

第7回国際土質基礎工学会議に提出された State of the Art Report の紹介

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土質力学に限らず、あらゆる学問で文献過剰が最近の傾向である。この状態にどのように対処すべきであるかは何人かによって論じられたり提案が行なわれたりしている。多数の人々によって抄録をつくり、それらを分類整理しておき、必要なときに必要な資料が利用できるようにしようということには変わりなく、かつ論文に順位を付けて重要なものとそれほどでないものを区別すべきであるというのも共通しているようである。しかし、論文の重要度を決めるということは、いうべくして難しいことである。

編集委員会から土質力学についての展望記事を書くように頼まれたのだが、自分が怠けているのを棚に上げて物をいわせて貰えば、そう簡単に展望などできるものではない。ところが幸いなことに、今夏(1969年)Mexico city で開かれた第7回国際土質基礎工学会議では、いままでのような国際会議に提出された論文を主とした一般報告の代りに、現況報告とでもいうのだろうが State of the art reports という論文がつくられた。これを紹介することも一法であると思った。約一年ほど前に会議の準備委員会から何人かが委嘱され、それぞれの部門の専門家から論文を募集し、それらを分類・系統立てて報告をつくったのである。筆者と項目とを書く

R.F. Scott, Hon-Yim Ko : Stress-Deformation and Strength Characteristics

V.F.B. De Mello : Foundations of Buildings in Clay

S.D. Wilson, R. Squier : Earth and Rockfill Dams

R.B. Peck : Deep Excavations and Tunneling in Soft Ground

A.W. Skempton, J. Hutchinson : Stability of Natural Slopes and Embankment

である。

わたくしは Scott と Ko のものしかまだ読んでいないが、他の報告は標題だけ見それだけでもかなり参考になると思った。Scott と Ko のはかなり良く書かれているが、何ととっても約 300 の論文をかなり密につまった印刷とはいへ 35 ページで書くためには、やはりはなはだ

しく簡潔に書かねばならないから、引用された論文の内容を十分に知るためには原論文を見なければならぬ。しかし、大略のことを知り、またいままで気のつかなかった論文を教えられるためには大変便利であった。あれだけ多くの論文を読み、あのように整理し報告にまとめることは非常に困難だったに違いない。われわれは Scott と Ko に感謝すべきだと思っている。当然のことだが、Scott と Ko の好みはかなり入っているが、それは仕方ないことである。ついでながら Ko は漢字で高漢楨と書く若い香港の人である。他の項目も非常に沢山の論文を整理したものであり、それぞれの部門の練達の士の手になるものだから、大変参考になると思う。以下すべての項目についての報告の見出しだけを紹介する。

ずるいやり方は自分でも余り感心していないが、無理して独力で下手なものを書くよりははるかに良く、多くの人々の役に立つと信じている。

R.F. SCOTT and HON-YIM KO, STRESS-DEFORMATION AND STRENGTH CHARACTERISTICS

Introduction

1. Microscopic and Physico-Chemical Studies

- 1.1 Experimental Studies of Structure
- 1.2 Rate Process
- 1.3 Granular Models

2. Consideration of Continuum Mechanics and Mathematical Methods

- 2.1 Elasticity
- 2.2 Plasticity and Failure Theories
- 2.3 Viscoelasticity
- 2.4 Theories of Consolidation and Mixtures
- 2.5 Statistical Approaches

3. Macroscopic or Engineering Behaviour

- 3.1 Testing Procedures and Apparatus
- 3.2 Deformation
- 3.3 Failure and Yield
 - 3.3.1 Sands
 - 3.3.2 Clays
 - 3.3.3 Partly Saturated Soils
- 3.4 Anisotropy
- 3.5 Consolidation; Time Effects

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- 3.5.1 Consolidation and Swelling
- 3.5.1 Time Effects
- 3.6 Temperature
 - 3.6.1 Volume Change and Pore Pressure
 - 3.6.2 Elastic Properties
 - 3.6.3 Strength
 - 3.6.4 Creep
 - 3.6.5 Swelling

V.F.B. DE MELLO : FOUNDATIONS OF BUILDING IN CLAY

1. Introduction
 - 1.1 Aim
 - 1.2 Scope
 - 1.3 Concept
 - 1.4 Method
 - 1.5 Difficulties
 - 1.6 Recommended generalized approach
2. THE ULTIMATE BEARING CAPACITY OF FOUNDATIONS
 - 2.1 Safety against failure : separate and prerequisite analysis
 - 2.2 Bearing capacity solutions most commonly applied
 - 2.2.1 Terzaghi's(1943) solutions and Krizek's(1965) empirical simplification
 - 2.2.2 Meyerhof's (1951, 1955) general solution and simplified recommendations (1963)
 - 2.2.3 Skempton's (1951) bearing capacity of clays
 - 2.2.4 Brinch Hansen's (1961, 1966) simplified recommendations
 - 2.3 Shear strength values applied to $\phi = 0$ analysis of bearing capacity
 - 2.3.1 Sampling and laboratory testing
 - (a) Sampling technique
 - (b) Laboratory testing
 - 2.3.2 Field vane testing
 - 2.3.3 Foundation failure and shallow plate tests
 - 2.4 Bearing capacity theory and formulae
 - 2.4.1 Summary of present status of plate bearing capacity
 - 2.4.2 Analysis of the significances of different theories
 - 2.4.3 Estimate of the field of practical interest and available confirmatory evidence
 - 2.4.4 Some basic problems associated with Prandtl theory and Bearing Capacity Formulae
 - 2.4.5 Bearing capacity solutions for special cases
 - 2.5 Bearing capacity of individual piles and piers
 - 2.5.1 Point and skin resistance for piles
 - (a) Point resistance
 - (b) Skin resistance
 - 2.5.2 Analysis and synthesis of load-stress distribution-settlement behaviour of single piles
 - 2.5.3 Some consideration on load tests on piles
 - 2.6 Complementary in-situ tests in wide-spread use
 - 2.6.1 The static cone penetrometer

- 2.6.2 The pressuremeter (Ménard)
- 2.7 Deep foundations in London Clay
 - 2.7.1 Driven piles
 - 2.7.2 Bored piles
 - 2.7.3 Large bored piles
- 2.8 The standard penetration test, used in clays
- 2.9 Interference of deformability and settlements in the interpretation of load tests

3. SETTLEMENTS OF SHALLOW FOUNDATIONS

- 3.1 Immediate settlements
 - 3.2 Consolidation settlements
 - 3.3 Recent advances in settlement prediction
 - 3.3.1 Stress-strain-time path method, using triaxial testing
 - 3.3.2 Generalized elastic theory treatment for settlement prediction under three-dimensional conditions
 - 3.3.3 Empirical stress-strain-time formulations
 - 3.4 Rate of settlement solutions
 - 3.4.1 Solutions connected with interpretation of laboratory tests, under the basic premises of the Terzaghi theory
 - 3.4.2 More general solutions for the consolidation of clay layers
 - 3.4.3 Rate of settlement solutions based on other rheological models
 - 3.5 Significant parameters interfering in settlement analysis and their ranges of dispersions
 - 3.5.1 Field information
 - 3.5.2 Stress distribution theories as regards differential settlements
 - 3.5.3 Pore pressure coefficients A and B
 - 3.5.4 Preconsolidation pressure p_c of a stratum
 - 3.6 Some special engineering solutions to problems of settlements of foundations
- ## 4. PILE FOUNDATIONS
- 4.1 Earlier routine design practices
 - 4.2 "Immediate" load-settlement behaviour of group of piles
 - 4.3 Execution effects in, and due to pile foundations
 - 4.3.1 Remoulding around displacement piles
 - 4.3.2 Stress changes near and around the pile
 - 4.3.3 Execution effect on adjacent structures
 - 4.4 Negative skin friction
 - 4.5 Some special piles for special purposes
- ## 5. ALLOWABLE SETTLEMENTS

S.D. WILSON and R. SQUIER : EARTH AND ROCKFILL DAMS

- Introduction
1. Historical
 - 1.1 Failures
 - 1.2 Ancient dams
 - 1.3 Nineteenth century dams
 - 1.4 Hydraulic fill dams
 - 1.5 Rockfill dams

- 1.6 Modern earth and rockfill dams
- 2. Field explorations
 - 2.1 General
 - 2.2 Geological and foundation investigations
 - 2.3 Reservoir studies
 - 2.4 Groundwater investigations
 - 2.5 Borrow areas
 - 2.6 Field tests
 - 2.6.1 General
 - 2.6.2 Tests on embankment materials
 - 2.6.3 Tests on materials in-situ
 - 2.6.4 Field permeability tests
 - 2.6.5 Test fills
 - 2.6.6 Test embankments
- 3. Laboratory testing
 - 3.1 General
 - 3.2 Cohesive soils
 - 3.2.1 Strength of compacted clay for end-of construction condition
 - 3.2.2 Strength of compacted clay for long-term steady seepage condition
 - 3.2.3 Strength of compacted clay for rapid draw-down condition
 - 3.3 Granular materials
- 4. EMBANKMENT DESIGN
 - 4.1 Selection of basic dam section
 - 4.2 Basic design requirements
 - 4.3 Stability analysis
 - 4.3.1 General
 - 4.3.2 Factors of safety
 - 4.3.3 Methods of analysis
 - 4.3.4 Conditions of analysis
 - 4.3.5 Limitations
 - 4.3.6 Evaluation of seismic effects
 - 4.4 Seepage control
 - 4.4.1 General
 - 4.4.2 Foundations and abutments
 - 4.4.3 Grouting
 - 4.4.4 Concrete cutoff wall
 - 4.4.5 Slurry trench walls
 - 4.4.6 Upstream impervious blankets
 - 4.4.7 Steel sheet piles
 - 4.4.8 Relief wells
 - 4.5 Special design considerations
 - 4.5.1 Cracking
 - 4.5.2 Load transfer
- 5. CONSTRUCTION
 - 5.1 Cofferdams and river diversion
 - 5.2 Foundation excavations
 - 5.2.1 General
 - 5.2.2 Core Contact treatment
 - 5.2.3 Abutment treatment
 - 5.3 Placement and compaction of material
 - 5.3.1 Core materials
 - 5.3.2 Transitions
 - 5.3.3 Rockfill
 - 5.4 Underwater fills

- 5.5 Rip-rap
 - 5.5.1 Soil cement
- 5.6 Field control
- 6. INSTRUMENTATION
 - 6.1 Introduction
 - 6.2 Piezometers
 - 6.2.1 Open standpipe piezometer
 - 6.2.2 Hydraulic type
 - 6.2.3 Pneumatic type
 - 6.2.4 Electrical type
 - 6.3 Internal movement devices
 - 6.3.1 Vertical movement devices
 - 6.3.2 Horizontal movement devices
 - 6.3.3 Horizontal strain meters
 - 6.4 Surface measurements
 - 6.5 Stress measurements
 - 6.6 Earthquake Recorders
 - 6.7 Additional comments
- 7. DEFORMATION OF EARTH AND ROCKFILL DAMS
 - 7.1 General
 - 7.2 Mammoth Pool Dam
 - 7.3 El Inffernillo Dam
 - 7.4 Netzahualcoyotl Dam
 - 7.5 Muddy Run Embankment
 - 7.6 Plover Cove Dam
 - 7.7 Oroville Dam
 - 7.8 La Villita Dam
 - 7.9 Miscellaneous
- 8. PROBLEMS IN DESIGN AND CONSTRUCTION

R.B. PECK : DEEP EXCAVATIONS AND TUNNELING IN SOFT GROUND

Foreward

- 1. Tunneling
 - 1.1 Introduction
 - 1.2 Requirements for a satisfactory tunnel
 - 1.3 Feasibility of tunneling
 - 1.3.1 Previous criteria
 - 1.3.2 Feasibility of use of digging machines
 - 1.3.3 conclusions
 - 1.4 Damages to surroundings
 - 1.4.1 Loss of ground
 - 1.4.2 Cohesionless granular soils
 - 1.4.3 Tunnels in cohesive granular soils
 - 1.4.4 Non-swelling stiff to hard clays
 - 1.4.5 Soft to stiff saturated clays
 - 1.4.6 Distribution of settlement
 - 1.4.7 Conclusion
 - 1.5 Design of lining
 - 1.5.1 Basic concepts
 - 1.5.2 Tunnel with primary and secondary lining
 - 1.5.3 Combined primary and secondary lining
 - 1.5.4 Semi-empirical basis for design of lining
 - 1.5.5 Ring stress
 - 1.5.6 Bending

- 1.5.7 Buckling
- 1.5.8 Influence of external conditions : Multiple tunnels
- 1.5.9 Influence of external conditions : other factors
- 1.5.10 Recommended design procedures
- 2. DEEP EXCAVATIONS
 - 2.1 Introduction
 - 2.2 Lateral movements and settlements
 - 2.2.1 Characteristic movements
 - 2.2.2 Summary of lateral movements of vertical earth supports
 - 2.2.3 Summary of settlements
 - 2.2.4 Settlements due to removal of struts
 - 2.2.5 Conclusions
 - 2.3 Base failure by heave
 - 2.3.1 Soft clays
 - 2.3.2 Stiff clays
 - 2.4 Reduction of settlement
 - 2.4.1 General Principles
 - 2.4.2 Trench method
 - 2.4.3 Cast-in-place concrete walls
 - 2.4.4 Dredging
 - 2.4.5 Air pressure
 - 2.4.6 Caissons
 - 2.4.7 Other procedures
 - 2.4.8 Summary
 - 2.5 Earth pressure
 - 2.5.1 Introduction
 - 2.5.2 Cuts in clay, $N=5$ or 6
 - 2.5.3 Cuts in clay $N<4$
 - 2.5.4 Cuts in clay $N=4$ to 6
 - 2.5.5 Clayey sands and sandy clays
 - 2.6 Conclusions

A.W. SKEMPTON, J. HUTCHINSON : STABILITY OF NATURAL SLOPE AND EMBANKMENT

- 1. Introduction
- 2. Types of landslides and other mass-Movements
 - 2.1 Some basic types of landslide on clay slopes
 - 2.1.1 Falls
 - 2.1.2 Rotational slides
 - 2.1.3 Compound slides and translational slides
 - 2.1.4 Flows
 - 2.2 Some examples of multiple and complex landslides
 - 2.2.1 Successive slips
 - 2.2.2 Multiple retrogressive slides
 - 2.2.3 Slump-earthflows
 - 2.2.4 Slides in colluvium
 - 2.2.5 Spreading failures
 - 2.2.6 Quick clay slides
 - 2.3 Rates of landslide movement
 - 2.3.1 Creep
 - 2.3.2 Pre-failure movements
 - 2.3.3 Movements during failure
 - 2.3.4 Post-failure movements
 - 2.3.5 Mudflow movements

- 3. Clays
 - 3.1 Types of clay
 - 3.1.1 Terzaghi's Grouping
 - 3.1.2 Clays produced by rock-weathering in situ
 - 3.1.3 Sedimentary clays
 - 3.1.4 Glacial clays
 - 3.1.5 Periglacial clays
 - 3.1.6 Clays transported by landsliding
 - 3.2 Basic shear strength properties
 - 3.2.1 Effective stress
 - 3.2.2 Piezometric head
 - 3.2.3 Peak and residual strengths
 - 3.2.4 Brittleness
 - 3.2.5 Failure criterion
 - 3.2.6 Anisotropy
 - 3.2.7 Undrained strength
 - 3.3 Discrepancies between field and laboratory strengths
 - 3.3.1 Sampling
 - 3.3.2 Sample orientation
 - 3.3.3 Sample size
 - 3.3.4 Rate of shearing
 - 3.3.5 Softening
 - 3.3.6 Progressive failure
- 4. Stability analysis
 - 4.1 Limit equilibrium methods
 - 4.2 Short-Term and Long-Term conditions
 - 4.3 Effective and total stress methods of analysis
 - 4.3.1 Effective stress analysis
 - 4.3.2 Total stress analysis
 - 4.4 Mechanics of stability analysis
 - 4.4.1 Circular slip surfaces
 - 4.4.2 Non-circular slip surfaces
 - 4.4.3 Planar slides in infinite slopes
- 5. Analytical case records
 - 5.1 First-time slides; short-term
 - 5.1.1 Congress Street
 - 5.1.2 Bradwell
 - 5.2 First-time slides; Long-term. Intact clays
 - 5.2.1 Drammen
 - 5.2.2 Lodalen
 - 5.2.3 Selset
 - 5.2.4 Caneleira
 - 5.2.5 Gradot Ridge
 - 5.3 First-time slides; Long-term. Stiff Fissured clays
 - 5.3.1 Northolt and Sudbury Hill
 - 5.4 Slides on pre-existing slip surfaces
 - 5.4.1 Sudbury Hill
 - 5.4.2 Folkestone Warren
 - 5.4.3 Walton's Wood
 - 5.4.4 Sevenoaks Weald
 - 5.4.5 River Beas Valley
- 6. Slope Development
 - 6.1 Valley slopes in boulder clay
 - 6.1.1 Peterlee
 - 6.2 Slopes in London clay
 - 6.2.1 Coastal Cliffs
 - 6.2.2 Inland Slopes

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