. In books on agriculture written by ancient and classical scholars only a small amount of space was devoted to soils, their characteristics and management. Much later, from the 18th century, more attention was paid to soils, their nature, soil management and fertility, as books dealing with these topics began to appear in several languages in Europe, summarising advise to farmers and developers on the best agricultural practices. During the 19th century scientific observations and analyses of soil began to be published also in almanacs and agricultural journals.
The specific study of soils as an independent object of study in its own right - pedology, including its applied aspects of soil productivity and soil management, is thus a relatively young science. Results of surveys, analyses and research began to be published in scientific journals in the second half of the 19th century. Beginning with the last three decades of the 19th century, the Russian school of V.V. Dokuchaev and his followers has contributed most significantly to the basic concepts of soil genesis [5, 15].

Pochvovedenie, the first journal entirely devoted to current scientific research results in soil science was founded in 1899 and continuously published since, an honor not shared by many scientific journals. Apart from being the main soil science journal in Russia it became a leading international soil journal, now again fully translated also into English. In the following I would like to discuss in a broader context the significance of this landmark and of two other landmark occasions of one hundred years ago, together with some observations and thoughts on the current state of inter-regional communication in soil science and some suggestions how to improve it.

One hundred years ago

The year 1899, when the new journal Pochvovedenie was founded and first edited by P.V. Otozki, followed for many years by A.A. Yarilov, was remarkable also in two other ways.

The first edition of N.M. Sibirtzev's textbook Pochvovedenie (Soil Science) was published in 1899 (in Warsaw). In it he expounded and systematized Dokuchaev's concept that genetic soil types correspond to a definite combination of soil forming agents (factors) This and later editions of Sibirtzev's book [8], the holder of the first chair of pedology at the N,ovo-Jekaterinburg Agricultural Institute of Agronomy and Forestry in Pulawy (now Poland), became most influential in spreading the new pedological concepts, as Dokuchaev himself did not produce a general soil textbook. Subsequently other, equally pedologically oriented textbooks became influential in training new generations of soil scientists.

In the United States of America the year 1899 is an important milestone in that it marks the initiation by the US Department of Agriculture, Division of Agricultural Soils (later Soil Survey Division of the Bureau of Soils) of federally supported systematic soil surveys on a large scale (1:63,000 or better) with the aim of showing the distribution of soil types (later 'soil series'), at that time mainly differentiated by texture and geological substrate properties [6, 9, 10]. In subsequent years the Soil Survey Division employed several hundred soil surveyors in all states of America. The soil series concept became refined, including the full soil profile. It permitted a better evaluation of the regional soil inventory, helped to devise a taxonomy based on observed properties and especially enabled improved soil management practices for the benefit of the soil users. Thus the preparation of a soil survey inventory is not cutting edge research, it is an essential foundation for it with a high subsequent impact.

Modern earth science is based on collecting detailed and systematic observations, both in the field and in the laboratory, supported by experimentation, followed by data organization and their interpretation, and finally presenting results to a wider audience. Any research is not completed before it is published in a generally available form and eventually when significant, entering the store of general knowledge in reviews, monographs and textbooks. Thus it seems that one hundred years ago, in 1899, two widely separate countries initiated appropriate and significant examples for three of these major aspects, albeit to be greatly expanded and developed in subsequent years: the collection and evaluation of field data (detailed soil science), presenting results of research (journal Pochvovedenie), and the spread of syntheses and generalizations (monographs and textbook). Much has been built on and developed from these early foundations.

The current situation

At present over 5000 soil science publications appear each year in a variety of languages, mostly in English (70%), in a large number of scientific journals and in specific thematic publications covering all fields of soil science. Pedology is indeed recognized as an independent science of soil bodies, closely connected to a number of related basic earth and bio-sciences and significant in various applied sciences besides agriculture [13]. It is taught as such at colleges and universities, requiring continuously up-to-date textbooks listing the most recent advances.

Apart from Pochvovedenie, there is now a large number of national and international journals specializing in soil science [7, 12], about 30 being most important in publishing the more frequently cited research results. Over 100 significant monographs and textbooks related to soil science are being published annually in several languages. Soil surveys are now being carried out on a regular basis in practically all countries of the world. Though generally applying much more sophisticated procedures, the detailed field survey has remained its mainstay.

National characteristics and local or language preferences were always a major obstacle in the international communication of soil science. In the early 1960's, some 43% of all internationally recorded soil research papers were published in the Soviet Union [11]. How this proportion has changed recently has not been estimated. Though Russia continues to boast a number of outstanding soil scientists and it is postulated that the leading soil science journals, it must be acknowledged that Russia lost its leading role in soil science long ago. During the Soviet period it was mostly because of the politization of the scientific enterprise and forced isolation of its young scientists from overseas contacts [4]. Currently it is strongly handicapped by outdated equipment, inadequate access to foreign publications and the language barrier.
Russian publications rarely cite non-Russian research, which unfortunately is reciprocated in American or European publications. We are still largely separated by language and reading habits, just like in Dokuchaev-Sibirtzev and Hilgard times when the landmark pedological paradigms were first published in Russia and the USA, respectively, without sufficient interaction among them [2, 5]. A major effort is needed to overcome this.

The need for better communication

During the last 40 years Pochvovedenie was translated first in total, later only selected papers of it, together with other translated research articles in the journal Eurasian (previously Soviet) Soil Science. Because of translation delays and the large costs of overseas professional translation this enterprise was in danger of folding, but was now taken over by a Russian publishing company for simultaneous publishing of the Russian and English editions. Hopefully this situation will endure.

However, it seems also imperative that Russian soil scientists publish directly, like some Eastern European, Chinese, South American and other soil scientists, significant research results in Western language journals which now lead this topic. Since the publication requirements of these are generally high and vary considerably from the Russian practice, young scientists ought to be trained not only in the use of modern equipment and research methodology, but also in the rather strict and demanding ways of presenting research results, separate from interpretations and discussions and fully documented by comprehensive citations of previous and/or relevant literature. At the same time, Russian publications publishing research of more general interest need to include longer, informative English-language abstracts. The preparation of the abstracts or summaries by the authors themselves is excellent training in concise and clear writing. As a result, non-Russian authors will hopefully become better acquainted with Russian soil research.

In a world which only recently became conscious of the limitations of natural resources including soils, and the often irreversible damaging effects on the environment brought about by human, basic and applied studies involving soils will increase in importance. We should aim at, besides the inevitable and needed local problem solving research, to have more soil science communication internationally, accessible and relevant.

References


Address:
Dan H. Yaalon, Institute of Earth Sciences, Hebrew University, Givat Ram Campus, Jerusalem 91904, Israel.
(Fax 972-2-566 25 81)

[Published in POCHVOVEDENIE, no 1, 1999, p. 30-32, in Russian]
The characteristic curve should indicate the effects of soil and shape of soil voids, and it is assumed rigid in the mechanical behavior. It should be done either by a dependent variable (as in Toll (1990)), or by both of the two. An example of the use of $\sigma - u_w$ and stress state variables. An example of how the state parameter takes distinctly different samples B and D. The parameter remains zero for fully penetrating of the value of $u_w$ at the soil boundary, as the sole stress.

Fig. 5: Schematic representation of bulk water and meniscus water within an unsaturated soil (after Karube et al. (1995) and Kato et al. (1995)).

The component $S_{ro}$, representing the volume