November 2022
Volume 18

INDIAN SOCIETY OF ENGINEERING GEOLOGY
(IAEG India National Group)
A Newsletter

ISEG NEWS

Bridging Communication Gap.....Dissipating Information

www.isegindia.org
www.joegindia.com

INDIAN SOCIETY OF ENGINEERING GEOLOGY (ISEG)

Indian Society of Engineering Geology (ISEG), founded in 1965, is a professional and a scientific forum comprising members from the fields of Geology, Engineering Geology, Geotechnical Engineering and Civil Engineering, representing almost all the leading organisations engaged in civil development projects in India (www.isegindia.org). It was inaugurated by Dr. K.L.Rao, the then Union Minister of Irrigation and Power on October 15, 1965 at Kolkata and its founder president was Dr. D.N.Wadia, the doyen of Indian geology. Since then the Society commenced its journey with the aim to promote the study of Engineering Geology and allied sciences and has successfully completed nearly five decades of glorious service to the nation. The ISEG, over the years, has effectively served as a formidable bridge between the geologists and engineers; has provided a vibrant platform for discussing and debating a host of geotechnical problems and state-of-the-art technologies; and projected the Nation's achievements in the field of Geotechniques and allied expertise. ISEG is also the India National Group of the International Association of Engineering Geology and the Environment (IAEG). The ISEG, being the Indian National Group of the International Association of Engineering Geology and the Environment (IAEG) has also earned the rare distinction by hosting the prestigious 4th International Congress of IAEG at New Delhi in 1982, the 8th Asian Regional Conference of IAEG "International Conference on Underground Space Technology" at Bangalore 2011, and the Golden Jubilee Celebration of ISEG – EGNM at New Delhi in 2015, which were attended by large number of delegates from across the world. Since 2017, ISEG has been regularly organising its yearly technical conference in the name of EGCON, and this year too, the ISEG is organising the EGCON-2022 in association with the Geological Survey of India at Kolkata during 16-17 November 2022 (https://egcon.in/2022). Apart from the above, ISEG regularly publishes its journal – Journal of Engineering Geology (www.joegindia.com), and the newsletter – ISEG News. Journal of Engineering Geology (JoEG) is the oldest journal on the subject of engineering geology in India and perhaps the only journal in this field. It is brought out on biannual basis and carries papers on Engineering Geology, Geotechnical Engineering, Geohazards (Seismology, Landslides, etc.), Environment Geology, Rock Mechanics, Soil Mechanics, Groundwater contamination and Geological Engineering. It was launched in the year 1966 soon after formation of the society.

The following ISEG Executive Council 2022-23 came into being after the ISEG Council Election 2022 held during Feb-March. The following current Council assumed its responsibilities w.e.f. April 01, 2022.

MESSAGE FROM THE PRESIDENT

The Indian Society of Engineering Geology (ISEG) takes immense pleasure in publishing its 18th issue of the ISEG NEWS in November 2022 to commemorate the crucial achievements by the Indian technocrats and professionals in the field of Engineering Geology and Geotechniques, and also by ISEG during the last one year. It would not have been so opportune a moment that ISEG is releasing this newsletter at the EGCON-2022 in Kolkata on November 16, 2022, when we are physically meeting after a long gap of three years to exchange our views, and opinions on many

Continued on Page 2

MESSAGE FROM THE SECRETARY

Dear Colleagues,

The ISEG NEWS- a highly cherished and informative newsletter tries to provide a vibrant interaction of ideas and experiences among geoscientists, engineers, and infrastructure developers.

In the recent natural and conceptual changing scenario, as the pump storage power projects are being preferred over river valley hydro-electric projects, communication tunnels are being constructed in place of surface transport facilities, and several geohazards such as landslide, flood earthquakes, and

Continued on Page 2

ISEG EXECUTIVE COUNCIL 2022-23

MESSAGE FROM THE PRESIDENT

Continued from Page 1

challenging technical issues, and will be organising an International Conference on Engineering Geology and Geotechniques for Safe and Sustainable Infrastructures, where about 200 technocrats, student, researchers will meet physically for participating in a very vibrant technical discourse.

The publication has always been a great source of inspiration to ISEG and we take special attention and care to collate vital and critical information on this particular technical domain as a small news article to spread greater interest, and attention amongst our members, and acquaintances in a faster mode. Hope this 18th issue of ISEG NEWS will also not be an exception, where several short descriptions of seminal achievements are enumerated. On the ISEG front, despite the Covid-19 pandemic during the previous year, we could successfully organise the EGCON-2021 event in a hybrid mode with a rich diaspora from the national and international arena, and a brief report of such has also been included in this edition of ISEG NEWS, apart from many interesting and relevant news items.

After the Covid-19 pandemic, the infrastructure sector has started witnessing a boon slowly but steadily since early 2022 despite severe fluctuations and adjustments in global economic conditions. The Government of India especially has taken special care in fast-tracking and spearheading the activities in all infrastructure sectors, including water resources development, and communication projects, where our roles as technocrats and professionals in Engineering Geology and Geotechniques are pivotal. In this endeavor, ISEG plays a responsible function in spreading knowledge through its online journals – Journal of Engineering Geology, and ISEG NEWS, and by regularly organising national and international level seminars, and conferences to ameliorate our technical expertise, commitments through meaningful discourse, and effective exchange of knowledge through online, offline, print media. Hope this endeavor of ISEG in publishing the 18th issue of ISEG NEWS will also be quite helpful and informative to the relevant community so that ISEG gets encouraged in publishing similar issues too in shorter intervals in the future.

(S. L. Kapil)
President, ISEG

MESSAGE FROM THE SECRETARY

Continued from Page 1

other environment-related problems are being witnessed due to prevailing climate changes, the effective interactions and communications among the various stakeholders are very much required for safe and sustainable infrastructure development of the nation and I firmly believe that the ISEG News plays a very vital and pivotal role in this endeavor.

Besides, disseminating technical knowledge, the newsletter also provides a string to connect all the esteemed members of the society for sharing important information related to ISEG activities.

I sincerely convey my best wishes for wider circulation, consultation, and acceptance of the ISEG News.

Dr. Mridul Srivastava
Secretary ISEG

MESSAGE FROM THE EDITOR

Since its inception in 1965, the Indian Society of Engineering Geology (ISEG) has been stressing on publication of various print materials to disseminate the growing knowledge of the Engineering Geology community to all stakeholders, students, researchers, and professionals. ISEG has its peer-reviewed journal – the Journal of Engineering Geology (JOEG), which happens to be the only and the oldest journal in the country on Engineering Geology. The first issue of this prestigious journal was released in 1966, immediately after the establishment of the society in 1965, and has been regularly publishing it every year as biannual issues. Currently, JOEG is released as an online journal (www.joegindia.com). It brings regular publications of scientific articles on a biannual basis on Engineering Geology, Geotechnical Engineering, Geohazards, Environment Geology, Rock Mechanics, Soil Mechanics, Groundwater contamination, and Geological Engineering, etc. The journal website has an archive section, which hosts a plethora of rich literature on its previous volumes.

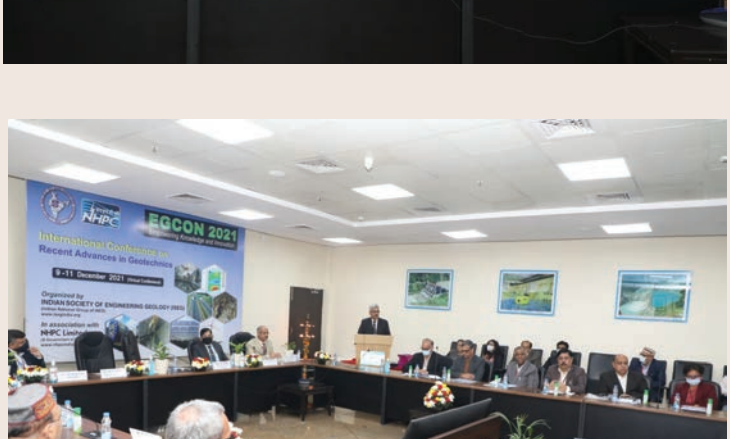
A similar effort of ISEG is the publication of ISEG News as a short, crisp, and informative news material or bulletin meant for dissemination of several current and immediate past achievements, affairs, new innovative techniques in this field, brief details of ISEG's core activities, report of recent national and international conferences, webinars, etc.

ISEG also has an illustrious Editorial Board comprising members from various related fields, who always assist the Editorial Team of ISEG in reviewing articles, news items, and other content. Currently, the Editorial Team ISEG takes the privilege to release its 18th issue of the newsletter – ISEG NEWS 2022 during EGCON-2022. Hope the rich, and vibrant content of ISEG News will be of great interest to our members and other interested readers. On behalf of the Editorial Team, I profusely thank all contributors, and reviewers for constantly assisting us in finalizing the manuscripts for publication. We are also hoping that soon we would also be able to release one online issue of JOEG this year too.

Dr. Saibal Ghosh
Editor, ISEG

A REPORT ON THE INTERNATIONAL CONFERENCE ON "RECENT ADVANCES IN GEOTECHNICS - EGCON-2021", 9-11 DECEMBER, 2021

The 3-days' International Conference on "Recent Advances in Geotechnics - EGCON-2021" was organized by the Indian Society of Engineering Geology (ISEG), in association with NHPC from 9th to 11th December 2021 through Virtual Platform. The conference was inaugurated in hybrid mode (physical and virtual) on 9th Dec 2021 and witnessed the presence of experts from India and abroad.



The conference was a great success wherein 17 keynote addresses were presented by renowned personalities from India and abroad. Some of the participative international keynote speakers at the Conference were Dr. Martin Wieland, Chairman Committee on Seismic Aspects of Dam Design (ICOLD), Dr. Wu Faquan Secretary General, IAEG, Dr. M.H.Loke, CEO, Geotomo Software Malaysia, Dr. Bineshian Hoss, Technical Director, Amberg Engineering AG, Switzerland, Dr. Thomas Fechner, Managing Director, Geotomographie GmbH, Germany, Dr. Rajinder Bhasin, Regional Manager Asia, NGI (Norway), Dr. Louis N.Y. Wong (Bulletin Editor in Chief Ex officio member-IAEG) and Dr. Praveen K Malhotra, President, Strong Motion Incorporation, MA, USA. The keynote address made by National speakers were Sh. Vineet Gahalaut, NGRI, Hyderabad, Dr. R. S. Jaka, IIT Roorkee, Prof K. S. Rao, IIT Delhi, Prof. VMSR Murthy, IIT(ISM), Dhanbad.

A total of 122 abstracts were received from the National and international levels. At the National level participations were from esteemed Government organizations i.e. GSI, CIMFR, CSMRS, NGRI, WIHG, NIRM, IIT-ISM Dhanbad, IIT Roorkee as well as from various PSU's like NHPC Ltd, NHDC, SJVNL, THDC, MECL, CVPPL as well as multinational companies engaged in the development of infrastructural projects. Around 650 members (ISEG and non-ISEG) have made registration to attend this online conference.

The three days conference witnessed 17 insightful keynote addresses which were well distributed in thirteen technical sessions. Under 14 conference themes, 59 papers were selected for oral presentation and 34 papers for poster presentation, after peer review. The proceeding of EGCON 2020 has a compendium of 53 nos of full-length papers and 69 abstracts.

Like the past EGCONs, the EGCON 2021 too provided a multidisciplinary forum for professionals, academicians and other related disciplines not only to debate and discuss but also to share their experiences with those in the same line of work. With the various Geotechnical themes, the conference successfully highlighted the importance of intricacies involved in infrastructure projects development in this field, and its usefulness in tackling complex geological and geotechnical challenges in infrastructure sector.

A NOTE ON THE AWARD CEREMONY OF 5TH WORLD CONGRESS ON DISASTER MANAGEMENT – DISASTER RISK REDUCTION (WCDM – DRR) AWARD HELD AT THE INDIA INTERNATIONAL CENTRE, NEW DELHI ON 22.06.2022

GHRM Centre, Geological Survey of India

The Geological Survey of India (GSI) has been awarded the World Congress on Disaster Management – Disaster Risk Reduction (WCDM – DRR) Award on 22.06.2022 at India International Centre, Max Mueller Marg, New Delhi. The Chief Guest of the ceremony, Shri G. Kishan Reddy, Hon'ble Union Minister of Tourism, Culture and Development of North Eastern Region, Government of India presented the award to GSI and Dr. Sandip Kr. Som, DDG, NM-IVA, GSI, CHQ, Kolkata received the award on behalf of GSI. Dr. Som has been accompanied by Dr. L.P. Singh, DDG; Shri S.N. Bhagat, Director; Smt. Neetu Chauhan, Suptdg. Geologist and Shri Dharmendra Kumar, Sr. Geologist from GSI, DGCO office, New Delhi.

The 5th World Congress on Disaster Management (WCDM) 2021 was held from 24th to 27th November, 2021 at IIT-Delhi. In this Congress, GSI was associated with WCDM as knowledge partner and has steered a Special Technical Session (STS) on 26-11-2021 (1430 hrs. to 2030 hrs.) on the topic titled "Creation and utility of national-level geoscientific spatial information for Geohazard research and management". The session was chaired by Dr. Sandip Kr. Som, Dy. DG, NM-IVA, GSI, CHQ, Kolkata and co-chaired by Dr. Saibal Ghosh, Director, GHRM Centre, GSI, CHQ, Kolkata. Four keynote talks were delivered by noted speakers: Prof. Cees van Westen, Faculty of GeoInformation Science and Earth Observation (ITC), University of Twente, the Netherlands; Prof. Ramesh P. Singh, School of Life & Environmental Sciences, Chapman University, California, United States and Dr. O.P. Mishra, Director, National Centre of Seismology (MoES). The keynote lectures were followed by 16 nos. of presentations by GSI officers (Snehasis Bhattacharya, Soumitra Bhargab Dasgupta, Sumit Kumar, Rabisankar Karmakar, Drishya G., Arun Bhadran, Sandipan Das, Sanjeev Kr. Bhattacharyya, Mausam Yadav, Shradha Shukla, P.K. Gautam, Nazia Khan, Nigar Jahan, Harish Bahuguna and Dhrubajyoti Chakraborty) and K.R. Viswanathan (on behalf of LANDSLIP project) on various domains like varied aspects of landslide susceptibility studies; GPS geodesy; seismic and tsunami susceptibility assessment in and around Port Blair; seismic microzonation of Gorakhpur, Silchar, Dibrugarh and Pasighat; seismic site response study; active fault mapping in parts of Himachal Pradesh and Uttarakhand; palaeo-seismic study in and around Alwar, Rajasthan; geological assessment of hazards associated with cloud bursts and extreme weather events in J&K; and macroseismic investigation in Central India.

The session was concluded with the Panel discussion on the topic "Importance of data sharing and collaborations in the fields of Geohazards research and Management". The panelists discussed and came out with the following takeways from this technical session of GSI:

1. The generation of multi-disciplinary geoscientific spatial data supported well by adequate field validation techniques would always ensure advanced and state-of-the-art scientific information for effective use in disaster risk reduction endeavours.

2. Geoscientific data generated through multi-disciplinary and collaborative approaches for use in disaster risk reductions must be shared mutually with all the relevant stakeholders without any financial obligations. These data generated by the multiple source agencies must be treated like a national treasure for use in all sorts of the public good.

The Jury of the 5th WCDM has highlighted the outstanding contribution of GSI in conducting the STS comprising several talks on multifarious geotechnical, geoenvironment and natural hazard studies and making important contribution to seismology by its studies and reports on numerous Indian earthquakes. For this stellar contribution, GSI has been awarded the WCDM – DRR Award to honour its legacy and continued excellence in the field of multidisciplinary geosciences by way of bringing new state-of-the-art practices, upgrading the existing tools/skill/procedure and innovating new areas.

The prestigious WCDM-DRR Award

Dr. S.K. Som, DDG, NM-IVA, CHQ on behalf of DG, GSI receiving the award from Shri G. Kishan Reddy, Hon'ble Union Minister of Tourism, Culture and Development of North Eastern Region

GSI Team with the award at the India International Centre, New Delhi

The WCDM-DRR Award with the DG, GSI; DDG, NM-IVA and M-IVA officers of CHQ

GSI Team behind the Award (Photograph taken after the GSI Special Technical Session of 5th WCDM held on 26-11-2021 at IIT Delhi

LANDSLIDES AS GEOMORPHOSITES IN INDIA – A PERSPECTIVE

Sudesh K. Wadhawan, Maneesha V. Ramesh, Nirmala Vasudevan, Balmukund Singh and M. Nitin Kumar

Amrita Vishwa Vidyapeetham, Kerala
Email: wadhawansk.leo@gmail.com

Landslides are important geomorphic phenomena that induce drastic landscape modifications, contributing significantly to mass-wasting, sediment erosion, detachment, transport, and deposition of slope-forming material on hillslopes. Landslides are normally identified and often considered a source of hazard inflicting loss of property and life. Although landslides are also important components of national geoheritage, yet awareness about their unique significance regarding lessons on disaster prevention, improving community resilience and scientific educational value seems scarce in the scientific community and general public. Besides, they are seldom identified as rare sites that need to be preserved as geoheritage sites. I have often wondered, how best to restore the devastated terrain affected by landslides for the benefit of the local community, possibly through successive and alternative land use practices supported by geoscientific and environmental research.

This note draws attention to landslides as potential geoheritage sites in India, highlighting their geoscientific importance. Landscapes showing various types of mass-wasting and slope failure mechanisms can promote understanding of the close interconnection between landslides-environment-society, thus providing opportunities for their conservation.

The concept of geoheritage has been a subject of increasing interest, both in the conservation and tourism sectors. Geoheritage is the abbreviated version of the term geological heritage. It includes any area/ place/ mining site located inland and/or offshore within the territorial waters of the country containing distinctive examples of geological materials (e.g., sediments, rocks, minerals, and fossils) and phenomena, stratigraphic type sections, geological structures and geomorphic landforms (geomorphosites) including caves, natural rock-sculptures of national/ international interest. It is part of the natural heritage of a certain area constituted by geodiversity elements with particular geological value and hence worthy of safeguard for the benefit of present and future generations (Gray, et al. 2013; Wadhawan, 2020).

The geomorphological heritage or geomorphosite embraces landforms and processes that are worthy of being protected and transmitted to future generations, as they play a key role in the understanding of the geomorphic phenomenon, and Earth history and are linked to the biological and the cultural heritage imprinted on the evolving landscape. Landslides-affected terrain can be recognized as geomorphosites that are defined as geomorphological landforms which have acquired a scientific, cultural/historical, aesthetic, and/or social/economic value due to human perception or exploitation (Panizza, 2001). They can be single geomorphological objects or wider landscapes and may be modified, damaged, and even destroyed by the impacts of human activities. The value of such geomorphosites is poorly known to the public and scientists from other disciplines. There is therefore a need to enhance the public profile of geomorphosites, to develop new methods to assess their scientific, cultural, aesthetic, and social/economic values, and finally to protect them under a legal framework.

Several landslides have been declared as geomorphosites or geoheritage sites in the European countries, Canada and America. As many of these sites are accompanied by spectacular landscapes, they also draw tourists for educational and recreational purposes. The three new values that should be considered when identifying a landslide as a geomorphosite include past and present climate changes, anthropic signature, and risk perception (Coratza and De Waele, 2012). These landslides include Bomarzo (Italy); the Vajont landslide (Italy); the Frank Slide (Canada) located on the east slope of Turtle Mountain in southwest Alberta, Canada; the diffused landslides of north-central Iceland, and the Island of Malta. The Vajont Landslide, Italy is significant from a geotechnical viewpoint. It occurred on 9th October 1963 at 10:39 pm local time, a mass of approximately 270–300 million m^3 of rock and debris detached from Mount Toc, Dolomites, Northeast Italy, and collapsed into the artificial lake created by the 262 m high double curved arch dam built across the Vajont valley. The wave overtopped the dam, destroying seven villages in the Piave River Valley and killing almost 2000 people. It is perhaps the deadliest landslide event in Europe in recorded history. The Vajont event was a human-induced disaster, as it was caused by the failures of experts, who provided an inadequate assessment of the possible consequences of damming the valley (UNESCO, 2008). The Vajont landslide has a unique scientific importance, as the complex geology and geomechanics of the landslide have been debated since the occurrence of the event. The Vajont landslide as an example of geomorphosites represents the risk perception and anthropic signature as the causative factor. Besides, so far only four landslides are recognized as geomorphosites, found on the UNESCO World Heritage List (i.e., Swiss Tectonic Arena Sardona; Dolomites (Italy); Tajik National Park; Pitons, cirques, and ramparts of Reunion Island). They all comprise landslides among various landforms that also represent the cultural and natural diversity of the geosites (Coratza and De Waele, 2012).

There are quite a few landslides in India that are unique and valuable for their geoscientific and geotechnical characteristics and deserve to be declared as geomorphosites of rare significance. These may include some selected typical landslides in the Himalayas, such as the extreme events of the Kedarnath-Chamoli landslide-flood cascades in the northwest; the Darjeeling – Kurseong in the east; and Munnar-Rajamala in the Western Ghats of Kerala, etc. Based on my personal field experience, some introductory details are enumerated on Munnar-Rajamala Landslide in Kerala as a geomorphosite with the potential to develop as a Geopark for the promotion of geotourism.

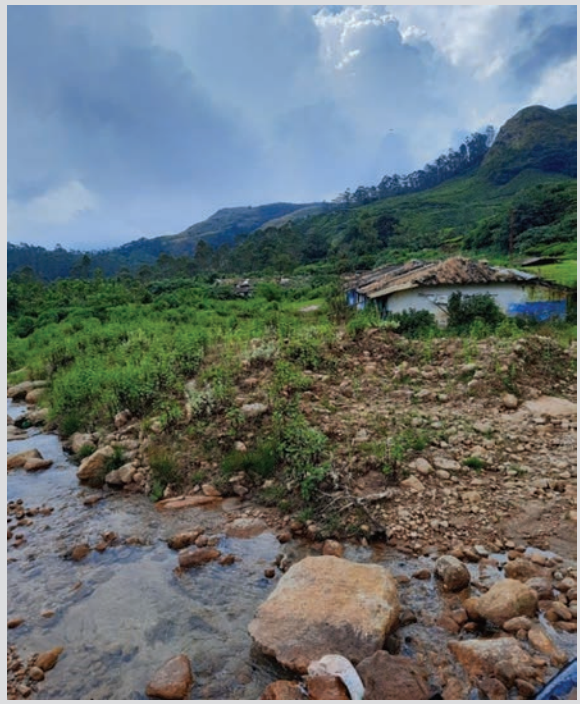


Fig.1a & b: Rajamala landslide showing long run-out along the stream carrying large sized dislodged boulders of granite-gneiss, traversing through the undulating tea gardens and destroying the human hutments built on the flood plain of Anaimudi Ar.

Munnar-Rajamala landslide in Kerala as a Geomorphosite

A massive landslide occurred at Nayamakkad (Pettimudy) tea estate (77.01°E longitude and 10.17°N latitude), near Rajamala near Munnar in Idukki district, Kerala, in the early hours of 7th August 2020 (Fig. 1a & b). This landslide killed 70 people, apart from demolishing four long hutments (called 'layams'- quarters for tea garden workers) and uprooting several trees and poles. This landslide traveled swiftly for about 1.3 km meeting the flooded Anaimudi Ar and finally debouched into the flooded Kanniyar river after destroying the hutments. The landslide – water-surcharged debris flow spread laterally and was enlarged in size as it proceeded downhill, forming a very long run-out. The high-intensity rains were the trigger for the Rajamala landslide where the 5-day antecedent rainfall was 766 mm and a daily rainfall of 167 mm. The rainfall on the previous day of landslide occurrence was 309 mm.

From the analysis of the pre-event images of Google Earth, it is observed that the landslide is confined to a barren flat-topped hill composed of Precambrian crystalline rock. The water pooled across the flat-topped hill was drained rapidly as the sheet flow into the nearest gully, which was a geomorphic first-order basin. It is in this geomorphic feature that the landslide occurred and flowed downstream charged with large-sized dislodged boulders of granite-gneiss. The landslide initiation point is the boundary between two land use categories: the barren rocky outcrop and forest plantation over debris slope (Sajinkumar and Oommen, 2020; 2021; Maneesha et al. 2021). The morphological interpretation of the terrain using the same set of Google Earth images also revealed a scoop-out portion, suspected to be a paleo-landslide, confining to the same geomorphic hollow, but on the downstream side and along a prominent first-order channel.

REFERENCES

Coratza, P., and De Waele, J. (2012). Geomorphosites and Natural Hazards: Teaching the Importance of Geomorphology in Society. *Geoheritage* 4, 195–203. doi:10.1007/s12371-012-0058-0

Gray, M., Gordon, J. E., and Brown, E. J. (2013). Geodiversity and the Ecosystem Approach: The Contribution of Geoscience in Delivering Integrated Environmental Management. *Proc. Geologists' Assoc.* 124, 659–673. doi: 10.1016/j.pgeola.2013.01.003

Maneesha Vinodini Ramesh, Sudesh Kumar Wadhawan, Nirmala Vasudevan, Balmukund Singh and M. Nitin Kumar (2021). Summary of multi-hazards at Kottayam and Idukki. 2021 Report submitted to the District Collectors, Government of Kerala.

Panizza M. (2001). Geomorphosites : Concepts, Methods and Example of Geomorphological Survey. *Chinese Science Bulletin*, 46, Suppl. Bd, 4-6. DOI : 10.1007/BF03187227

Sajinkumar K.S. and Oommen T. (2021) Landslide Atlas of Kerala. Geological Society of India, p 34.

Sajinkumar K.S. and Oommen T. (2020) Rajamala landslide: Continuation of a never-ending landslides series. Journal Geological Society of India. (6:310.

Wadhawan, Sudesh Kumar (2020). Geoheritage sites and potential geoparks in India strategies for sustainable development. Indian Journal of Geosciences, Volume 74, No. 3 July - September, 2020; pp. 354-362

UNESCO (2008). International Year of Planet Earth - Global Launch Event 12-13 February 2008. Available at: https://en.lswn.it/events/international-year-of-planet-earth-global-launch-event-12-13-february-2008/ (Accessed March 16, 2021).

GEOLOGY BY NON-GEOLOGISTS

M. Raju
geolraju@gmail.com

Part 3

In this three part series, the author has presented short biographies of few great personalities whose field of science was different, still that was not a hurdle to find / propose new ideas in the science of Geology. In the first two parts of this series, published in the previous issues of ISEG NEWS, we presented short biographies of 13 such illustrious scientists from the non-geological sciences that made specific scientific contributions in the subject of Geology. In the last and the third part of this series published in this issue, we continue from where we had left and bring to you biographies of five more such notable personalities.

Thomas John Newbold (1807-1850), was an English soldier in the service of the East India Company, known as a traveler and orientalist. He was elected as a Fellow of the Royal Society (FRS) in 1842 for his work on the geology of the Indian Peninsula. He passed away during his studies at Mahabaleshwar on 29th May 1850 at the age of 40 years. Newbold investigated the mineral resources of India and was an authority on the geology of Southern India, which he investigated with great thoroughness. The results of his observations were published from time to time in scientific periodicals. He was also an oriental scholar and studied Eastern poetry.

Capt. F. Dangerfield belongs to the Bombay Native Infantry and served as Scientific Officer in Central India from 1820-1821. His report on the Geology of Central India constitutes a part of Major General Sir John Malcolm's Memoir on Central India. He first published a geological map of a part of India, after Voysey's map was submitted. It is referred to as one of the first geological maps of the country, published in 1823, as 'A Geological sketch of Malwa and part of Adjoining Provinces'.

John McClelland, who first coined the term Geological Survey of India in 1848, the man who played the most crucial role to convince the East India Company about the economic compulsions of geological research in the country, ultimately leading to the setting up of the Geological Survey of India. When the subject of India's coal supplies was under consideration, which leads to the formation of a Committee for investigation of coal and mineral resources of India (commonly known as the Coal Committee) in 1836, McClelland served as the Secretary to the Committee during 1837-1845. He compiled all information on the subject and requested the East India Company for posting a regular Geologist in India. Due to his persistent efforts, the Court of Directors of the East India Company appointed David Hiraw Williams, as the Geological Surveyor in 1846. Williams served in India but died soon. After the death of Williams, McClelland volunteered his services and remained in charge of the Geological establishment and designated himself as 'Officiating Surveyor' of Geological Survey till 1st April 1850. Due to his continuous efforts, Thomas Oldham was appointed as the new Geological Surveyor and on his arrival in Calcutta in March 1851, a continuous period of Geological Survey of India was commenced.

Alfred Lothar Wegener (1880-1930), was a German polar researcher, geophysicist, and meteorologist. During his lifetime he was primarily known for his achievements in meteorology and as a pioneer of polar research, but today he is most remembered as the originator of the theory of Continental drift by hypothesizing in 1912 that the continents are slowly drifting around the Earth. His hypothesis was controversial and widely rejected by mainstream geologists until the 1950s, when numerous discoveries such as paleomagnetism provided strong support for continental drift, and thereby a substantial basis for today's model of plate tectonics.

Lt. Col. Sir Vincent Arthur Henry McMahon (1862-1949), of the Indian Staff Corps, though not a geologist by profession, made a beginning and he was the first person to introduce in India, the use of the microscope in petrology. McMahon's petrographic description of the Central Gneiss of Simla Himalayas in 1877 is astounding. He duly identified that most of the geological work was being done without the help of a microscope and acted accordingly. He could infer the effect of heat and achievement of a granitoid condition with attendant plasticity in these gneisses. The history of crystallization of the inclusion and engulfing phases could be identified by him along with the cavity-filled superheated water or gas phases and directional growth of inclusion.

Organizations do have geoscientists with varied streams like Geology, Geophysics, Chemistry, etc. Even in the Geology stream, several specializations like mapping, exploration, petrology, paleontology, geochronology & isotope geology, photogeology and remote sensing techniques, engineering geology, etc., are available. As the subject has a broad spectrum of specializations, a sensible and overarching view of one another, an interaction among geoscientists of various disciplines, unmindful of their cross borders, is needed and the same may be more effective for a comprehensive study of their subject. Further, as geoscience is a natural science and common sense play a dominant role in its study, it is not uncommon to note that many of our field guides, helpers, and surveyors who associate with working geoscientists in the field also gain a certain extent of familiarity of rock types and help the main team to locate, identify and delineate rock formations during fieldwork. Such type of bondage is encouraged in the field of geosciences

DOMAIN-BASED LANDSLIDE SUSCEPTIBILITY ZONATION ON A MESO SCALE (1:10,000) WITH THE INTRODUCTION OF A LANDSLIDE MANAGEMENT MAP

Sunandan Basu, Geological Survey of India (sunandan.basu@gsi.gov.in)

Landslide is a perennial problem in the Himalayas due to high to very high rainfall, high relief, immature topography, poor rockmass condition, presence of adverse discontinuity, and proximity to major thrust zones. The widely adopted landslide-dependent methodologies in landslide susceptibility zonation on a macro-scale (1:≥25000) usually generates a more qualitative landslide susceptibility map which is unable to define the detailed landslide dynamics on the local scale. Hence, a domain-based semi-quantitative landslide susceptibility zonation on meso-scale (1:10,000) has been attempted through mapping of various qualitative factors and site-specific quantitative determination of geotechnical properties of rock (RMR_{basic}) and overburden material (cohesion (c), angle of internal friction (φ), grain size analysis, liquid and plastic limit, etc.). The area has been divided into different landslide domains, i.e. a spatial extent having similar physiographic and geological characteristics that control the type of landslide occurring within it. Domain-specific geofactors have been identified based on the landslide types within a domain and domain-specific quantitative landslide initiation zone susceptibility maps have been prepared by integration of the rated geofactor maps using the weighted multi-class index overlay method. To make the output products more user-friendly for the stakeholders, a combined landslide initiation zone susceptibility map for the entire area has been prepared and classified into low, moderate, and high degrees of susceptibility. But the risk from the landslides is not only from the source zone and areas at the downslope of the landslide source zone can be severely affected by landslide runouts. Hence, one separate debris flow impact probability map showing the potential susceptible zones from runouts at the downslope has been prepared. Besides, for effective mitigation of the critical landslide-affected areas, site-specific landslide management maps have been prepared as value addition to the project. These landslide management maps have information about the landslide and its generic mitigation measures, alternative new road alignment or diversion of the existing road alignment through tunnels/ bridges, escape routes, safe shelter locations, etc. These maps have been prepared mainly for the stakeholders so that the stakeholders find this information more meaningful and may use for landslide management purposes.

Fig. 1: Rockfall zone under rockfall domain.

Fig. 2: Rock slide on modified slope under cut slope domain.

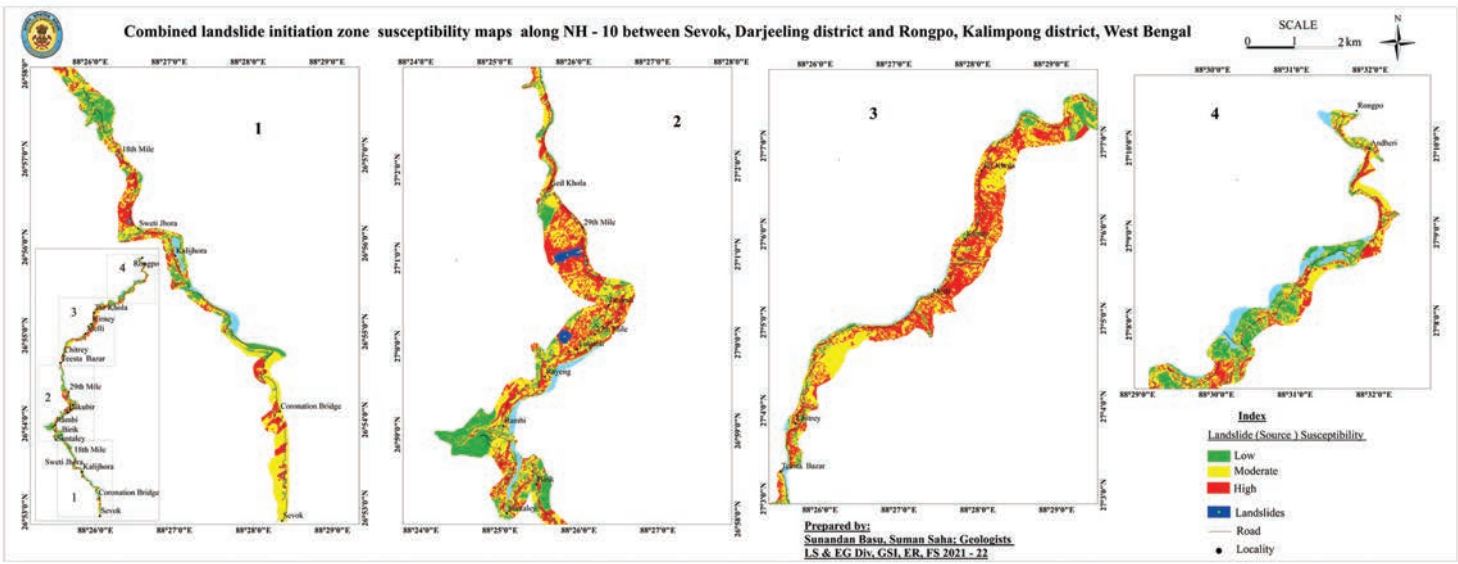


Fig. 3. Combined landslide initiation zone susceptibility map along NH - 10; from Sevok, Darjeeling district to Rongpo, Kalimpong district, West bengal.

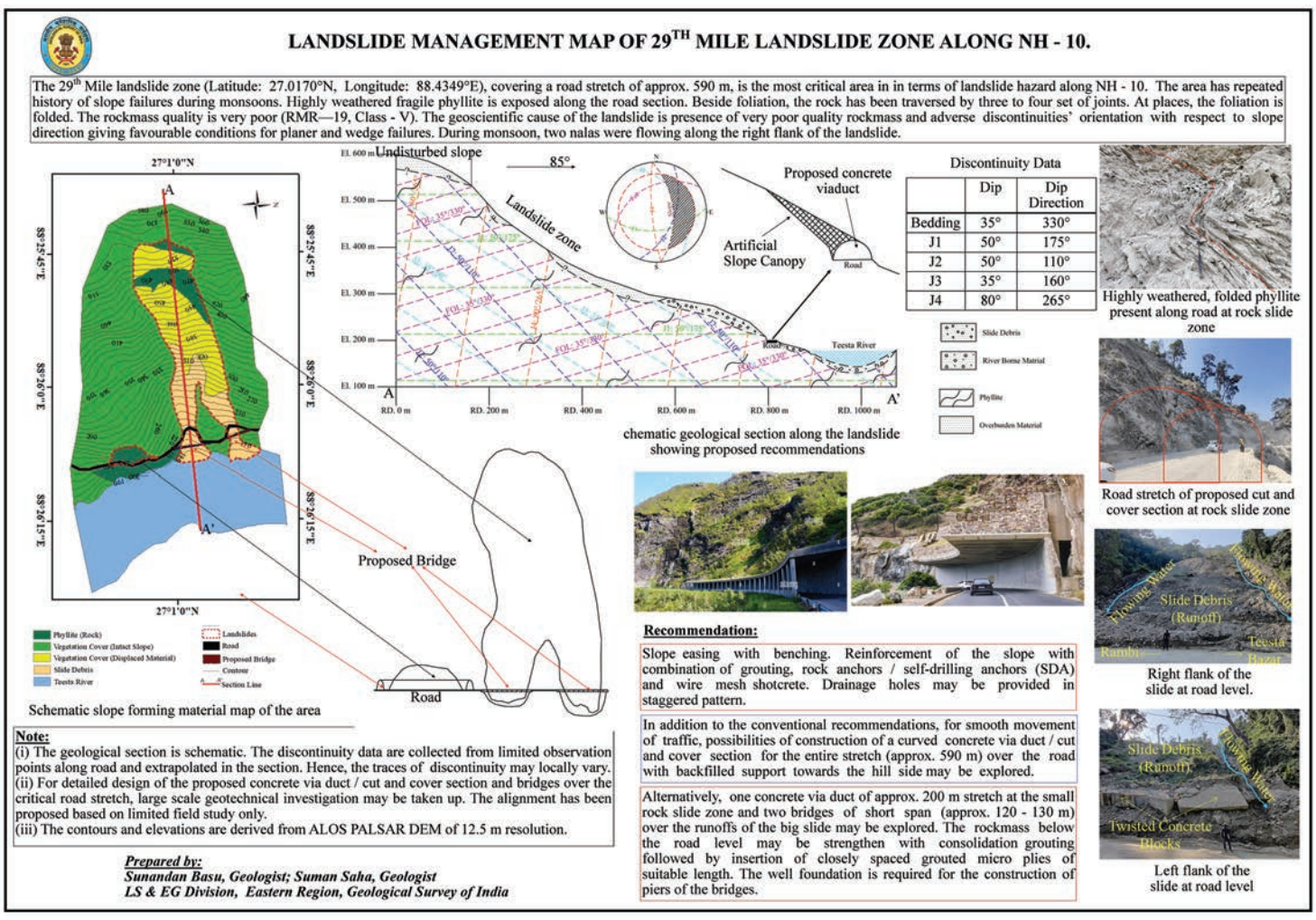


Fig. 4. Example of a landslide management map: 29th mile landslide zone of along NH - 10, Darjeeling district of West Bengal

I-SYSTEM SOFTWARE 1.8.8 IS RELEASED

Dr. Bineshian Hoss
Technical Director of AMBERG Engineering AG
Email: DrBineshian@outlook.com

I-System Software is comprehensive engineering software for geotechnical and geomechanical engineering. It is fully based on I-System (Bineshian, 2019, 2020, 2021) and (I)-TM (Bineshian, 2022). Development of I-System Software is funded by Terrene Pvt Ltd (Australia) based on Dr. Bineshian Hoss's inventions and developments as the author and programmed by M Zarepour. It is comprehensively applicable for civil, mining, and oil & gas structures in the ground including but not limited to abutments of bridges and dams, caverns, deep and shallow foundations, embankment and tailing dams, galleries, deep and shallow metro stations, mine stopes, open pits, shafts, slopes, trenches, tunnels, underground spaces and storages, wells, etc. This package of software contains several applications used in pre-design, design, construction, and post-construction phases in underground, semi-surface, and surface structures as follows:

- I-System: Index of Ground-Structure (Bineshian, 2019, 2020, 2021), which is an engineering classification system for ground including both soil and rocks. The output is (I)-Class, which is the I-System's Classification for ground structure.
- (I)-GC: I-System's Ground Characterisation (Bineshian, 2019, 2020, 2021), which quantifies the ground's mechanical properties including mass Cohesion, Compressive Strength, Internal Friction Angle, Modulus of Deformation, Poisson's Ratio, and Tensile Strength.
- (I)-TM: I-System's Tunnelling Method (Bineshian, 2022), which is the output of the I-System analysis in form of (I)-Class for underground structures.
- GCD: An application to calculate Ground Conductivity Designation (GCD; Bineshian 2020, 2022) in the assessment of ground conductivity for pre-/post-grouting/injection.
- PL Advisor: An application to calculate the optimized pull length for advancement in tunneling using drill and blast technique developed by Bineshian (2021).
- PPV Predictor: An application to calculate the peak particle velocity in the design of blasting and control of blast-induced damage developed by Bineshian (2021).
- SSH Identifier: An application to identify the Squeezing, Swelling, and Heaving (SSH) ground from non-SSH ground applicable in tunneling developed by Bineshian (2020).
- SysB Configurator: An application to calculate and configure the systematic bolting in tunneling developed by Bineshian (2021).
- ViD Assessor: It includes three methods in form of utilities to assess Vibration-induced Damage (ViD; Bineshian, 2021) using any type of excavation in tunneling by employing a Damage indicator (Di; Bineshian, 2021), Ground Conductivity enhanced factor (GCef; Bineshian, 2021), and Half Cast Factor (HCF; McKown, 1986).

I-System Software is a commercial design package; however, the full version of the same is available for free for students and academicians, geologists, engineers, and designers to improve the design of structures on ground, which is available with ISEG that can be provided upon request.

GEO-TOURISM AN INCIPIENT CONCEPT FOR SUSTAINABLE DEVELOPMENT OF MINING SECTOR: AN OVERVIEW

Prof. S.N. Patil, KBC North Maharashtra University, Jalgaon (drsnpatil9@gmail.com)

Exploring the mining environment, interpreting mining technology, and preserving mining history are all parts of mining tourism, which also offers visitors entertainment and education. Worldwide, especially in industrialized nations, this type of tourism is becoming more and more popular. One of the most important industries for a nation's economic growth is mining. This operation requires a significant quantity of land that may be useless after the mines are depleted. By repurposing mining areas for tourists, the growth of mining tourism might lead to new job possibilities and improve land management.

The mining site must thus be considered for other uses as well, and mining-based tourism proves helpful in this regard. The growth of mining tourism has numerous advantages, including a) an increase in tourism in areas where it had not previously existed; b) more opportunities for economic activity and employment through tourism; c) the chance for visitors to travel to uncharted areas; and d) increased awareness, protection, and preservation of mining heritage. The idea of mining tourism emerged in the 1990s as a result of academics' rising concern over the management of vast tracts of barren land created by the extraction of minerals. On the one hand, mines have been considered a component of secondary or human-made geological variety and a geo-heritage, hence it is considered an element of geo-tourism.

On the other hand, it is viewed as a cultural legacy that illustrates the advancement of industrial civilizations and the brilliance of human technological advancement. Interestingly, the idea of utilizing mining sites for tourist purposes perhaps influenced the creation of the ideas of geotourism and industrial heritage tourism. The term "geo-tourism" was initially used in 1995 by University of Bristol geologist Thomas A. Hose, who subsequently remarked that "the rising losses of mines and quarries due to hostile after-uses and reclamation programs" was one of the major driving forces behind this idea.

Similarly, Edwards and Coit, geographers from the University of Wales, discussed the potential of mines and quarries as an industrial legacy and how society may profit from this in 1996. Hose (1995) and Edwards and Coit (1996) both addressed the situation in the United Kingdom (UK). In the United Kingdom, where the industry began, the quantity of useless land owing to mining was increasing, prompting researchers from many academic backgrounds to consider alternate uses for the mining landscape.

Currently, mining tourism is a subject of academic discussion from the perspectives of geo-tourism and industrial heritage. Many researchers have showcased several instances and case studies from around the world and dealt with various strategies and ways to interpret mining tourism. Rybár and Trba (2016) contend that mining tourism should be viewed as "an individual form of tourism which, in many cases, is related to geo-tourism and industrial tourism but is on the same level as geo-tourism and industrial tourism" because there are important distinctions between geo-tourism, industrial tourism, and mining tourism. To experience the atmosphere and gain knowledge, they described mining tourism as a type of tourism that encourages both the general and specialized public to visit in-situ mines, mining museums, culture-historical monuments, and mining communities. However, the transformation of the post-mining environment into a tourist destination is a difficult process that presents several difficulties for the stakeholders, tourism managers, and locals.

First of all, the idea of mining legacy is very different from the conventional sense of beauty while compared to other tourist spots, it is frequently seen to be unsightly, dusty, and unappealing. For instance, the UK's Big Pit National Coal Museum, a UNESCO-designated cultural site, saw almost 150.000 visitors last year alone. Additionally, due to safety concerns, many individuals do not think it is worthwhile to visit mines, which are high-risk areas. Sometimes an increase in demand for the material extracted from the mine may give rise to the possibility of continuing to produce the material while discarding its tourist appeal. Before mining tourism could begin, all of these challenges had to be solved. Nevertheless, despite the challenges, several mining tourist destinations receive a sizable volume of visitors each year.

The UNESCO list of world-historic sites now includes around 20 mining sites from throughout the globe, many of which are exploited for tourism. Hence geo-tourism can play a major role in achieving the goal of suitable development of the mining sector in particular and society in general.

Photo 1: Limestone quarry at village: Chunadi, Tah..: Bhuj, Dist.: Kutch, Gujarat

Photo 2: Umarsar Lignite Mines, Kutch, Gujarat

Photo 3: Salt lake Rann of Kutch, Gujarat

Photo 4: Field visit to Rampura Agucha Mine, Udaipur, Rajasthan

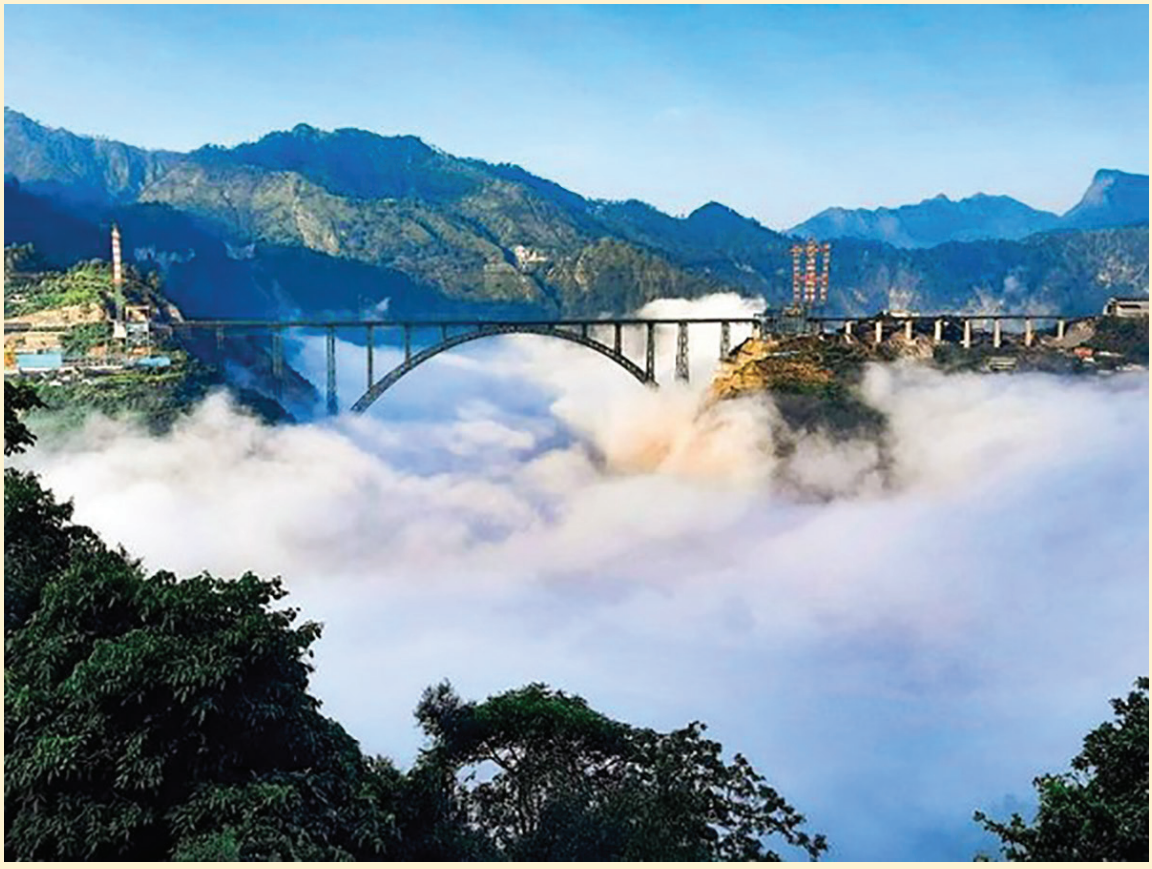
Photo 5: Zeolite from rock quarry, Jalgaon, Maharashtra

Author details:

Dr. S. N. Patil
ISEG Council Member (LM-1122)
Professor and Head, Department of Applied Geology,
School of Environmental and Earth Sciences,
Kavayitri Bahinabai Chaudhari North Maharashtra University,
Jalgaon, India-425001
Email: drsnpatil9@gmail.com / sanp2@rediffmail.com
Mobile: 9423937400

STABILITY ANALYSIS OF JOINTED ROCK SLOPES OF CHENAB BRIDGE ABUTMENTS

Prof. K. Seshagiri Rao
Emeritus Professor, Department of Civil Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi - 110016, E-mail: raoks@civil.iitd.ac.in



Abstract: The iconic Chenab railway bridge is under construction to cross River Chenab in the state of Jammu and Kashmir, India. The global stability of the bridge abutments was assessed and discussed in detail. The highest bridge in the World at a height of 359 m from the riverbed level, of 1263 m long, consists of a 950 m span steel arch in tandem with a 313 m long viaduct of a total of 18 piers. The loads exerted by these piers would affect the stability of the slopes. Apart from this, as the site falls under seismic zone V as per the seismic zonation map of India, the seismic loads were also considered in the analysis from a site-specific study. The hill slopes are carved due to the persistent geological processes with large nallahs and steep natural slopes. 2D and 3D analyses using UDEC and 3DEC were carried out for predicting the behaviour of the jointed rock slope of the abutments of the Chenab bridge.

Fig. 1. (a) Abutments of proposed Chenab bridge (b) Strata on right abutments, (c and d) View of the 3 sets of joints (J1, J2, J3) in Dolomitic rock on left abutment (Rao, 2009)

Geological and Structural Features: The railway alignment passes through the Shiwaliks and Pre-Tertiary rocks overlain by unconsolidated sediments of recent to sub-recent periods. The primary lithological units are dolomitic limestone with different degree of fracturing and occa-sional weathering. The geological nature of strata between toe and below the proposed arch foundation on both the abutments was assessed. The abutments of the proposed bridge across Chenab are shown in Fig. 1. (a and b).

The top layers are moderate to highly weathered but invariably the dolomite is fractured resulting in blocky mass. Foliation planes and other joint sets are very clear in the drifts made in the left and right abutments at expected arch foundation levels. The close-up view of the joints in the dolomitic strata for the left abutment is shown in Fig. 1 (c).

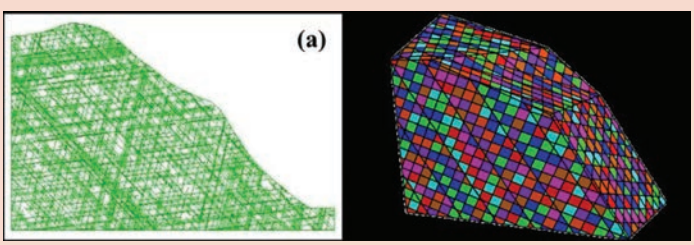


Fig. 2. Left abutment, (a) UDEC model, (b) 3DEC model (Rathod et al. 2011, 2012)

A detailed long term stability measures including drainage system were suggested (Rao, 2009). The study cleared the way for the construction of world's highest Chenab Bridge.

PRESIDENT, ISEG VISITS TO POLAVARAM MULTIPURPOSE PROJECT, ANDHRA PRADESH

On the request of the Central Water Commission, Ministry of Jal Shakti, Govt of India and Water Resources Department, Govt. of Andhra Pradesh, Sh. S. L. Kapil, President of ISEG visited Polavaram Multipurpose Project, Andhra Pradesh during 28th – 29th June 2022 for inspection. The Polavaram Project is an under-construction multi-purpose irrigation project on the Godavari River near Ramayyapeta, Polavaram in West Godavari District, Andhra Pradesh to meet the demands of irrigation, drinking water, and Power generation. It is located 40 km upstream of Sir Arthur Cotton Barrage located in Rajahmundry City. The project would constitute an earth-cum-rock fill dam of 2,310 meters in length, a spillway of 907 meters with 44 vents to enable the discharge of 100,000 m^3/s of water, and a powerhouse for generating 960MW of power.

The spillway is located on the right bank of the river for which nearly 5.5 km long and 1.0 km wide approach and spill channels up to river bed level have already been constructed. An Earth cum Rock Fill (ECRF) Dam is proposed to be constructed with the entire dam length demarcated into three zones viz., Gap-I (564m length), Gap-II (1750m length), and Gap-III (140m length). As a part of the construction of the ECRF dam in Gap-II, a 1.5m wide plastic diaphragm wall has been provided to arrest the seepage in the subsurface underneath the ECRF dam.

During the site visit all the components of the project viz., Dam area (Gap-I & Gap-II), Powerhouse area, Upstream & Downstream Coffer Dam, had been visited and assessed.



Discussions with dam authorities (WRD, Andhra Pradesh) along with PPA, WAPCOS, and MEIL have been undertaken during the site visit and meetings at the office of WRD, PPA, Andhra Pradesh.

REGIONAL LANDSLIDE EARLY WARNING SYSTEM (LEWS) – AN ENDEAVOUR BY GSI FOR LANDSLIDE DRR IN THE COUNTRY

Geohazards Research & Management Centre, GSI, CHQ, Kolkata

Being the nodal agency for landslide hazards in the country, the Geological Survey of India (GSI) has been engaged in an international project–LANDSLIP (Landslide multi-hazard risk assessment, preparedness and early warning in South Asia integrating meteorology, landscape and society) between 2017 and 2022, to develop and test an advanced and globally contemporary technology of regional landslide early warning system (LEWS) for the country. LANDSLIP (www.landslip.org) is a multi-consortium research group involving Geological Survey of India (GSI), British Geological Survey (BGS), UK Met Office, CNR-IRPI, Italy, Kings College, London, Newcastle University, UK, Practical Action (UK and India) and also the Amrita Vishwa Vidyapeetham, India who worked together to develop a prototype model of such regional LEWS for two test sites (Darjeeling, and the Nilgiris) in India. However, this prototype regional LEWS model with the required site-specific refinement is currently put under testing by GSI at four test locations (Darjeeling, and Kalimpong districts in West Bengal, The Nilgiris district in Tamil Nadu, and Rudraprayag district, Uttarakhand) in India. The Regional LEWS tool depends on the rainfall forecast and the terrain-specific rainfall thresholds on a regional scale (down to sub-division/ block level) for issuing both short range (up to 72 hours) and medium range (3-10 or 15 days) landslide forecasts (Figs. 1 & 2), and for

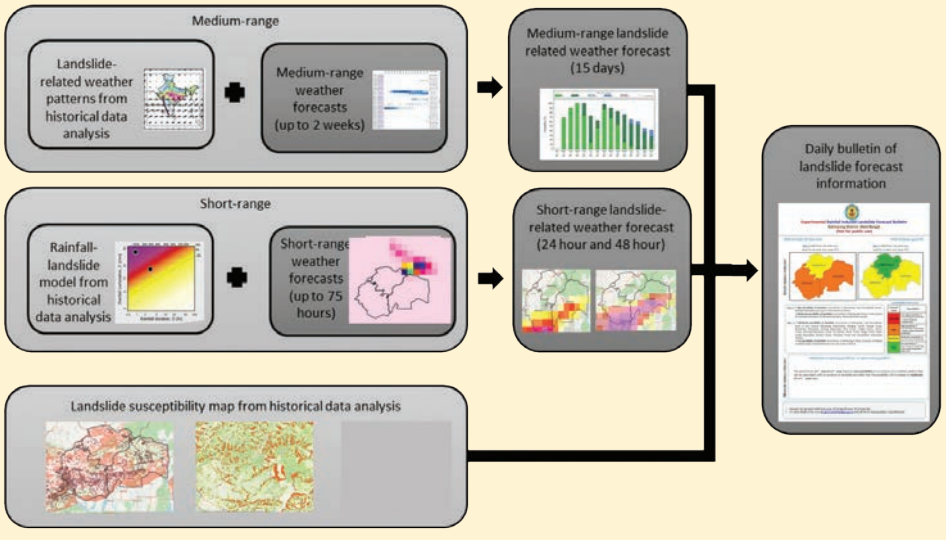


Fig. 1: The inputs behind the forecast generation (modified after LANDSLIP Project - www.landslip.org)

which GSI has already started long-term institutional partnerships with India Meteorological Department (IMD), National Centre for Medium Range Weather Forecasting (NCMRWF), National Remote Sensing Centre (NRSC), and concerned SDMAs of the application States for similar in future.

With the approval of the Ministry of Mines, Government of India, GSI is now involved in extending similar research-based programs in other landslide-prone states too, and currently GSI is pursuing such endeavour in 10 states (West Bengal, Tamil Nadu, Uttarakhand, Kerala, Sikkim, Himachal Pradesh, Karnataka, Assam, Meghalaya, and Mizoram) to arrive at an operational regional LEWS model in phases for the country from 2025 onwards to minimise the landslide risks and losses. To undertake this time-bound task, GSI is also establishing a National Landslide Forecasting Centre (NLFC) at GSI headquarters, Kolkata to integrate, generate and disseminate daily landslide forecast bulletins for multiple states.

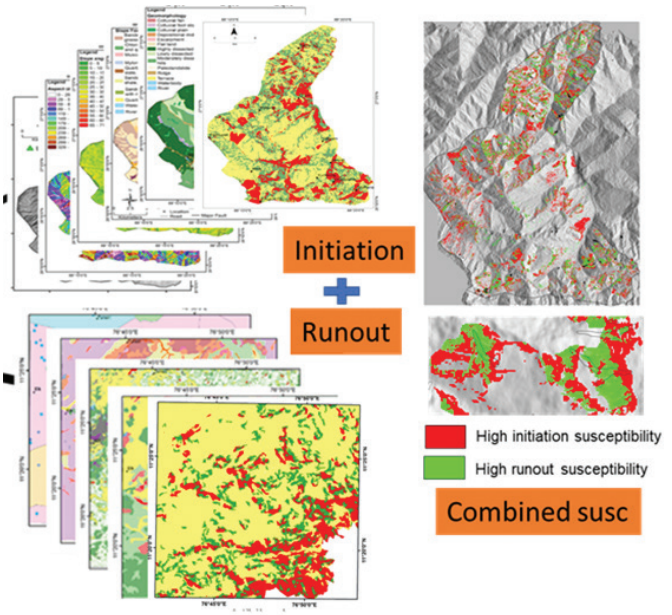
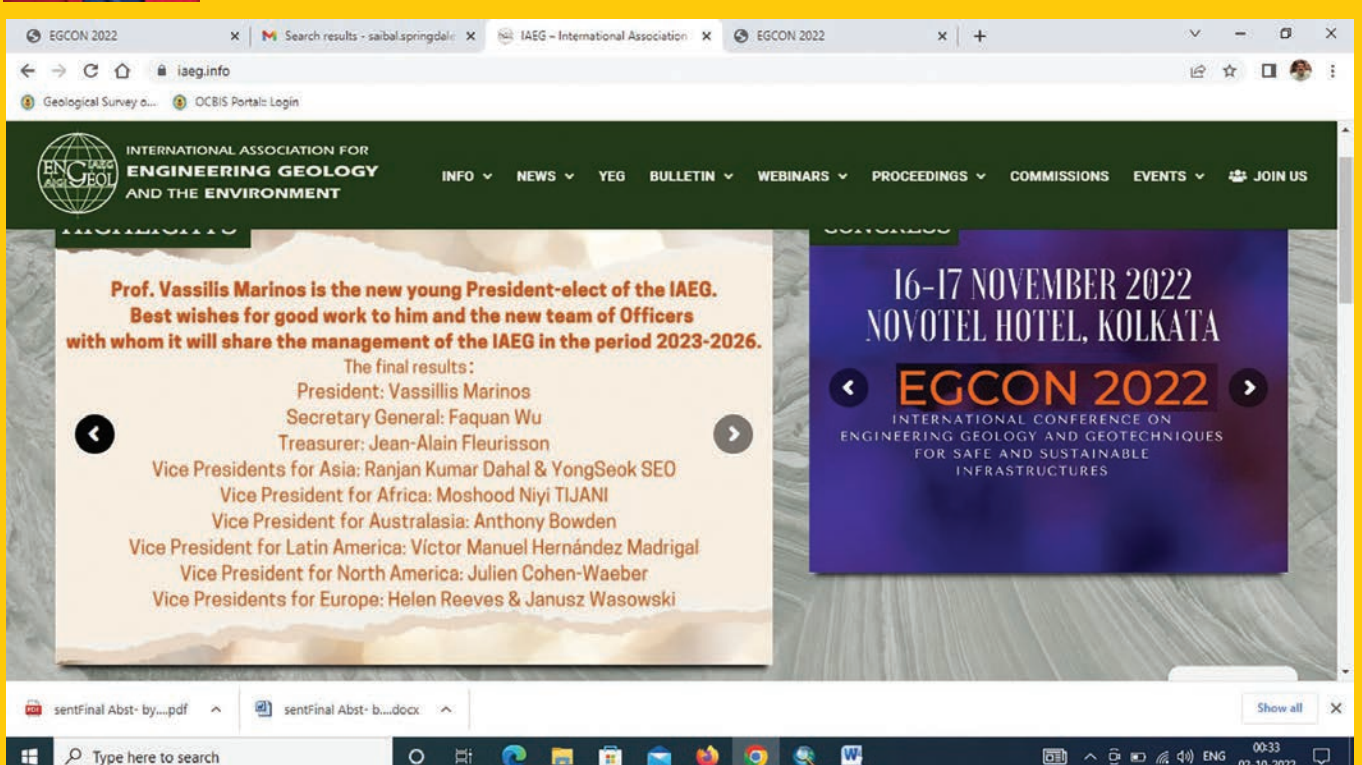


Fig. 2: Example of a combined susceptibility map of high initiation and run-out impact map–the vital landscape inputs used as a background for decision making in assessing the landslide forecasts.

RANJAN KUMAR DAHAL (PHD, POST DOCTORATE, M. ASCE)

Central Department of Geology Tribhuvan University, Kirtipur, Kathmandu, Nepal



ISEG congratulates Dr. Ranjan Kumar Dahal, a professional geology engineer/ geohazard expert of Nepal and a Life Member of ISEG for being elected as one of the Vice Presidents for Asia of IAEG for the term 2023-2026 (https://www.iaeg.info/).