# OCIEBS Newsletter

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## *In* Focus

This is the final issue of volume I, which also suggests that the OCIEBS Newsletter project has successfully completed its journey of the critical first year. It was a busy time understanding the demands of electronic publication. Starting from the selection of a suitable software and learning how to effectively use it to compose the Newsletter, we also had to master the art of event reporting, scanning pictures to strike the difficult balance between resolution and file size and, finally, what format to choose for distributing electronically without jamming recipients' mailboxes. Encouraging feedback from the readers have inspired us to come this far and we take this opportunity to thank all for extending the kind support.

As we reflect on our experiences in the first year, we immediately realize that for long term sustainability of this Newsletter, its scope must be expanded from a mere vehicle for periodically updating you on our current activities and future programmes. We must expand it into a platform for effective two-way communication by opening the door for your active participation. We are publishing a technical article on geotechnical investigation contributed by Dr Kamruzzaman in this issue. We hope that this will encourage you to come forward and contribute articles based on your professional as well as social experiences that you wish to share with you fellow community members.

While we are on the topic of inviting your contribution, please allow me to answer again the question that was discussed in the editorial note of the last issue: What is the benefit of taking up the membership of OCIEBS? OCIEBS is the collective identity of Bangladeshi Engineers in Singapore. We need your support to first build this organization without asking for any return. A strong OCIEBS can help us attain professional recognition that may seem impossible at this time.

We are making an ardent appeal to all Bangladeshi Engineers in Singapore to come forward and define the future of OCIEBS - participate in building OCIEBS from infancy to its full potential.

The Management Committee of OCIEBS takes this opportunity to send belated wishes to all our readers for a peaceful and prosperous 2006 in good health.

**.....From the Editorial Desk**

## Role of Geotechnical Investigations in Civil Engineering Applications


A H M Kamruzzaman, PhD


Major geotechnical problems arise in modern urban and rural civil engineering construction in Southeast Asia mostly on different kinds of soil. Common geotechnical problems include bearing capacity, deformation and stability. In such circumstances, knowledge on properties of soil such as classification, shear strength and deformation are very essential. Geotechnical properties play vital role for the analysis and design of various types of foundations, temporary and permanent earth retaining structures, dams, embankment, roads etc. As such, wide range of good laboratory and field investigations are required to get right geotechnical parameters to solve various types of geotechnical problems involving civil engineering application. The use of sophisticated geotechnical engineering computer programs along with traditional methods in the analysis of wide range of simple and critical problems has increased significantly worldwide. Unfortunately, many industries often use these tools without proper understanding of the behavior of soil arising from geotechnical investigations. The use of incorrect soil properties leads to an unsafe or over-conservative design of civil engineering structures (e.g. foundations, earth retaining structures, dams), which sometimes turn into loss of life as well as millions of dollars. This short article is aimed to provide some understanding on the importance of geotechnical field and laboratory investigations on civil engineering applications. The importance of proper geotechnical investigations is presented along with case studies.

Common geotechnical parameters of soil include unit weight, specific gravity, Atterberg's limits, total and effective vertical and horizontal in-situ stress, undrained shear strength, effective cohesion and friction angle, undrained and drained elastic modulus, earth pressure coefficients, pre-consolidation pressure, compression index, over-consolidation ratio, and coefficient of permeability. All these parameters can be obtained either from field or laboratory or both investigations. Common field and laboratory investigations and their applications are given in Tables 1 and 2.The importance of good geotechnical investigations can only be realized seriously with failure case studies. As such two case studies are presented here.

**Failure of Nicoll Highway, Singapore**
(20th April 2004)

Of the few causes of *Nicoll Highway* collapse in Singapore, the committee of inquiry found that the undrained shear strength of marine clayey soil was over-estimated. The failure caused death of four people and loss in millions of dollars.

**Failure of Teton Dam, USA**
(5th June 1976)

Of the few causes of *Teton Dam* failure, the committee of inquiry found that highly erodible silty soil was used during construction and not compacted up to maximum density or near the optimum moisture content. The failure caused death of fourteen people and loss in millions of dollars.

The above discussions on various aspects of geotechnical investigations lead to the following conclusions:

1. It is necessary to get right geotechnical parameters from appropriate number and type of test based on requirement..
2. For any major civil engineering projects involving geotechnical works, good quality investigation team and right geotechnical professional to be engaged for the interpretation of the results.


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# Role of Geotechnical Investigations

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3. Properties of soil are not unique like other civil eng materials and vary from place to place with geological history. Hence, adequate knowledge on the subject matter of geotechnical engineering is necessary to solve civil engineering problems involving geotechnical works.

**About the author:** The author is currently a Principal Geotechnical Engineer with Cast Laboratories Pte Ltd, Singapore. He holds a PhD degree from the National University of Singapore (NUS), MEng from Asian Institute of Technology (AIT), Bangkok and BScEng from Bangladesh Institute of Technology (BIT), Khulna. He has over 12 years of experience in various fields of geotechnical engineering in consulting, construction, testing and research industry. His fields of specializations are Geotechnical Investigations, Jet Grouting/Deep Cement Mixing, Temporary and Permanent Earth Retaining Structure and Piled Foundation. He is actively involved in various national and international engineering societies. Email: k.zaman@cast.com.sg

**Table 1. Common geotechnical field investigations and their applications.**

| Types of Field Investigations | Geotechnical Parameters | Most Relevant Applications |
|---|---|---|
| Soil Boring | Consistency of soil | Civil engineering problems involving geotechnical works for preliminary assessment |
| Sand replacement, Water replacement, Core cutter and Nuclear | Density | Road, embankment and slope protection |
| Vane Shear | Undrained shear strength | Foundations and earth retaining structures |
| Cone Penetration | End bearing and frictional resistance | Foundations and earth retaining structures |
| Plate Bearing | Bearing capacity | Shallow foundation |
| Light Dynamic Cone Penetrometer | Bearing capacity | Shallow foundation |
| Pressure meter | Elastic modulus and earth pressure coefficient | Earth retaining structures |
| California Bearing Ratio (CBR) | CBR value | Road and embankment |

**Table 2. Common geotechnical laboratory investigations and their applications.**

| Types of Laboratory Investigations | Geotechnical Parameters | Most Relevant Applications |
|---|---|---|
| Moisture Content, Unit Weight, Particle Density, Particle Size Distribution, Atterberg's Limits | Classification and index | Civil engineering problems involving geotechnical works for preliminary assessment |
| Unsoaked and Soaked California Bearing Ratio | California Bearing Ratio (CBR) value | Road, embankment, slope protection |
| Standard and Modified Proctor | Optimum dry density and moisture content | |
| Unconfined Compression (UC) | Strength and deformation in total stress condition | Foundations and earth retaining structures |
| Triaxial Compression (Undrained and Drained) | Strength and deformation in total and effective stress conditions | |
| Direct Shear (Undrained and Drained) | Strength and deformation in total and effective stress conditions | |
| Oedometer Consolidation | Consolidation and settlement | Foundations |
| Constant Head and Falling Head Permeability | Coefficient of permeability | Earth retaining structures, dam, cut-off wall |