



ISERME 2021

International Symposium on
Earth Resources Management & Environment

10th December 2021

PROCEEDINGS



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

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International Symposium on Earth Resources Management & Environment

10th December 2021, Colombo, Sri Lanka

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Message from Dr. G.V.I. Samaradivakara - Symposium Chair

Welcome to the fifth International Symposium on Earth Resources Management and Environment [ISERME 2021], organised by the Department of Earth Resources Engineering, University of Moratuwa, Sri Lanka.



The research culture of the department revolutionary changed sixteen years back, and in year 2005 with the implementation of World Bank funded project for Improving Relevance and Quality of Undergraduate Education [IRQUE]. We are grateful to the "IRQUE" Project for encouraging and funding the department to organise the first annual research conference in year 2006, which eventually evolved up to an International Symposium in year 2017.

Since 2016, the department has been networking with the international Mining Engineers and Earth Scientists in organising this symposium, annually.

In the past year, we had scheduled to hold this symposium in Hokkaido, Japan, based on the collaboration that we have with Hokkaido University, Japan. However, as Hokkaido was affected by the spreading virus at that time, we had to change our plans. We look forward to having our symposium jointly with them and in Japan also, in the coming years, once the circumstances will back to normal.

On behalf of the Department of Earth Resources Engineering, I wish to extend my sincere thanks to Professor N.D. Gunawardena, Vice-Chancellor of the University of Moratuwa and Professor N.K. Wickramarachchi, Dean-Faculty of Engineering of the University of Moratuwa for granting their kind permissions to hold the inauguration of this year's symposium in the hybrid-mode at the University of Moratuwa.

I greatly appreciate Professor Ajith De Alwis, Dean-Faculty of Graduate Studies of the University of Moratuwa for providing Boardroom facilities of the Faculty, for hosting the inauguration of the symposium in hybrid-mode.

The external reviewers of the symposium are commended for their timely given insightful reviews. Thanks are also extended to all the authors for their excellent submissions made to this symposium.

I'm certain that this symposium will continue to network with more researchers in the fields of Mining and Earth Resources Engineering, in the coming years.

I wish you all, a productive and enjoyable Symposium!

Dr. G.V.I. Samaradivakara - Symposium Chair - ISERME 2021
Head - Department of Earth Resources Engineering, University of Moratuwa
02nd December 2021

Message from Dr. (Mrs.) A.B.N. Dassanayake - Symposium Secretary

On behalf of the Organizing Committee and as the coordinator of the symposium, I would like to warmly welcome your participation in the 5th International Symposium on Earth Resources Management and Environment organised by the Department of Earth Resources Engineering, University of Moratuwa, Sri Lanka. As with the most scientific forums, in ISERME 2021 we have to move to a virtual format due to the challenging times with the COVID-19 pandemic situation.



The event with the theme of "Earth Resources Management and Environment" brings together many academics, students, industry leaders, alumni, and well-wishers and is graced by Prof. P.K.S. Mahanama, Deputy Vice-Chancellor, University of Moratuwa as the Chief Guest, and Dr. Manoj Verman, a well-known Tunneling and Rock Engineering Expert and the President of International Commission on "Hard Rock Excavation" as the keynote speaker. This event creates an international forum for academics, researchers, industry leaders, professionals, and alumni to come together sharing the latest findings, and have constructive discussions across a broad range of disciplines related to Mining and Earth Resources Engineering. The event also seeks to network with a large number of organisations and individuals at national and international levels.

I wish to express our special recognition to our sponsors and supporting institutions for their financial support and dedication. I sincerely thank the organising committee and technical program committees for their contribution toward ISERME 2021 and all the academic and non-academic staff members of the Department of Earth Resources Engineering for effectively fulfilling the individual tasks undertaken to make the event a success.

We would like to express our deepest appreciation to the authors whose technical contributions are presented in these proceedings. We have been able to prepare this proceeding, because of their excellent contribution made and hard work.

Dr. (Mrs.) A.B.N. Dassanayake
Senior Lecturer - Symposium Secretary
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03rd December 2021

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Keynote Address

Challenges of Tunnelling

Dr. Manoj Verman
Tunnelling & Rock Engineering Expert
President, International Commission on "Hard Rock Excavation"
President, Indian National Group of ISRM



These are exciting times for infrastructure growth. With the focus on development in several developing countries, we in the infrastructure sector are hoping for a great future, and tunnelling is one of the most promising areas.

Tunnelling has become a vast subject, encompassing a wide variety of topics within its realm. It is a surprise that, despite its vastness and its significant relevance to civil engineering, this subject is hardly taught at the graduate and post-graduate levels. The world is looking at a substantial shortage of engineers skilled at various aspects of tunnelling. This presentation is an attempt to create a spark in the minds of the youngsters to take up tunnelling as a career while, at the same time, to introduce the uninitiated into the exciting world of tunnelling - both in the difficult terrain of the mountains, and in the tricky conditions of an urban setting.

While keeping the above objectives in mind, the presentation will meander through a range of topics associated with tunnelling - from the basic philosophy to planning to design to construction and so on. Some interesting yet fiddly aspects of tunnelling will be particularly highlighted, and a few case histories will be included to drive the point home. Besides the technical aspects, some non-technical aspects of tunnelling would also be covered.

While it is simply not possible, in a short time, to dwell upon all the challenges that this exhilarating subject throws, an attempt will be made to give the participants a strong flavour of the exciting world of tunnelling.