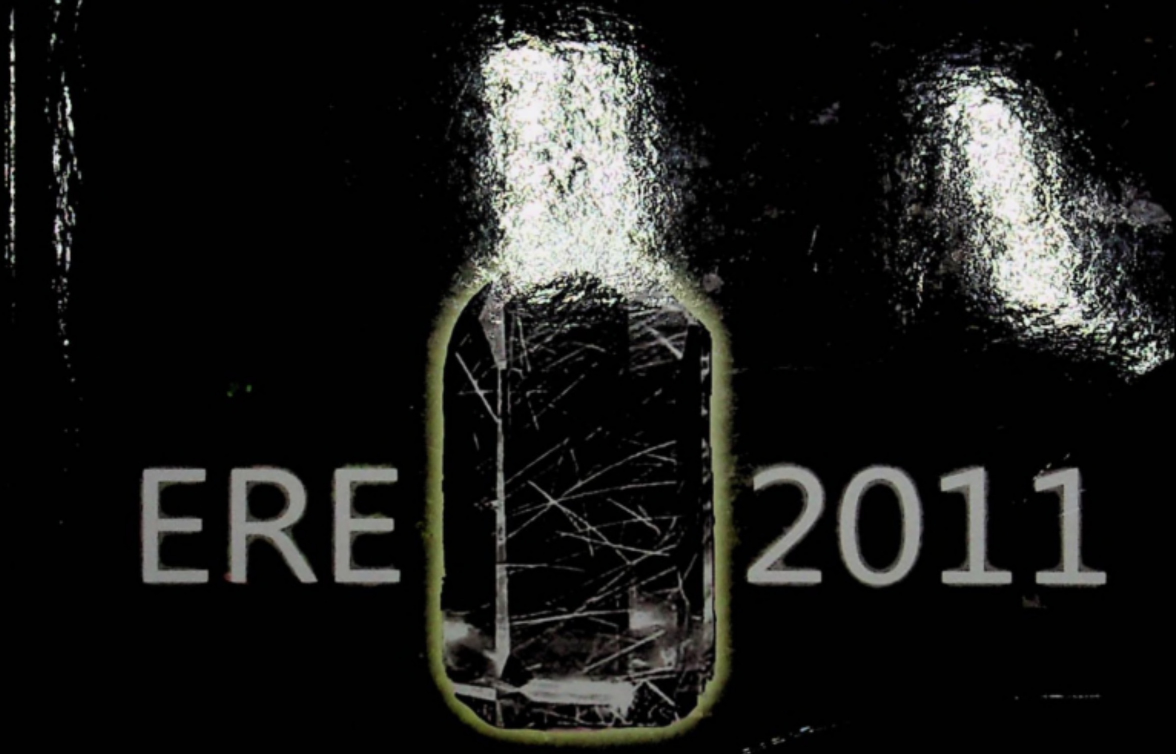
Proceedings of 6th National Conference on

MINERALS AND INNOVATIVE THINKING



ERE 2011

Organized by
Department of Earth Resources Engineering
University of Moratuwa
Moratuwa, Sri Lanka

Proceedings of ERE2011

6th National Conference on "Minerals and Innovative Thinking"

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ERE 2011

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6th National Conference

on

"Minerals and Innovative Thinking"

25th November 2011

Department of Earth Resources Engineering

Faculty of Engineering

University of Moratuwa

Sri Lanka

ISSN 1800-346X

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Published by the Department of Earth Resources Engineering

Faculty of Engineering

University of Moratuwa, Katubedda, 10400, Moratuwa

Prepare yourself to be challenged, excited and inspired!

It is indeed a pleasure for me to join my colleagues in welcoming to have you here sharing the ERE 2011 - 6th National Conference on 'Minerals and Innovative Thinking' organized by the Department of Earth Resources Engineering, University of Moratuwa.

"The Annual Conference" is the pinnacle of the key events of the department where the present students, Alumni and related professionals get-together and actively take part in presenting their new findings to their colleagues for constructive discussion, leading the way for Earth Resources and Mining Engineering applications of those findings for betterment of the trade, industry and standards of public life.

I hope this timely theme would enhance your knowledge on Sri Lankan mineral wealth and would inspire you to develop innovative products and processes to help develop our motherland.

I would like to convey my heartfelt gratitude towards all those who have helped me to organize this event and, especially, the reviewers and the co-editor who have put so much of effort to bring this edition into a successful one. This gathering would not have been possible without the cordial assistance of our sponsors.

Dr. N. P Ratnayake

Conference Coordinator
ERE 2011

25th November 2011

It is with great please I send this message to the proceedings of ERE 2011 - 6th National Conference on 'Minerals and Innovative Thinking'.

Mother is the ancestry of the humanity on this planet, called EARTH. It is the mother who looks after her children with such loving care, no matter what they say or how they behave. Similarly, we have inherited innumerable natural wealth from our MOTHER NATURE. She has been so generous in doing so for especially to the living beings on this beautiful island nation, Sri Lanka.

Today, natural resources are threatened due to overexploitation and how these limited resources should be utilized rationally for generations after generations demand for innovative thinking. In recent decades, humankind has realized that population, resources, environment and development problems are major threats to the future of humanity. The adverse environmental scenarios continuously took place in the recent past rings alarm bells to remind us that there is 'only one globe' and humanity shares a 'common future'. Economic growth is no longer the sole factor and humans now pay more attention to coordinated development among society-human and natural, and past, present and future.

The wealth of industrial minerals the Mother Nature has bestowed upon us such as ball clay, kaolin, and other clays, calcite, dolomite, feldspar, gemstones, graphite, limestone, mica, mineral sands containing limonite and monazite, phosphate rock, quartz, gem stones and silica sand has to be utilized in a sustainable manner with much wisdom. Unfortunately, according to the published literature, mining for minerals is a minor economic activity contributing only about two to three percent of the gross domestic product in our country. As a nation we can be proud that Sri Lanka leads the world in high-grade graphite mining though we can go further with a bit of innovation and certainly, innovative thinking in the correct direction. It is with such vision that the Department of Earth Resources Engineering is hosting this annual research dissemination seminar and we sincerely hope that this event will mark a mile stone in reaching the winning goal.

Today, this grand event was made possible because of several key persons. First I must congratulate the conference coordinator and his team for the hard and untiring work done during the past several months. All the sponsors of this event, contributed generously towards fulfilling a national endeavour. Also, I must congratulate all the authors and presenters of today's conference for tremendously contributing towards the success of this event.

I herewith, invite you all to be a part of this fruitful deliberation during the day and take it up to a national level dialog from there onwards.

Dr. Shiromi Karunarathna
Head, Department of Earth Resources Engineering

24th September 2010

ERE 2010

Department of Earth Resources Engineering

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8.30 – 9.00 Registration

Opening Ceremony

9.00 – 9.10 Traditional Lighting of the Oil Lamp and the National Anthem

9.10 – 9.15 Welcome address by the Head, Department of Earth Resources Engineering, University of Moratuwa

9.15 – 9.25 Address by the **Guest of Honour**--Dean, Faculty of Engineering, University of Moratuwa

9.25 --10.00 **Keynote Address** –Eng. Upul S. Goonasekera, Additional General Manager (Special Projects), Central Engineering Consultancy Bureau – "Development of Engineering Geology and its Roll in Engineering Construction Field"

10.00 – 10.20 Sponsor Presentations

10.20 -- 10.40 MORNING TEA

Technical Sessions

Session I-- Minerals and Innovations

10.40 -- 10.55 Address by **Chairperson – Mr. N. Karunasinghe, Vice President (Leasing), DFCC Bank.**

10.55 -- 11.10 Design of a Gravity Wheel for Mineral Transport and Power Generation. Premalal DADTR, Karunanayake WAPC, Kodikara NE, Razmy SAM and Dissanayake DMDOK.

11.10-- 11.25 Identifying Phlogopite Mica Mineralization in the Area around Rathnapura and Suggesting Suitable Mining Methods for Sustainable Exploitation. Sashikala JRM, Nishshanka NAC, Karunarathna AWKN, Anuradha HWL *Weerawarnakula S and Abeysinghe AMKB

11.25-- 11.40 Designing and Fabrication of a Low Cost Magnetic Separator for Beach Sand Separation. Hettiwatte MC, Siyanath HAN, Amalan K and Rohitha LPS.

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11.40-- 11.55 Developing a Hydrogeological Model for Aruwakkalu Limestone Mine, Puttalam. Dayarathna EAC, Pethum LLDI, Sunanda DJ, Wedisinghe WMCC, Dassanayake ABN and Wickrama MADMG.

Session II– Environment/Disaster Management-

11.55 -- 12.10 Address by Chairperson – **Dr. HAG Jayathissa, Engineering Geologist/Landslide Studies and Services Division, National Building and Research Organization (NBRO)**

12.10 – 12.25 Instrumentation and Monitoring of Mahawewa Landslide off Walapane. Idirimanna IAND, Perera KAC, Bandara KMT, Kumara WGBT, Indrathilake HML, Premasiri HMR, Weerawarnakula SW and Abeysinghe AMKB

12.25 – 12.40 Coastal Problems Associated with Southern Colombo Harbour Expansion Project.Nawarathna NMIB, Jeevakan T, Ranatunga RPUM, Jayasena JHDJ and Ratnayaka NP

12.40 13.40 **LUNCH**

Session II– Environment/Disaster Management contd….

13.40 – 13.55 Optimization of Drainage Network to Minimize Urban Floods Using Remote Sensing and GIS Techniques. Nadeeka PM, Kumari MADN, Abeysinghe AMKB, Chaminda SP and Premasiri HMR.

13.55 -- 14.10 Parameter Estimation of Pollutant Removal for Subsurface Horizontal Flow Constructed Wetlands Treating Greywater. Wijesiri MKBS, Jayasooriya VM and Karunarathne S.

Session III-- Mining and Rock Blasting

14.10 -- 14.25 Address by Chairperson – **Mr. Wathsara Wedage, Mining Engineer, Holcim Lanka (PVT) Ltd.**

14.25 – 14.40 Optimization of Blasting Geometry for Different Rock Types. Sameera JDAM, De Silva HCN, Vijithan K, Warnasooriya WMNT, Chaminda SP, Abeysinghe AMKB and Hemalal PVA

14.40 – 14.55 Performance Evaluation of Emulsion/Water-Gel Explosives and Comparison with Dynamite in Sri Lankan Quarrying Practices. Sanjeewa KWD, Fernando PLD, Zoysa AUD, Ramees AM, Hemalal PVA and Dharmaratne PGR

14.55 – 15.10 Minimization of Secondary Fragmentation with a View to Enhancing the Blasting Economics. Piomathusoothanan F, Batugampala BBMP, Harischandra YCK, Amaranath RMSPK, Hemalal PVA and Dharmaratne PGR

15.10– 15.25 Cost Reduction of Quality Controlling in Metal Quarrying. Basnayaka LR, Samarathunga SPGN, SusanthTKJ, Nawaneethan M, Wickrama MADMG, Samaradiwakara GVI and Dassanayake ABN

15.25 – 15.40 Suitability of Light Coloured Silicate Metamorphic Rocks of Sri Lanka in Construction Industry. JKWPC Karunathilaka,S Karunarathne and LPS Rohitha.

15.40 - 15.50 Closing Ceremony and Vote of Thanks

15.50 - 15.55 EVENING TEA [End of the Program]

Keynote Address – Development of Engineering Geology and its Roll in Engineering Construction Field

Eng. Upul S. Goonasekera

Additional General Manager (Special Projects), Central Engineering Consultancy Bureau

Ladies and Gentlemen, Colleagues and Students

I am honoured to be with you today at your 6th Annual National conference on *"Minerals and Innovative Thinking"*. As an engineer, practicing an important branch of Earth sciences I am pleased to address this gathering of colleagues and students pursuing studies in various branches of earth sciences.

The theme, I selected for the Keynote Speech is development of engineering geology and its role in construction field. Before going into the details, first let me take a short time to explain how subject matter of engineering geology came in to light.

As you may be aware behind every science or art discipline there is a basic philosophy. That philosophy helps to define the area of study of that particular discipline and correct approach to the study of the subject matter.

If we turn to Engineering Geology, what is its underlying basic philosophy?
The philosophy of engineering geology is based on three simple premises.

They are

1. All engineering works are built in or on the ground
2. The ground will always, in some way, react to the construction of the engineering work
3. The reaction of the ground to the particular engineering work must be accommodated by the work -Work means the structure that we are building.

The first *premise* would seem to be fairly obvious.
The second premise that the ground will always react to the construction of engineering work also seems rather obvious .The problem is to assess the magnitude and nature of the reaction of the ground to both construction and the operation of the project. This ground reaction, the engineering behaviour of the ground, could be small and insignificant or massive and perhaps disastrous depending on the nature of site geology and the engineering work.
To determine the engineering behaviour of the ground the engineering properties of the ground mass and the proposed design of the engineering work must be brought together and processed in order to calculate the engineering behaviour of the ground.

Birth of Engineering Geology

After briefly outlined basic philosophy of engineering geology, I wish to outline the birth of engineering geology.

Though engineering and geology advanced independently, civil engineers knew very little about geology and geologists were inadequately knowledgeable in civil engineering.

Therefore neither geologists nor civil engineers were able to determine the engineering behaviour of the ground once engineering work built on or in the ground. Thus a new breed of professionals dealing with the ground for engineering construction purposes came in to being: They were initially either engineers or geologists .Then onwards the professionals dealing with such matters and problems ware called Engineering Geologists. Yet acceptance of the discipline of Engineering Geology as an integral component of engineering education took a long and difficult path.

History of Engineering Geology

Before dealing with the Sri Lankan chapter on emergence of discipline of Engineering Geology, I would like to briefly look into the history of this discipline in general.

Since the beginning of civilization, man interacted with his environment to extract materials to satisfy his needs: that may be stones for making a dwelling or naturally occurring metal for making tools. Thus mining is not new. Ancient men gained some intuitive knowledge about rocks and minerals that were found near earth's surface. Ancient Greece developed some primary geological concepts concerning the origin of the Earth.. The popular, booming mining industry during the 18th century drove scientists to form more systematic and detailed studies of the composition of the Earth's strata. As a result in1741, Geology became a specific field of study to be taught at the National Museum of Natural History in France. Same trend can be seen in other European countries during this period. Geology and mining developed together mutually enriching the human knowledge base.

This was the time of the industrial revolution that brought about major changes in agriculture, manufacturing, mining, transportation, and technology. These changes had a profound effect on the socioeconomic and cultural conditions of the times. Sweeping changes in the field of education spread throughout Europe, North America, and eventually the world.

The introduction of steam power, fuelled primarily by coal, dramatically increased production capacity. The development of all-metal machine tools in the first two decades of the 19th century facilitated the manufacture of more production machines for manufacturing in other industries.

Steam powered excavators allowed the construction engineers to execute excavations of scales that the mankind could never imagine before. That was the dawn of large infrastructure development work. Engineers planned structures like Panama Canal, Suez Canal and Transcontinental Rail road. They were confronted with practical problems in engineering which could only be solved with the help of knowledge of the ground conditions. Such practical problems made them to be interested in geology. That means the interest in Geology stemmed from a 'need to know' basis.

In the 19th century both geology and engineering advanced, geology becoming a respectable branch of science forming a part of system of education. Engineering, characterized by canal and railway construction remained as an eminently practical subject. The geological knowledge of the engineer, confronted by increasingly difficult engineering problems, did not progress as rapidly as geological knowledge advance under the leadership of geologists such as James Dana in America, Albert Heim in Switzerland and Sir Archibald Geikie in Great Britain. Thus by the end of the nineteenth century majority of civil engineers knew very little about geology and very few geologists were concerned about engineering.

This widening division between geology and engineering was partly bridged by development of soil mechanics by engineers such as Coulomb and Rankine i n the nineteenth and twentieth century. They developed methods of calculating deformations of earth masses under the stresses imposed by engineering works. Subsequent publications by Karl Terzaghi revealed clear understanding of the significance of geological conditions in civil engineering design.

However, failures of engineering works such as the Austin dam in Texas in 1900 and St Francis dam in California in 1928 showed that there was often a lack of appreciation of the importance of geological conditions in engineering design.

Such failures emphasized the need for expert assessment of geological conditions on civil engineering sites and there was, by 1940's, a trend for civil engineers to employ geologists in an advisory capacity However, while certain gifted individual, such as Zaruba in Czechoslovakia performed this function very well it was not always a successful liaison. Main reason for this situation was that few geologists had sufficient knowledge to understand the requirements of the engineer and few engineers had more than the most superficial knowledge of geology. As usual new area of study was at the over lapping area of two sciences namely engineering and Geology.

Eventually engineering geology became sufficiently developed for the subject to form part of university curricula. Thus, in Imperial College, London, engineering geology was taught as early as 1957. Courses were developed elsewhere in Europe America and Canada during nineteen fifties and sixties. Now there are few countries in the world where engineering geology is not taught in some form or the other.

Now I would like to look in to the history of geology education in Sri Lanka. In the University of Peradeniya, Department of Geology was established in 1964. The Department offers undergraduate and graduate courses in Geology and Earth Science related disciplines. The undergraduate program is designed to serve both major in geology (4 years) and non-major (3 years). Graduates with a B.Sc. degree in Geology are prepared for careers in Exploration Geology, Natural Hazards Monitoring, Environmental Geology, Engineering Geology, Exploration of Water Resources and Development, Marine Geology and many other areas. In collaboration with the Postgraduate Institute of Science, the department offers several postgraduate courses leading to MSc and MPhil degrees.

The history of your own department of earth resources engineering at the University of Moratuwa dates back to1973. As you know your department was established as a department of the Faculty of Applied science with link of Leeds university of UK. From the year 2000, the Department of Earth Resources Engineering conducted two study streams as Mining and Mineral Engineering and Earth Resources Engineering

Those who have passed out in late seventies and eighties from these universities are presently holding very high positions in state sector as well as in private sector. Among them I perso nally know some world-renown scientists who migrated to developed countries.

Role of Engineering Geology

After elaborating on history and development of teaching of geology and other earth sciences in higher educational system I would like to briefly explain role of engineering geology in the engineering construction field.

Engineering Geology may exist under other titles, such as "geological engineering"," geotechnical engineering" and so on. If there is a difference in the content of the disciplines described under these names it probably lies in the origins of the practitioner. Engineering geology is taught in most countries as a Masters degree on top of some sort of first degree of qualification. If the first degree is geology then the product after the Masters degree is an engineering geologist. If the first degree is in engineering then the product may be considered as a geological or geotechnical engineer.

Whatever their origins and training are such people have the task of ensuring that engineering works do not fail as the result of any misunderstanding or lack of knowledge about the nature of the ground conditions on or in which the engineering work is to be constructed.

Engineering failures cost lives and certainly cost money. To prevent such failures happening, the influence of geology of the site on the design and construction of the engineering work must be understood and clearly explained. As it happened elsewhere in the world need for engineering geological input in civil engineering has been brought to limelight when some major failures engineering works occurred at several occasions over the last several decades. When I say this one may start wondering whether this whole thing is built upon Failures! It is not so! Many successful engineering works silently serving the mankind do so due to the great advances made in the field of engineering geology.

Earlier, I have mentioned about some major failures of engineering works in other countries and I would like to turn to Sri Lanka and talk about our share of such failures here.

Before going into details of such failures, I think I must explain to you how engineering geology field was ignored in civil construction industry here. The field of Civil Engineering developed through centuries assimilating the knowledge accumulated by the mankind in different fields of study such as mathematics, materials, surveying, hydrology etc. just to name a few contributing disciplines. As the need arose, in order to execute the tasks in hand, methodologies from other relevant fields of studies were borrowed or adapted into civil engineering practice. Thus if one dissects civil engineering into its contributing component parts an amazing paradoxical picture would appear.

Yet, unfortunately, due to oversight, sometimes Engineers fail even to recognize such contributing areas of studies as relevant to engineering. (Not only have they ignored them as irrelevant)

As Professionals of earth sciences the moral you have to learn here is very vital. As engineers we should have an open mind to gather and improve our knowledge-base without prejudice. Only such an approach would help us to solve engineering tasks that come with ever increasing challenges.

Sri Lankan Chapter

Now, I would like to turn to the scenario in Sri Lanka- how we fared in this particular field here in Sri Lanka

First, I would like to draw your attention to our construction industry and how the industry treated the discipline of Engineering Geology in Sri Lanka.

When I started my carrier in the seventies of the past century there was hardly any recognition for the discipline of engineering geology in the construction industry here.

That was the time our country embarked on massive Mahaweli development work. Mahaweli accelerated development programme played a very important part in establishing engineering geology as an important area of study. I would deal with its impact separately.

In late seventies, the professionals involved in construction industry in Sri Lanka had very little awareness and understanding of the subject matter of engineering geology. At that time even civil engineering undergraduates quarried why they need to study engineering geology. Many professional and engineering students often call this field of work simply as geology but not engineering geology .Even my engineering colleagues who worked with us did not want to recognize the importance of engineering geology in the field of hydro power construction. Similarly there was some reluctance in recognizing other important and distinct engineering disciplines such as Geo- technical engineering, Agriculture engineering nuclear engineering, etc At that time the Institute of Engineers Sri Lanka recognized only three traditional primary engineering disciplines, namely civil, electrical and mechanical. Even aeronautics was not recognized as relevant to engineering. Of course the situation has changed over the years and they started to recognize other engineering fields such as agricultural engineering, mining, earth resources, building services, information technology etc.

Mahaweli Accelerated Development Programme

As I have stated earlier, now I would describe the impact of the Mahaweli development programme and its influence on emphasizing the need of earth sciences.

In 1977 a decision was made by the Sri Lankan Government to accelerate the implementation of master plan for the development of Mahaweli Ganga Basin. Five major multipurpose reservoir projects were to be constructed over a time span of six years to generate 540MW of power, irrigate 130,000hectares of new land s and improve 12,000 hectares of existing land. The main consultancy works on the head works of the Mahaweli accelerated program were provided by expatriate consultants of international reputed consultancy organization selected by the donor countries. The CECB technical staff assisted these consultants in the planning, investigation, design and construction supervision. In view of this requirement a large number of geologists with engineering geological background were required in anticipation of the extensive engineering geological studies involved in the Mahaweli Head Works projects. In the initial years a very few experienced engineering geologists were available in Sri Lanka. The young geologists just passed out from the universities had the opportunity work with eminent engineering geologists from some of the world's best consulting engineering firms. Further opportunities were available for Geologists to pursue post graduates studies aboard in engineering geology. This exposure built up a team of capable engineering geologists conversant with the latest technologies. However with the completion of head works of Mahaweli accelerated program there was a drop of demand for engineering geologist in Sri Lanka. As a result, many experienced and talented local engineering geologists sought greener pastures in developed countries.

Failures in Sri Lanka

As promised, now I would like to turn to our share of failures here in Sri Lanka. The main reason to study these case histories of failures is that they guide us in our future endeavours.

Presenting material on failures of works due to geological related reasons is a mammoth task that may need several lectures to cover. I would only talk about few case histories where I was involved..

Remember, the failure events I am going to describe did happen due to lack of appreciation of engineering geological conditions at relevant sites at appropriate stages.

Cracking of penstock tunnel of Kotmale project is the first example I am going to describe here. Kotmale hydropower project was commissioned in June 1985 and in September 1985 it had to be temporarily closed as water started to seep from power cavern wall through joints in the rock. Then the operation of station stopped and flooding of cavern prevented. Subsequent inspection revealed that the reinforced concrete lining of inclined pressure shaft delivering water to the power cavern had developed longitudinal cracks. Two cracks ran along the shoulders of the concrete lining: they had openings of several centimetres. Water released through these cracks had found its way into the cavern. A comprehensive investigation plan was formulated and executed prior to the remedial measures. The investigation that included in-situ stress measurements revealed that the rock mass had been under residual tectonic stress field where the lowest stress component had been close to zero. In the original design process a normal stress field had been assumed it seems since the rock mass had been defined as fresh, and very strong. As the permanent remedial measure steel lining was recommended to overcome this situation.

Another large construction work that had problems due to lack of engineering geological understanding of the ground situation is the Samanalawewa project.
The construction of Samanalawewa project commenced in year 1986 and the main works were completed in 1991.Initial impounding of the reservoir was commenced in June 1991 immediately after completion of the main dam. As the reservoir level was rising, a small water leak started on the downstream area of the slope on right bank about 300 m away from the dam initially the seepage was about 5 l/sec. A section of the slope on right bank around the seepage point failed when the water level reached elevation 440m and a catastrophic flow of water emerged from a cavity in the rock exposed by slipping. The washed away earth and rock mass volume estimated to be about 25,000m3 within hours. Estimated peak flow 7 m3/sec and then within 10-12 hours water flow reduces to 2 m3/sec. Though the quantity was not very large the problem lied in the high ground water level in the right bank hill area beyond the abutment. There the ground water level responded and matched with the reservoir level. After operation of the project at a lower reservoir level for some period an expensive soil blanket was placed on selected areas of reservoir bed. With those

remedial works the leakage and undesirable groundwater level was brought down and now the reservoir is operating at its full capacity. Even after 20 years of operation, investigations are underway to understand the nature of seepage paths through right bank hill. These include use of isotopes for tracking paths of seepage.

If we go further back in time we come across another related problem in hydropower construction due to lack of engineering geological study. That is the Canyon hydropower project in the Laxapana complex. During the course of excavation of headrace tunnel in 1980 when the excavation was closer to its halfway point a mud flow with weak ground was encountered. This unforeseen situation arose due to presence of a thick Calc Gneiss layer that had not identified before. With the mud flow work had to be stopped and investigation was carried out. Based on the findings tunnel alignment was modified to minimize the distance that comes within the weathered Calc Gneiss layer. Investigation of the problem, execution of remedial measures and driving through weak ground caused additional expenditures and delays. However the project was successfully commissioned in 1983.

All these events of failures that I have mentioned so far belonged to our time.

You may be interested to hear about a failure of a dam that took place in the ancient times probably due to the geological problems in foundation strata. This is a special case of large dam failure in Sri Lanka. This is the case of Old Maduru Oya Dam and the new dam that we built there in the eighties of the past century. Topographic survey work at the Maduru Oya dam site was conducted in nineteen seventies. They showed a long ridge like extension originating from the right bank hillock that was to form the right abutment for the new dam. At that time this long earth mound was taken as a natural topographic feature. As the time passed it was identified as a part of an old straight dam that closed the river gap forming a large reservoir. The left two third of the dam had been washed away. By length and height this old dam must have been comparable with the new dam that had been proposed. Most interesting thing to note here is that the investigation programme conducted for the new construction revealed weak hydrothermally altered body under the failed section of the old dam. There the new dam had been shifted towards upstream to avoid this natural weak feature. This weak zone could have been the cause of the failure of the old dam due to piping at its base level.

Whether it happened in ancient times or modern times all the above failures have originated from lack of appraisal of engineering properties of the ground.

These failures have taught us an expensive lesson. They indicate at the necessity of expert technical evaluation of engineering geological conditions of construction sites from the civil engineering point of view, in relation to the structures to be constructed.

Now let us see what is meant by "*engineering geologic conditions*" of a project site or area. The total complex of geological conditions of a site which determine planning, designing and construction of structures rational usage of land and various construction conditions, stability of the structure shall be understood as the *engineering geological conditions* of a project site.

Engineering Geological Investigation

How do we appraise the engineering geological condition of a particular site? A long process of investigations is involved in engineering Geological appraisal..
In engineering geological investigation the natural ground conditions are studied and information is gathered. Generally, for all civil engineering construction projects, for the purpose of planning, feasibility study design, construction etc; three type of engineering investigations are required to be carried out, and they are

1. Engineering geodetic investigations - conducting engineering surveys at the site under consideration

2. Engineering hydro-metrological investigations - under these the climate, hydrology etc: studied

3. Engineering Geological Investigations - under these studies are conduct on: rock/soil as a natural foundation or sub soil of the structure to be constructed, hydro geological i.e. ground water conditions, geological processes and their forms of appearance, rock and soil as a construction material etc.

Main objective of engineering geological investigations is to study and explore the engineering geologic conditions of an area or site to be used for development/construction, to obtain basic technical data which will facilitate, making technically viable and economically feasible decisions for planning, designing and construction, in respect of a certain construction project.
As you see now engineering geological investigation is one of the three main categories of investigations of civil engineering projects and briefly outlines the stages of engineering geological investigations in a certain sequence

1. Reconnaissance surveyor
2. Preliminary investigations
3. Detailed investigations
4. Additional investigations(pre construction or during construction)

Due to time constraint, I am not going to discuss these stages in details here.

Of course these investigations stages have to be carried out in major projects. However most of the investors/developers are bit reluctant to allocate sufficient funds for engineering geological investigations .But this reluctance may lead to major failures which may cost money and time. From other hand engineering geologists who design and plan investigations should able to justify each and every item in the site investigation in terms of the value of that item in building up the geotechnical model.
Though I have emphasized the vital role of engineering geology in civil construction field please keep in mind that other professionals involved in civil construction field such as Planners, Architects, Building Engineers and Utility Engineers also play a very important role. Finally success comes through team work of all professionals. Success comes through cooperation and contribution.

Employment Opportunity

I have talked to you briefly about birth of engineering geology, development of engineering geology .construction failures due to lack of appraisal of engineering geological condition and its role in engineering construction field. At last, please let me allow talk few words about present employment opportunities for professionals involved in earth resources engineering. Educational institutions such as yours consider that it is your duty to produce employable earth resources graduates and we have a responsibility to find suitable employment for them in our industries.

What are the opportunities available for the Earth science graduates in the current job market? . We who work in the industry take a special interest in absorbing as many as possible young graduates to our organizations. Unlike civil engineering discipline, we are not in a position to find employment for all of earth resource engineering graduates due to limitation of availability of opportunities in this field. As all of you are aware, employment opportunities in developed countries such as Australia Canada, UK for your graduates are enormous. Though I never encourage migration, it is a well known fact that those who have migrated during last three decades have gained high positions and doing very well.

I know that you are producing some of the best earth resources graduates here. They have the core knowledge-base to go into environmental, materials, mining, engineering geology, geotechnical engineering, instrumentation etc. Continuing education is a must in the modern day knowledge based society. Nobody can stand still when it comes to acquiring marketable skills. We have to adapt to ever changing demands of the society and industry.

With that note I conclude my speech. Good wishes to the Earth Resources Department to continue your Good work.

Thank you all very much.

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