ASNEngr

American Society of Nepalese Engineers

Proceedings/Book of Abstracts
of

The Second Annual Conference

of

American Society of Nepalese Engineers (ASNEngr)

"Engineering and Science for Sustainable Development of the Society"

Held at

Oakland Convention Center (Oakland Marriott Hotel City Center),
Oakland, CA
1001 Broadway, Oakland, CA 94607, USA
(with 2009 ANA Convention)

during

July 3 - 4, 2009

Edited by

Ramesh B. Malla, Binod Tiwari and Pradeep Khanal

American Society of Nepalese Engineers (ASNEngr)
P. O. Box 39524, 4904 York Road
Baltimore, Maryland 21212-9998,U.S.A.
Email: info@ASNEngr.org / Web: www.ASNEngr.org

ASNEngr

American Society of Nepalese Engineers

P. O. Box 39524, 4904 York Road, Baltimore, Maryland 21212-9998. Email: info@ASNEngr.org / Web: www.ASNEngr.org

Conference Organizing Committee:

General Chair:
Ramesh B. Malla, Ph.D., University of Connecticut, Storrs (CT)

Technical Chair:
Binod Tiwari, Ph.D., California State University, Santa Fullerton (CA)

Technical co-Chair:
Pradeep Khanal, Intel, Santa Clara (CA)

Organization Committee Members:

Ambika Adhikari, D. Des (AZ)
Komal Dutta (IL)
Jagannath Ghimire (MD)
Samana Ghimire (CA)
Prakash Khanal (MD)
Shraddha Joshi (CT)
Prakash B. Malla, Ph.D. (GA)
Parag Neupane, Ph.D. (CA)
Sujit Pant (CA)
Bishnu Phuyal, Ph.D. (IL)
Pratibha C. Phuyal (IL)
Prem Rimal, P.E. (CA)
Pradhumna Shrestha (TX)
Rajendra K. Shrestha, Ph.D. (TX)
Rohit Mishra, Ph.D. (CA)
Prabal Upadhyaya (CA)

WELCOME FROM ORGANIZERS

On behalf of the Organizing Committee and the Society's Board of Director, we would like to extend our greetings and welcome you to the Second Annual Conference of the American Society of Nepalese Engineers (ASNEngr) being held in Oakland, CA, U.S.A., July 3 - 4, 2009 with the 2009 Annual Convention of the Association of Nepalese in Americas (ANA).

The objective of ASNEngr is to promote professional growth and advancement of individuals with Nepalese background and interest in Nepal, who have expertise and training in any engineering, scientific and technical areas; and to facilitate for their increased contribution to the progress of engineering and scientific education, research, training, practice, and technology transfer for the benefit of humanity. We believe that this conference is very important to meet several targets that are set forth by the objective of the society.

ASNEngr organizes the conference annually. This conference is the second in the series. The first conference was organized in Hunts Valley/Baltimore, MD, during July 03-04, 2008. Theme of this second conference is "Engineering and Science for Sustainable Development of the Society". The objective of the conference is to gather engineers and scientists, who are directly or indirectly affiliated to promote the development pertinent to the scientific, engineering, and other related fields. The conference provides common venue for those engineers, scientists, and related professionals to have a collaborative effort for further research and development.

The program includes three technical sessions and a panel discussion titled "Knowledge Sharing for Career Advancement.". The presenters and participants in the technical and panel sessions are engineers, scientists, and related professionals who come from academia, government agencies, and leading private industries. The program covers multi-disciplinary areas that include but not limited to the mitigation of natural disaster such as landslides and earthquake, sustainable engineering design for infrastructure, bridge design and construction, advanced materials, advanced exploration and structures including on lunar environment, advanced medicine/clinical treatment, urban planning, geophysics, petroleum engineering and science. We would like to express our heartfelt gratitude to the authors who sent us their abstracts on time. We believe that presentations and the forum for discussion at the Conference will give the participants ample opportunities to share the knowledge of research and development in the pertinent area and create a common discussion ground for the further enhancement.

We would like to thank the Conference attendees for taking their valuable time participating and supporting the conference. Thanks are also due to the tireless effort of organizing committee members and the members of the Board of Directors of ASNEngr, who provided their invaluable suggestions from time to time to make this event a success.

We are looking forward to meeting and greeting you at the conference.

With warm regards,

Ramesh B. Malla, Ph.D.
Conference General Chair
University of Connecticut
Storrs, CT, USA

Binod Tiwari, Ph.D.
Technical Chair
California State University
Fullerton, CA, USA

Pradeep Khanal
Technical Co-Chair
Intel
Santa Clara, CA, USA

ASNEngr
American Society of Nepalese Engineers

Overall Program Schedule At-a-Glance

Friday, July 3rd, 2009

09:30 AM – 10:00 AM: *Conference Opening* *(Room: 204)*

10:00 AM – 11:20 AM: *Technical Session I* *(Room: 204)*

3:30 PM - 5:00 PM: Panel – *Knowledge Sharing for Career Advancement* *(Room: 204)*

Saturday, July 04th, 2009

09:00 AM – 10:20 AM: *Technical Session II* *(Room: 204)*

10:20 AM – 10:30 AM: *Break*

10:30 AM – 11:50 AM: *Technical Session III* *(Room: 204)*

11:50 AM – 1:00 PM: *Lunch Break (on your own)*

1:00 PM – 2:30 PM: *Annual General Membership/BOD Meeting* *(Room: 204)*

Detail Program Schedule

Friday, July 03rd, 2009

Conference Opening *09:30 AM – 10:00 AM* *(Room: 204)*

09:30 AM – 10:00 AM
Conference Opening Remarks and Introduction by ***Ramesh B. Malla, Ph.D****, ASNEngr President and Conference General Chair*

Technical Session I *10:00 AM – 11:20 AM* *(Room: 204)*
Session Chairs: Ramesh B. Malla, Ph.D., University of Connecticut, Storrs, CT; and **Pradeep Khanal**, INTEL, Santa Clara, CA

10:00 AM – 10:20 AM
"Preparation of Landslide Potential Map of a Road Sector with Deterministic Analysis" by ***Dinesh Shrestha***, California State University, Fullerton, CA

10:20 AM – 10:40 AM
"Earthquake Retrofitting of School Projects in Nepal" by ***Kanhaiya Kayastha, P.E., S.E.,*** La. Habra, CA

10:40 AM – 11:00 AM
"Prospects of Tele-medicine/Tele-ophthalmology to prevent cataracts in Nepal" by ***Amod Pokhrel***, University of California at Berkeley, Berkeley, CA

11:00 AM – 11:20 AM
"Construction Practice in the USA – difference with the practice in Nepal" by ***Dol Raj Adhikari, P.E.,*** Department of Transportation, Sacramento, CA

Panel Discussion *3:30 PM – 5:00 PM* (Room: 204)

3:30 PM – 5:00 PM
Panel Topic: ***Knowledge Sharing for Career Advancement***
Moderators: Binod Tiwari, Ph.D., California State University, Fullerton, CA; and **Ambika Adhikari, Dr.Des., AICP,** SRPMIC, Scottsdale and Arizona State University, Tempe, AZ

Panelists:

Ramesh B. Malla, Ph.D	University of Connecticut, Storrs, CT
Rajendra K. Shrestha, Ph.D	ConocoPhillips, Houston, TX
Raja Upadhyay	Pincock Allen & Holt, Lakewood, CO
Naveen Dutta	Avaya Lab Research, Westminster, CO
Dol Raj Adhikari, P.E.	Department of Transportation, Sacramento, CA
Pradeep Khanal	INTEL, Santa Clara, CA

Saturday, July 04th, 2009

Technical Session II *09:00 AM – 10:20 AM* *(Room: 204)*

Session Chairs: Ramesh B. Malla, Ph.D., University of Connecticut, Storrs, CT; and **Rajendra K. Shrestha, Ph.D**., ConocoPhillips, Houston, TX

09:00 AM – 09:20 AM
"Design Practice for Slope Stabilization Works – State of The Art Practice and Future Improvement" by ***Binod Tiwari, Ph.D,*** California State University, Fullerton, CA

09:20 AM – 09:40 AM
"Bridge design and construction Practice in the US" by ***Prem Rimal, P.E,*** California Department of Transportation, Sacramento, CA

09:40 AM – 10:00 AM
"How the Compressibility and Plasticity of Soil Changes with Mineralogical Composition" by ***Ishwar Dhungana,*** California State University, Fullerton, CA

10:00 AM – 10:20 AM
"Advanced Composites in Today's Context" by ***Pranav D. Shah, Ph.D.***, Stanford University, Palo Alto, CA

Break 10:20 AM – 10:30 AM

ASNEngr
American Society of Nepalese Engineers

Technical Session III *10:30 AM – 11:50 PM* *(Room: 204)*

Session Chairs: Pranav Dhoj D. Shah, Ph.D, Stanford University, Palo Alto, CA; and **Jagannath Ghimire**, Baltimore, MD

10:30 AM – 10:50 AM
"Petroleum Engineering in the Oil and Gas Industry" by ***Rajendra K. Shrestha, Ph.D***, ConocoPhillips, Houston, TX

10:50 AM – 11:10 AM
"Comments on Building Construction Practice in Nepal in View of Earthquake Safety" by ***Suresh Acharya, S.E.,*** City of Concord, CA

11:10 AM – 11:30 AM
"Towards Developing Indicators for Kathmandu" by ***Ambika Adhikari, Dr. Des., AICP***, SRPMIC, Scottsdale and Arizona State University, Tempe, AZ

11:30 AM – 11:50 AM
"Structural Analysis of Percussive Penetrometer System for Lunar Exploration" by ***Ramesh B. Malla, Ph.D***, University of Connecticut, Storrs, CT

Lunch Break 11:50 AM to 1:00 PM (on your own)

Annual ASNEngr General Membership Meeting and Closing (Room: 204)
1:00 PM – 2:30 PM: Annual General Membership and Board of Directors meeting & Closing

CONFERENCE ABSTRACTS

ASNEngr
American Society of Nepalese Engineers

Preparation of Landslide Potential Map of a Road Sector With Deterministic Analysis

Dinesh Shrestha
Graduate Student, California State University, Fullerton
Binod Tiwari, Ph.D.
Assistant professor, California State University, Fullerton, USA

Landslides frequently block the highways and cause tremendous delay in traffic in addition to a huge property loss. Every country has this problem in different magnitude. However, there are a few researches done on the deterministic way of forecasting those problems. We collected the topographic map as well as geological map of 16 km road sector of Prithiwi Highway, Nepal and digitized them to GIS. We conducted field survey to get soil specimen for the measurement of field density and shear strength. We distributed the field measured shear strength and density of soil spatially to perform automated calculation to identify unstable slopes during extreme natural events that include heavy rainfall and earthquake. Then, we prepared a slope instability map and proposed the worst chainages the highway where strong alert is necessary. We also identified the rivers which are potential to have landslide damming that may wash away the bridges constructed along the highway.

Earthquake Retrofitting of School Projects in Nepal

Kanhaiya Kayastha, M.S., P.E, S.E., F.ASCE
Consulting Structural Engineer
E-mail: kkayastha@aol.com

Nepal lies in an earthquake zone. Nepal is also placed in a zone that has the highest probability of risk and the greatest potential of major damage to buildings and infrastructures during an earthquake episode, and is more or less comparable to California.

The majority of school buildings, even constructed in recent years, are generally constructed without the input of engineers trained in the earthquake-resistant design and the compliance of the minimum building design standards required by the building code.
A major percentage of the existing schools in Nepal, public and private, are currently in operation in many existing old buildings, built in the traditional brick and mud construction, mixed with structural wood members. These types of construction do not posses the necessary lateral-load-resisting capabilities in the building, to withstand the forces generated by major earthquakes and, therefore, are very vulnerable to earthquake tremors. The buildings can crumble, sometimes, even collapse, in a moderate earthquake, depending upon its soil conditions and the types of construction.

Recognizing the necessity to reduce the risk of major property damage and the loss of lives in future earthquakes, the National Society of Earthquake Technology – Nepal (NSET) and GeoHazards International, U.S.A. (GHI) launched the first school-retrofitting project in Nepal, in 1999. Accordingly, NSET in partnership with GHI started the seismic-retrofit (earthquake-resistant reconstruction) of "Bhubaneswori Secondary School" at Nangkhel, Bhaktapur, Nepal, in 1999. With much appreciation and encouragement received from the local communities, individuals, and the international organizations, NSET is currently retrofitting the 20th school in Tanahu, Nepal, under its "School Earthquake Safety Program" (SESP).

Therefore, in order to make more existing schools earthquake-resistant in Nepal, thereby preventing sudden collapse and sustain only minor repairable building damages, various low-cost seismic-retrofitting techniques can be utilized, taking into consideration the site conditions and the easily available construction materials.

The author would like to welcome all, for their ideas and support in this voluntary endeavor of school retrofitting project in Nepal, thus help save many human lives and properties from future catastrophes.

The author can be contacted for any suggestions and the earthquake-retrofitting projects in Nepal.

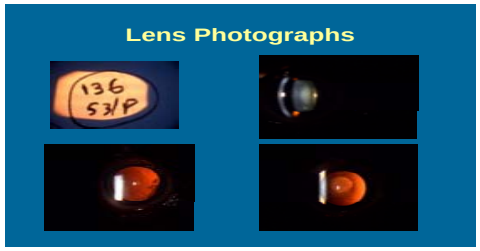
ASNEngr
American Society of Nepalese Engineers

Prospects of Tele-medicine/Tele-ophthalmology to prevent cataracts in Nepal

Amod K. Pokhrel

Doctoral candidate at the School of Public Health, University of California, Berkeley
amodpokhrel@yahoo.com

In Nepal about 86% of people live in rural areas and only 29% of the poor people can reach health facility within half hour time. Among other prevalent diseases, the prevalence of cataracts is higher in rural areas than in urban areas and a higher proportion of females than males are visually impaired from cataracts. Contrary to higher burden of cataracts, there is one ophthalmologist for about a quarter million people in Nepal and for various reasons, majority of ophthalmologists are concentrated in city centers. Considering the need of eye care program in rural areas, a prospect of tele-ophthalmology or tele-medicine program was evaluated by conducting a lens opacity cross-sectional study in Manipal Teaching Hospital in Pokhara Nepal with the collaboration of UC Berkeley's School of Public Health and School of Optometry. The cross-sectional study involved administration of questionnaires, physical exams (visual acuity), eye photography, and documentation of lens opacity in women who had no previous diagnosis of lens opacity or cataract surgery. Digital photos of the cross-sectional and retro-illumination views of lenses were collected from 139 participants through slit-lamp with digital camera. Photographs were sent to experts in UC Berkeley School of Optometry for evaluation and grading on fine scale. These whole exercises were completed via teleconference and e-mail, where high-resolution photos of participants were sent via e-mail followed by photos on compact disks. This study developed a new method and protocol to document lens opacity at the pre-clinical stage and identify risk factors for earlier damage of lens in women. Examination of lens at the earlier stages will offer earlier intervention and prevention of most common cause of blindness- cataracts in Nepal. There is a possibility to expand the protocol and methods developed in this study for rural eye care program in Nepal and similar technique can be expanded in other areas of other health care such as tele-dermatology and tele-radiology.



Cross sectional images of lens with nuclear opacity, nuclear color, cortical and posterior sub-capsular opacities/cataracts.

Construction Practice in the USA – difference with the practice in Nepal

Dol Raj Adhikari, P.E.
California Department of Transportation, CA

Construction of transportation facilities is very important for the sustainable development of a nation. Transportation also impacts in the socio-economic situation of a nation. Different countries have their own ways to execute the construction of transportation facilities. Various steps that are involved till the final transfer of highways to the consumers are surveying, planning, design, bidding process, construction, and construction supervision. Highway authorities also take the responsibility of maintenance of highways in their territory. All of the above mentioned steps are executed in slightly different ways in a developing country as opposed to the developed one. This presentation will include the major differences between the design, construction bidding and supervision process for the construction of highway projects in Nepal and USA. There are several aspects that developing countries don't consider in the contract document, which always put a large room for the contractors to claim for price escalation.

ASNEngr
American Society of Nepalese Engineers

Design Practice for Slope Stabilization Works – State of The Art Practice and Future Improvement

Binod Tiwari, Ph.D.
Assistant professor
California State University, Fullerton, USA

While planning and constructing infrastructures along slope, we need to make sure that those infrastructures are not affected by the failure of the slope. Landslides are the major slope disasters that cause a huge loss of lives and properties due to the damage to the infrastructures. Although it is almost impossible to control the natural phenomenons that trigger landslides, there are several ways that we can protect our infrastructures from the possible landslides. Moreover, different countries have their own standards to design slope stabilization measures. This paper deals with the monitoring and investigation process for landslides and the landslide prevention practices standardized for Japan, USA, and Nepal. The paper also includes the appropriate methodology that can significantly enhance the landslide mitigation practice in developing countries.

Bridge Design and Construction Practices in the US

Prem Rimal, P.E.
California Department of Transportation, CA

With the advancement of our knowledge and the availability of state of the art bridge design and construction information, we try to overcome the challenge created by the need of the current drastic growth of the human population. This requires and inspires us to innovate the new, advanced design and construction of the quickly and easily constructible, easily accessible, aesthetically pleasant, and environmental friendly bridge structure. The US, as a pioneer in bridge construction technology, mostly independently leads the world with great pride in her state of the art bridge design and construction practices.

In this presentation, a simple introduction to design and construction of bridge structure will be discussed. At first, the structural components of the bridges will be given which will be basis of all types of bridges. Depending on the span length of the bridge structure, availability of construction materials, construction cost, ease of constructability, and historical importance and aesthetic need of the location, different types of bridge structures are used. The design loading will also be the major key player in sizing the bridge components. The constructions of few types of bridges will be presented.

ASNEngr
American Society of Nepalese Engineers

How the Compressibility and Plasticity of Soil Changes with Mineralogical Composition

Ishwar Dhungana
Civil Engineer, KPFF
Binod Tiwari, Ph.D.
Assistant professor, California State University, Fullerton, USA

To evaluate the geotechnical properties of a soil mass, different soil specimens were prepared in the lab by mixing various proportions of quartz, smectite, and illite. Liquid limit, plastic limit, and volume change behavior in terms of compression and swelling indices were measured according to the procedure mentioned in the respective ASTM methods. Those minerals are considered as the most common minerals that are found in expansive soils that include mudstone/clay stone, marl and shale. Such expansive soils are always considered as problematic soils in geotechnical engineering. The results show that plasticity index and liquid limit depend on the proportion of smectite and total clay content. A parabolic relationship could be observed between the liquid limit and proportion of smectite. Smectite is mainly controlling the plasticity characteristics. Likewise, volume change properties also depend on the proportion of smectite and liquid limit. A parabolic relationship was observed between the compression index and proportion of smectite, whereas a linear relationship was observed between the liquid limit and compression index. The results clearly show that we can estimate the coefficient of consolidation, and compression and swelling indices of a soil mass with reasonable accuracy with liquid limit and proportion of dominant clay mineral. This finding has a great significance in the geotechnical engineering because with a small amount of soil that can be collected from a boring core, we will be able to evaluate liquid limit, mineralogical composition, and clay content. Those parameters can be used to estimate the compressibility and hydraulic conductivity of a soil mass. They are very important in numerical simulation, foundation design, and many other applications in geotechnical engineering.

ADVANCED COMPOSITES IN TODAY'S CONTEXT

Dr. Pranav Dhoj Shah, PhD
Postdoctoral Research Associate
Department of Aeronautics and Astronautics, School of Engineering
Stanford University, California, USA
pdshah@stanford.edu

Due to high specific strength, corrosion resistance and other superior properties, composites have seen a tremendous increase in their use over conventional materials such as metals. The use of these high performance materials has been found to be noticeably beneficial in various engineering applications including aerospace, naval, terrestrial and recreational fields. For example, in the context of current energy crisis, the weight savings in aircraft structures due to the use of advanced composites translates directly to the savings in fuel which produces a lighter, durable, fuel efficient and greener mode of transportation. In addition, the use of composites in aircraft structures result in reduced maintenance and increased passenger comfort level. In the same note, composites have found its use in the components of wind turbine which is a popular device to tap in the alternate source of energy. Thus the use of composites is going hand-in-hand with today's need and can play a key role in socio-economic development. Although composites have been in use for more than half a century, there is a lot to be understood about the mechanics and behavior of this multiphase material. Recent advancements in analytical, numerical and experimental methods have furthered our understanding of their behavior and performance. Various numerical methodologies have been developed for design optimization, prediction of failure modes and estimation of strength and life of composite structures thus enabling stronger, lighter, stiffer and durable structures. However, on the contrary, the current industry design practices involving composites are still confined to traditional methodologies. As a result, the weight and cost savings achieved are considerably lower than what could be achieved with a smarter design with composites. With the undergoing research and development in the field of micro and macro mechanics of advanced composites, the traditional approaches can be challenged to utilize the potential of composites to one's best advantage.

ASNEngr
American Society of Nepalese Engineers

Petroleum Engineering in the Oil and Gas Industry

Dr. Rajendra K. Shrestha
ConocoPhillips Company
Houston, Texas

Petroleum Engineering, which saw its humble beginning in the universities of Pennsylvania and California in 1910, has come a long way and has become an integral and indispensable part of the oil and gas industry in all stages of the development of a field: from exploration to production, and then on to abandonment. Petroleum engineers, including reservoir engineers, drilling engineers, completion Engineers and production engineers, work side by side with petroleum geoscientists in the upstream sector of the oil and gas industry to maximize economic and efficient production of crude oil and natural gas. In the modern world, petroleum engineers face many challenges such as drilling horizontal wells, drilling wells in hostile (high pressure - high temperature) environment, deepwater drilling, enhanced oil recovery, and operation in extreme weather conditions, such as Arctic and extreme heat.

Comments on Building Construction Practice in Nepal in View of Earthquake Safety

Suresh Acharya, S.E.
Plan Check Engineer, City of Concord, California

Nepal is situated on the boundary of Eurasian and Indian tectonic plates. Indian plate is constantly pushing against the Eurasian plate. This movement is responsible for creation of Himalayas and generating severe earthquakes in the region. History indicates that several big earthquakes have occurred in the Himalayas in the past, but fortunately, no big earthquakes have hit the big cities of Nepal in recent history. Despite the know earthquake hazards, modern building construction practice in Nepal does not reflect the need for minimizing the risks. Common practice in Nepal is to construct concrete moment frames with brick in-fill walls. While the moment frames are intended to be a ductile system, the brick in-fill walls are inherently brittle. Therefore, combination of these two elements are not compatible. This presentation discusses the problems the incompatible system could create during earthquakes, and possible solutions.

ASNEngr
American Society of Nepalese Engineers

Towards Developing Indicators of Environmental Sustainability for Kathmandu, Nepal

Ambika Prasad Adhikari, Dr. Des., AICP
SRPMIC, Scottsdale and Arizona State University, Tempe, AZ, USA
Ambika@alum.mit.edu

Sustainability is now considered a key objective of urban planning and development. Whether in the development of a comprehensive plan, zoning ordinance or building codes, sustainability is a central requirement. Both the Nepali Government and donor agencies now require that sustainability is incorporated as the central criteria in the planning, and implementation of urban development programs in the country.

However, due to inappropriate planning, weak institutions, lack of resources and poor implementation of policies, most big cities in the developing world have become less environmentally, economically and socially sustainable, than they were in the past. Kathmandu is a typical example of such unsustainable practices, where the new developments are visible examples of urban inefficiency, chocking transportation, water and energy shortages and poorly managed urban waste system. Further, the lack of open spaces, recreational facilities, parks and common urban amenities have drastically reduced the quality of life in the cities.

In the past, at least until some four decades ago, Kathmandu, Nepal enjoyed a unique tradition, rich history and a moderate state of sustainability in all areas, particularly a strong environmental sustainability. Cities were planned in time tested manner, construction was locally supported and urban design was congruent with the culture and ecological need of the area. However, the rapidly growing and modernizing Kathmandu is facing serious problems of sustainability in all fronts: economic, social, environmental and ecological. Whereas, environmental and economic sustainability was tacitly imbedded in the traditional planning practices, the rapid expansion and modernization of all the major cities in the Kathmandu valley is happening without a commensurate growth in local capacity and thus is making the urban area increasingly unsustainable. The environmental quality has been dramatically degraded, the social and cultural structure has lost its traditional anchors, and a large portion of the urban population remains outside the mainstream economic realm of the city.

This paper discusses elements of planning for a sustainable Kathmandu and develops a methodology for creating indicators of sustainability in major urban activities. Indicators are then proposed to reflect the state of sustainability of urban planning and development. These indicators will be useful in measuring the effect of policy intervention and planning efforts in the city, aiding in the planning, implementation and evaluation processes for enhancing the livability of the cities in the Kathmandu Valley.

Key words: Sustainability, Indicators, Planning, Kathmandu

Structural Analysis of Percussive Penetrometer System for Lunar Exploration*

By
Ramesh B. Malla, Ph.D., Associate Professor**
E-Mail: MallaR@engr.uconn.edu
and
Bibek R. Shrestha, Graduate Research Assistant
E-mail: Bibek.Shrestha@engr.uconn.edu

Department of Civil & Environmental Engineering
University of Connecticut, Storrs, CT 06269-2037, U.S.A.

EXTENDED ABSTRACT

This research involves finite element modeling and analysis of percussive penetrometer system designed for lunar surface/ground exploration and construction. The instrument consists of a single tubular rod or several tubular rods connected to each other in a telescopic fashion, operated by a powered mechanism. The instrument is envisioned to operate under high frequency vibration which will reduce the force required for pushing a rod into the regolith (lunar soil) by certain order. The main focus is on maximizing efficiency of the drilling system by use of different materials and structural configuration.

A finite element model of a percussive penetrometer developed using the ABAQUS finite element code is shown in Fig.1. The propagation and nature of stress and displacement waves along the length of the system made of different material and geometric dimensions to determine energy available at the drill bit are being studied. Another key element of the study is to determine the effects of compressive pre-load applied at the joints connecting the drill strings on the stress and displacement transfer and whether it is effective to keep the rods together.

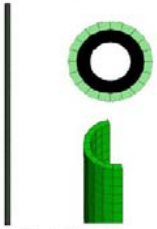


Fig 1: Finite Element Model of a Percussive Device

As an example of the nature and extent of the results obtained from the study, Fig. 2 shows the stress wave propagation for initial 0.4 ms along the length of a drill string model consisting of two hollow cylindrical rods of length of 0.50 m each, connected end to end. One end of the penetrometer device is subjected to a single hammer blow impact of certain magnitude for short duration and other end is considered fixed. A preloading force equivalent to 500 N has been applied at the joint. Forward propagation of waves can be seen from time, t = 0.00 s (the start of load application) to time, t = 0.2 ms. The stress wave reflects at the boundary end (fixed end) at time, t = 0.2 ms and reaches back to the loading end at time, t = 0.4 ms. The 'spike' in stress at 0.50 m from the loading end as seen in Fig. 2 is the preloading stress. The displacement wave (not shown here) shows that the two rods separate from each other at the joint during certain interval of time. On the other hand, a similar analysis for a joint pre-load of 3 times as large showed that the rods do not separate from each other at any time. This information has great significance in the design of joints in the drill strings.

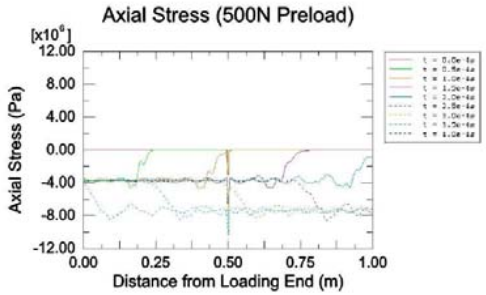


Fig 2: Propagation of Axial Stress

*A part of the project sponsored by NASA, Washington, D.C. and Honeybee Robotics Spacecraft Mechanism Corp., NY. The authors gratefully acknowledge the support provided by the sponsors.
** Corresponding author, Tel. (860)-486-3683; Fax. (860)486-2298