普通高等学校"十三五"规划教材

ENGLISH FOR GEOLOGICAL AND GEOTECHNICAL ENGINEERING

地质与岩土工程
专业英语

（第2版）

刘汉东　王四巍
于怀昌　李华晔　编著

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内 容 提 要

本书以培养学生专业英语阅读和翻译能力为主要目标，内容包括土力学、岩体力学、地下水文学、工程地质学、地基与工程、水利工程、喷锚支护与盾构施工等方面的一些知识。全书由20个单元组成，每个单元均有译文。书后附有科技文章翻译和写作（摘要）指南。

本书可作为地质工程、岩土工程、地下水文、水利工程、土木工程等专业的本科生和研究生的教材或课外阅读材料，也可供从事相关专业的工程技术人员、管理人员和教师参考。

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再版前言

本书是在原有《地质与岩土工程专业英语》的基础上修订的，增加了岩土工程基本的理论和应用，使得本书更注重岩土体的基本理论和实际应用技术。

本书主要内容包括土力学、岩体力学、地下水文学、工程地质学、地基与工程、水利工程、喷锚支护与盾构施工等学科有关的一些内容，目的是为地质工程及岩土工程等相关专业学生阅读有关文献打下专业词汇和理解原文的基础。

另外，考虑到一些读者的专业知识和英语水平，编写了科技文章翻译和写作（摘要）指南。

全书共分 20 个单元，每个单元分为两部分——课堂教学和课下阅读，这两部分均给出了参考译文。20 个单元课堂教学全部讲完一般需 50 ~ 60 学时，如学时不够，可根据专业性质有针对性地讲解一些相关的内容。本书语言规范、内容广泛、针对性强，有利于自学。

参加本书编写的有华北水利水电大学的刘汉东、王四巍、于怀昌和李华晔。

为便于读者对文章有更好的理解，有些章节内容稍有修改和增减。全书由刘汉东统稿并对原文、译文进行了多次校对，但由于编者水平有限，错误和不足之处在所难免，恳请广大读者批评指正。

编著者

2016 年 1 月

目　录

Unit 1

Text

Soil Mechanics

Soil mechanics is concerned with the use of the laws of mechanics and hydraulics in engineering problems related to soils. Soil is natural aggregate of mineral grains, with or without organic constituents, formed by the chemical and mechanical weathering of rock. It consists of three phases: solid mineral matter, water, and air or other gas. Soil are extremely variable in composition, and it was this heterogeneity that long discouraged scientific studies of these deposits. Gradually, the investigation of failures of retaining walls, foundations, embankments, pavements, and other structures resulted in a body of knowledge concerning the nature of soils and their behaviour sufficient to give rise to soil mechanics as a branch of engineering science.

1 History

Little progress was made in dealing with soil problems on a scientific basis until the latter half of the 18th century, when the French physicist Charles-Augustin de Coulomb published his theory of earth pressure (1773). In 1857 the Scottish engineer William Rankine developed a theory of equilibrium of earth masses and applied it to some elementary problems of foundation engineering. These two classical theories still form the basis of current methods of estimating earth pressure, even though they were based on the misconception that all soils lack cohesion, as does dry sand. Twentieth-century advances have been in the direction of taking cohesion into account; understanding the basic physical properties of soils in general and of the plasticity of clay in particular; and systematically studying the shearing characteristics of soils—that is, their performance under conditions of sliding.

Both Coulomb's and Rankine's theories assumed that the surface of rupture of soil subjected to a shearing force is a plane. While this is a reasonable approximation for sand, cohesive soils tend to slip along a curved surface. In the early 20th century, Swedish engineers proposed a circular arc as the surface of slip. During the last half century considerable progress has been made in the scientific study of soils and in the application of theory and experimental data to engineering design.

A significant advance was made by the German engineer Karl Terzaghi, who in 1925 published a mathematical investigation of the rate of consolidation of clays under applied pressures. His analysis, which was confirmed experimentally, explained the time lag of settlements on fully waterlogged clay deposits. Terzaghi coined the term soil mechanics in 1925 when he published the book "Earth—Building Mechanics".

Research on subgrade materials, the natural foundation under pavements, was begun about 1920 by the U. S. Bureau of Public Roads. Several simple tests were correlated with the properties of natural soils in relation to pavement design. In England, the Road Research Board was set up in 1933. In 1936 the first international conference on soils was held at Harvard University.

Today, the civil engineer relies heavily on the numerical results of tests to reinforce experience and correlate new problems with established solutions. Obtaining truly representative samples of soils for such tests, however, is extremely difficult; hence there is a trend toward testing on the site instead of in the laboratory, and many important properties are now evaluated in this way.

2 Engineering Properties of Soils

The properties of soils that determine their suitability for engineering use include internal friction, cohesion, compressibility, elasticity, permeability, and capillarity.

Internal friction is the resistance to sliding offered by the soil mass. Sand and gravel have higher internal friction than clays; in the latter an increase in moisture lowers the internal friction. The tendency of a soil to slide under the weight of a structure may be translated into shear; that is, a movement of a mass of soil in a plane, either horizontal, vertical, or other. Such a shearing movement involves a danger of building failure.

Also resisting the danger of shear is the property of cohesion, which is the mutual attraction of soil particles due to molecular forces and the existence of moisture between them. Cohesion forces are markedly affected by the amount of moisture present. Cohesion is generally very high in clays but almost nonexistent in sands or silts. Cohesion values range from zero for dry sand to 100 kPa for very stiff clays.

Compressibility is an important soil characteristic because of the possibility of compacting the soil by rolling, tamping, vibration, or other means, thus increasing its density and load-bearing strength.

An elastic soil tends to resume its original condition after compaction. Elastic (expansible) soil are unsuitable as subgrades for flexible pavements since they compact and expand as a vehicle passes over them, causing failure of the pavement.

Permeability is the property of a soil that permits the flow of water through it. Freezing-thawing cycles in winter and wetting-drying cycles in summer alter the packing density of soil grains. Permeability can be reduced by compaction.

Capillarity causes water to rise through the soil above the normal horizontal plane of free water. In most soils numerous channels for capillary action exist; in clays, moisture may be raised as much as 30 feet by capillarity.

Density can be determined by weight and volume measurements or by special measuring devices. Stability of soils is measured by an instrument called a stabilometer, which specifically measures the horizontal pressure transmitted by a vertical load. Consolidation is the compaction or pressing together of soil that occurs under a specific load condition; this property is also tested.

3 Site Investigation

Soil surveys are conducted to gather data on the nature and extent of the soil expected to be encountered on a project. The amount of effort spent on site investigation depends on the size and importance of the project; it may range from visual inspection to elaboration subsurface exploration by boring and laboratory testing. Collection of representative samples is essential for proper identification and classification of soil. The number of samples taken depends on previously available data, variation in soil types, and the size of the project. Generally, in the natural profile at a location, there is more variation in soil characteristics with depth than with horizontal distance. It is not good practice to collect composite samples for any given horizon (layer), since this does not truly represent any one location and could prove misleading. Even slight variations in soil characteristics in a horizon should be duly noted. Classification of the soil in terms of grain size and the liquid and plastic limits are particularly important steps.

An understanding of the eventual use of the data obtained during site investigation is important. Advance information on site conditions is helpful in planning any survey program. Information on topography, geological features (outcrops, road and stream cuts, lake beds, weathered remnants, etc.), paleontological maps, aerial photographs, well logs, and excavations can prove invaluable. Geophysical exploration methods yield useful corroboratory data. Measurement of the electrical resistivity of soils provides an insight into several soil characteristics. Seismic techniques often are used to determine the characteristics of various subsurface strata by measuring the velocity of propagation of explosively generated shock waves through the strata. The propagation velocity varies widely for different types of soils. Shock waves also are utilized to determine the depth of bedrock by measuring the time required for the shock wave to travel to the bedrock and return to the surface as a reflected wave.

Dependable subsurface information can only be obtained by excavation. A probe rod pushed into the ground indicates the penetration resistance. Water jets or augers are used to bring subsurface materials to the surface for examination. Colour change is one of the significant elements such an examination can reveal. Various drilling methods are employed to obtain chips from depth. Trenches or pits provide more complete information for shallow depths. Pneumatic or diamond drilling may be required if hard rock is encountered. At last a few of the boreholes should exceed the depth of significant stress that is established for the structure.

Avoidance of structural disturbance of the sample is not critical for some tests but is very important for in-place density or shearing strength measurements.

Complete and accurate records, such as borehole logs, must be prepared and maintained, and the sample themselves must be retained for future inspection.

土力学

土力学是一门在工程上与土有关的科学,它使用了力学和水力学的定律。土是含或不含有机质的矿物颗粒自然的堆积,是由岩石受到化学和力学机械风化而成。它由三种成分构成:固体矿物、水和空气或其他气体。土在成分上有很大变化,它很复杂,使得长时间对这种材料的研究受到阻碍。由于对残墙、基础、堤坝、道路和其他建筑物破坏的不断调查产生了与土自然状态和它的特性有关知识的集合体,且演变为土力学作为工程科学的分支。

一、历史

直到18世纪后半叶,以科学为依据的土力学有关的问题才得到一些进展,这时法国物理学家 Charles-Augustin de Coulomb 发表了他的土压力理论(1773)。在1857年苏格兰工程师 Willlian Rankine 提出了土体平衡理论并用于基础工程的一些基本问题。尽管这两个理论有着错误,即所有土缺少黏结力类似干砂,但它们依然构成了估算土压力常用方法。20世纪的进步是在计算中考虑了黏结力;知道了土总的基本物理特性和在特定条件下的塑性;系统研究了土的剪切特性,即在滑动条件下的表现。

Coulomb 和 Rankine 理论假定土受到剪切破坏面是一个平面。这对砂土基本可行,黏土滑动沿着曲面。在20世纪早期,瑞典工程师提出滑动面是一个圆弧。在最近半个世纪,为了工程设计,在土的科学研究、理论应用和试验资料方面取得了不少进步。

一个重要成就就是由德国工程师 Karl Terzaghi 得到的,他在1925年发表了在加压条件下,黏土固结速率的数学分析。他的分析由试验证实并解释了饱水黏土沉陷时间滞后效应。他于1925年出版了《土—建筑力学》一书并提出土力学这一术语。

在路基材料研究方面,道路下的天然地基大约是在1920年由美国垦务局开始研究的。有几种试件试验涉及路基设计天然土的性质。在英国,道路研究委员会于1933年成立。1936年,关于土的第一次国际会议在哈佛大学举行。

今天,土木工程师多依赖于试验成果增加经验并把新问题与建立的解联系起来。对试验来说,获得有代表性的土样是非常困难的;由此趋于现场试验替代室内试验,许多重要特性以这一方式评价。

二、土的工程性质

对土的性质来说,决定用于工程使用的指标包括摩擦系数、黏结力、压缩性、弹性、渗透性和毛细现象。

摩擦系数是土体滑动所产生的抗滑现象。砂和砾石比黏土摩擦系数要大;在黏土中增加水分会降低摩擦系数。在建筑物自重作用下土的滑动趋势以剪切的方式发生;也就

是说,土体在平面上移动要么水平,要么垂直或其他方式。这样的剪切移动对建筑物是危险的。

抗剪切破坏也是土的黏结力的特性,它是土颗粒相互吸引产生的,与土颗粒之间的分子力和水分存在有关。黏结力明显受到水分的含量影响。黏结力在黏土中非常高,在砂和粉砂中几乎不存在。对于干砂来说,黏结力是零,对非常硬的黏土达到 100 kPa。

压缩性是土的一个重要特性,由于滚动、夯实、震动或其他手段可以使土发生密实,由此可增加它的密实度和承载能力。

任何有弹性的土在压实后会趋于恢复到原有状态。弹性土(膨胀土)作为柔性道路路基是不合适的,因为当车辆经过时会产生压实和膨胀,引起道路破坏。

渗透性是允许水通过土渗流的一种性质。冬天的冻融循环、夏天的湿干循环会改变土颗粒的密度。压实会使渗透性减小。

毛细作用使水升高,即高出土中垂直自由水位所形成的水平面。对大部分土来说有大量毛细作用通道存在。在黏土中由于毛细作用,水可以升高 30 英尺。

密度是质量与实测土的体积之比或用专用测量装置来确定。土的稳定性由稳定仪来测定,它可测定由垂直荷载引起的水平力。固结是一种密实或在特定荷载条件下使土压缩在一起。这种性质要进行试验。

三、现场调查

土的测绘是指在工程中对可能遇到的一定范围的土和其天然状态进行资料收集。现场调查所花费的工作量依赖于工程规模和重要性;现场调查可以由肉眼鉴定、用钻孔对地下钻探以及实验室试验。为了对土做适当鉴别和分类,收集有代表性的试样是基本的工作。所取试件的数量依赖于以前所获得的资料、土的类型和工程的规模。一般在天然露头上,土的特性在垂直方向比水平方向明显。在给定的水平方向(水平层)收集综合性试件是不合适的,因为这不能代表任何部位,而且会产生错误导向。甚至是土特性在水平方向轻微的变化都应给予记录。按土颗粒大小、液限和塑限做土的分类特别重要。

理解在现场调查期间所获得的资料的最终应用是重要的。在现场条件下所得到的信息对计划任何测绘内容是有帮助的。地形、地貌(露头、道路、溪水冲刷、湖床、风化残积物等)、古生物圈地图、航空照片、钻井日记和开挖提供了有价值的资料。地球物理方法可对一些资料进行验证。土的电阻率量测可提供了解一些土的特性。地震技术常用来确定不同地层的特征,通过爆炸使地震波穿过地层测其传播速度来实现。传播速度在不同类型的土中有着较大变化。地震波也可用于确定岩层的深度,方法是通过测量地震波到达岩层再反射到地表(反射波)所需要的时间获取岩层的埋深。

地下可信的信息只有开挖才可得到。插入地层中的钻头测杆可给出穿过地层的电阻。水枪和麻花钻可用于把地下资料带到地表进行检查。检查中所显示的颜色变化是值得注意的环节之一。为了获得深部的碎片,可采用不同的钻探方法。在浅处可用沟槽或试坑来获得信息。如果达到坚硬岩石,可用气动或金刚石钻进。为了修筑建筑物,要打几个钻孔使其穿过显著应力区。

对有些试验来说,防止试件破坏是不重要的,但对测试原位密度和剪切强度非常

关键。

完整和精确的记录(如钻孔日记)要准备好和保留好,试件本身也是如此,以备进一步检查。

Reading Material

Geologic Origins of Soils

It is a feature of earth's geologic activity that the rocks forming the earth's mantle are continually being pushed out of the earth onto the surface, where they are then exposed to earthquakes, glaciation, freeze-thaw, water erosion, chemical attack, waterborne abrasion, wind erosion, and other forms of weathering. Under such attack, the rocks are broken progressively into huge boulders, these into smaller boulders, these into cobbles, these into pebbles, and finally, the pebbles are reduced to grains. Deposits of these assorted particles of rock and rock grains are called soils.

There is at present no word in engineering geology that is used specifically to describe the ever-continuing reduction of rock into smaller and smaller particles. For the sake of simplicity, it is termed degradation in subsequent discussions. Degradation of rock into soil grains is not something that happened only in some vague geologic past. It is a continuing process, as active today as it was a million years ago.

As the size of the particles become progressively smaller, the particles become progressively easier to transport. Transported first by such things as glaciation and avalanche, the particles are reduced to smaller and smaller size as they are subjected successively to rushing floods, then ,when smaller, by white water rapids, later by rapidly moving streams, eventually by muddy meandering rivers, and finally, when small enough, to wind and duststorms. At any stage, the particles might be deposited in a recognizable stratum for a few thousand years before something happens to cause them to be picked up, transported, and deposited in some new location along with particles transported similarly from a hundred other locations.

At every stage of deposition and stratification, water is the ever-present medium of erosion and transport. Water deep within the ground carries acids and bases that chemically attack the particles even when they are buried thousands of feet deep. At the surface, rain, snow, and sleet combine to erode, freeze-thaw, and further reduce chunks of rock into smaller and smaller pieces.

Whenever exposed, the soil particles become subject to organic attack by vegetation, carbon dioxide, and atmospheric acids, changing them chemically into other compounds or even other minerals. Picked up again, redeposited, and exposed again and again, the particles might undergo thousands of years of changes before they come to rest for a few hundred years in relative quiet. It is at one of these quiet periods that the foundation engineer is given a stratum of these particles on which to place a foundation.

Because nature works on such a huge scale, the strata are usually (but not always) so large that the foundation can be located entirely on one stratum. But underlying this stratum could be another stratum having vastly different engineering properties, and underlying this, yet another. The material to be used to support a building foundation is thus a heterogeneous mixture of minerals coming from countless sources over the breadth of a continent, randomly deposited, irregularly stratified, and absolutely inconsistent. It is, in short, soil.

With such a description, defining the engineering properties of a material as variable as soil would seem to be hopeless. Within recent years, however, real progress has been made in defining the engineering properties of soils. Although these properties are more appropriate within large brackets rather than to refined exact details, the response of most soils to a bearing load can now be predicted with some degree of confidence.

Insofar as the engineering properties of a soil are concerned, the mechanism of geologic transport, deposition, burial, and exposure is one of the more important influences. With few exceptions, all soils have been transported to their present locations from somewhere else. They have been blended, disturbed, chemically modified, reblended, mixed, crushed, restratified, picked up and redeposited, sometimes loaded by thousands of feet of overburden, and finally exposed when the overburden was eroded away. The mechanism by which the stratum was finally deposited and later exposed will be seen to be of profound importance when the soil is used as a foundation material.

A second major influence is the groundwater. The location of the water table, the amount of its rise and fall throughout the year, and the chemistry of the groundwater can profoundly affect both the type of foundation and the ability of the soil to carry the foundation. In some circumstances, however, the water entering the soil from the surface can be far more important than that in the water table below.

A third major influence is the residue of vegetation. Even in the most barren deposits of soil, a few plants will manage to survive. The residue from their eventual death and decay will provide a somewhat more hospitable environment for the next generation of plants. The detritus of these plants in turn will deepen the fragile layer of organic material, providing a yet more fertile ground for other plants, and so on. Eventually, a gradient of organic material is developed, with the high organic content at the surface diminishing steadily with depth. As always, water is the primary vehicle for transporting the organic material downward. Aided in this case by disturbances from root penetration.

These combined effects of deposition, water percolation, vegetation, and other influences on the soil eventually produce a typical distribution of soil and organic matter called a soil profile by agronomists.

The presence of humus or organic material in a soil can cause serious changes in engineering properties as the organic material continues to decay. Due to this variability, engineered foundations must be placed well below the organic agricultural soils and into the parent soils of the Chorizon. The engineering properties of the soils in the Chorizon are reasonably constant and are not subject to change due to the decay of organic material.

Although soils have long been classified into broad groupings, the engineering properties of various classifications of soils cannot be determined once and used thereafter as constants; a soil in Wyoming classified as clay might have vastly different properties from a soil in Georgia classified as clay. There are, however, certain characteristics that are common to all soils regardless of origin or chemistry. Such characteristics can be used as a basis for soil classifications. One such characteristic is the size and shape of the individual particles that comprise the soil .

阅读材料

土的地质起源

形成地幔的岩石在不断地冲出地壳到达地表,这是地球地质活动的一个特征,在地表它们会受到地震、冰川、冻融、水侵蚀、化学反应、水的磨损、风蚀作用,同时也受到其他形式的风化。在此情况下,岩石会逐渐地被破坏成为巨大的砾石,再变为较小的砾石,到大鹅卵石,到卵石,最后卵石成为砂砾。各种岩石颗粒和岩石颗粒沉积物叫作土。

目前,在工程地质中还没有专用名词来描述岩石不断变小一直成为微粒这一过程。为了简明扼要,在后面的讨论中用裂解一词。成为土粒的岩石裂解并不是在遥远的地质史上发生的。它是一个连续过程,在亿万年前和今天是一样的。

当颗粒变得越来越小,搬运会更容易。首先它们受到冰川和雪崩搬运,当它们不断地受到洪水冲刷时,颗粒会进一步减小,其后受到急流再后是急速小溪的作用,颗粒会更小,再后来是带泥质缓慢河水作用,最后变得足够小,受到风干,甚至成为沙尘暴。由于某种原因引起颗粒发生分选、搬运和在一些新位置沉积发生前,在任何一个阶段从可识别的地层知道这些微小颗粒已沉积了千万年,在其他地方颗粒搬运是类似的。

在沉积物和岩层的每一时期,水总是在剥蚀和搬运中起作用。水挟带着酸和碱渗入地下,颗粒会受到化学作用,甚至它们被埋藏几千英尺也会发生。在地表,雨、雪或雨夹雪联合发生剥蚀、冻融,这样会使岩石块度减小,成为越来越小的碎屑。

只要剥蚀存在,在植被、碳氧化合物、大气中酸的作用下土颗粒就会承受有机质腐蚀,使它们在化学上成为一种另外的化合物,甚至变为另外的矿物。在它们相对静止下来千百年之前,由于再分选,再沉积,一次又一次地剥蚀,使颗粒受到上千年的变化。在其中的一个静止期,基础工程师把土颗粒构成的土层作为基础。

由于自然界在一个巨大尺度上起着作用,岩层分布非常广,使地基完全布置在同一个岩层上(也有个别例外)。但这一层下面的一层会是有不同工程特性的另外一层,在其下的又是另外一层。而用于支撑建筑物基础的材料是不同种类矿物混合物,它们来源于一个宽广大陆的无数地方,随机沉积,具有不规则和完全不协调的特征。人们叫它土。

如上所述,定义土这种易变材料的工程特性似乎有困难。然而,最近几年,在确定土

的工程性质上取得了实质的进展。虽然这些性质更多表现在大的范围内而不是确切的细节,但大部分承载力效应在一定程度上是可预测的。

从土的工程特性而言,地质搬运机制、沉积、埋藏和剥露最为重要。除个别情况,所有土都是从其他的位置被搬运到现在的地方。它们被混合、扰动、化学变化,再混合、掺和、冲刷、成层作用、分选,再沉积,有时会受到上覆几千英尺荷载,最终,上覆层受到剥蚀暴露于地表。当土作为地基材料时,土层最终沉积机制和其后裸露机制是最为重要的。

第二个主要影响因素是地下水。水位高程,在一年中水位升降的数量,地下水的化学作用对基础的类型、地基土的承载能力有着重要的影响。在一些情况下,从地表进入土中的水远比下面的地下水更为重要。

第三个主要影响是植物的残留物。即使在大部分贫瘠的土层中,也有少量的植物残存。植物最终死亡和腐烂的残积物在某些程度上为下一代植物提供了更加有利的环境,进而这些植物的碎屑转化成有机质的碎屑层,为其他植物提供了一个更为肥沃的土层。最终有机质成分增加了,与此同时,地表有着很高的有机含量的土随着深度增加有机质逐渐消失。水总是把有机质向下搬运的载体。根系的作用使这一过程得到加强。

土层、水的渗入、植物和其他因素联合作用最终构成土和有机物的分布,农学家称其为土剖面。

当有机质不断腐烂时,土中的腐殖质或有机质会使土的工程特性发生变化。由于这种变化,工程基础必须布置在有机农业土以下,放在 C 层(Chorizon,母质层)原生土中。C 层土的工程特性相当稳定,不会受到有机质腐烂的影响。

虽然土长时间以来已划分若干类,但各类土的工程性质不能一次来确定,并认为是不变的;黏土 Wyoming 分类与 Georgia 分类在特性方面可能有着很大不同。然而,对整个土来说,除了起源和化学成分外肯定会有共性。如此一些特性可作为土分类的一个依据,如土颗粒的大小和形状就是各类土所具有的。

Unit 2

Text

Soil Failure Surfaces

Failure conditions and strength parameters are very important in the solution of stability problems in soil mechanics. Two values of the shear strength, the peak (maximum) and the residual (ultimate), are required in order to characterize the strain softening materials, such as overconsolidated clays and dense sands at low confining pressures. The term failure is used herein to define the limiting peak (or maximum) stress conditions.

It should be emphasized, however, that in problems involving such soils as dense sands and overconsolidated clays, both peak and residual strength parameters are needed. In this case, the actual maximum shear stress mobilized at overall failure of a soil mass lies between the two limits of the peak and residual values (Bishop, 1972).

In the following, various strength characteristics are discussed with reference to the shape of the failure envelope in Mohr's diagrams. In the Mohr's diagram the normal stress σ and the shearing stress τ are used as coordinates.

From a plot of Mohr's circles corresponding to various failure stress states (in terms of effective principal stresses, $\sigma_1' \geq \sigma_2' \geq \sigma_3'$), the Mohr's failure envelope can be obtained as the common tangent curve to these circles, as shown in Fig. 2. 1. In general, the failure envelopes are curved, particularly for dense soils, such as dense sand or oversolidated clay. In many cases,

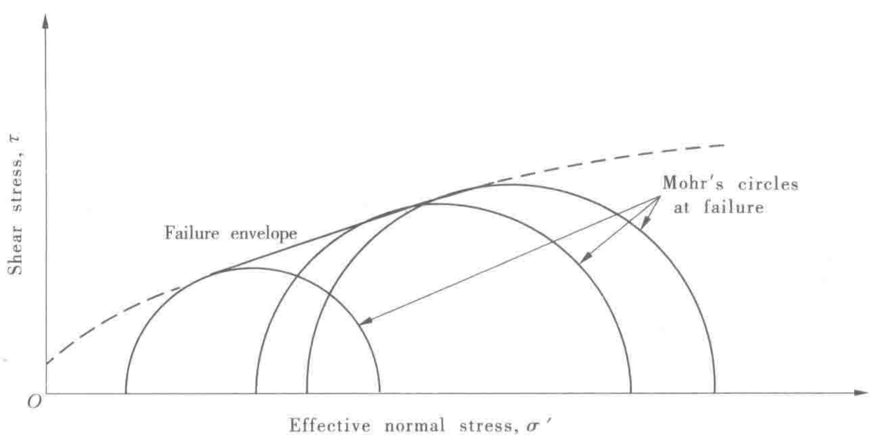

Fig. 2. 1 Typical Mohr's failure envelope for soils