A collection of research activities of NEA-JC members

NEA-JC

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NEA-JC RESEARCH DIGEST

(*A collection of research activities of NEA-JC members)*

VOLUME - 1

Editorial

With the 2nd Executive Committee of NEA-JC approaching the end of its tenure, the Publication Committee of NEA-JC ultimately has been able to come up with this annual publication 'NEA-JC Research Digest', a collection of research activities of its members.

'NEA-JC Research Digest' being our first attempt regarding the research activities of members, we lacked the participation from all the members and could receive information only from few. So we limited this publication to the soft version. We are thankful to the members who directly indirectly co-operated us to materialize this publication in spite of their hard schedule. Since this is just a start, we hope that with more cooperation from the members, NEA-JC will be able to come up with a good number of research collection in both soft and hard versions in the coming days.

This digest includes most of the research which are carried in Japan or in Japanese context. It might be difficult to say how these works could be utilized in the context of our motherland. But by learning and working here in this developed country, we come to know how to conduct and carry out research works from basic level to advance. Bringing back those knowledge and experience to our motherland and utilizing the resources available there, we are sure that we can do something considerable for our nation. We also expect that the information in this digest about the research efforts of our members will be disseminated to the others and their field of specialization and expertise would be utilized accordingly wherever needed.

Appreciation and forgiveness are two important things which we all should believe. Let's make a habit of appreciating others works leaving back the habit of complaining and criticizing the things instead of suggesting or advising. Let's appreciate each others works and efforts and suggest if necessary so as not to let down ones spirit and moral towards working.

Meeting and forgetting the events and people is the process in our life. But when we recall our past, good events come up with 60%. Recently, one research made in Japan showed that people recalled their past in 6:3:1 ratio (good:bad:general). It would be our pleasure if this part of our attachment to the Publication Committee of NEA-JC could come up within that 60% when we recall our present life of Japan in future.

Finally, we would like to congratulate the newly elected executives of NEA-JC and extend our best wishes for their successful tenure ahead.

Editors

Dr. Er. Surendra B. Tamrakar

Er. Bijay Giri

Dr. Er. Rabin Tuladhar

Layout

Er. Bijay Giri

Cover Photo

Third nuclear reactor in Hokkaido Electric Power Company under construction (as of August 2005)

'NEA-JC Research Digest' , an annual publication of NEA-JC, provides the latest update of research activities of NEA-JC members in series.

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Current Research Activity

Information sharing can be effective with structured data. The Semantic Web is mainly aimed at structuring information by creating widely accepted ontologies. However, users have different preferences and evolving requirements. It is not practical to attempt perfect schema definitions with strict constraints. Creating structured formats should be a collaborative and evolutionary process. Social software motivates wide participation by providing easy interface. We propose a system called StYLiD for sharing a wide variety of structured information. Users freely define their own structured concepts. The system consolidates different versions defined by different users. The attributes of the different concept versions are aligned semi-automatically into a single unified view. Popular concepts gradually emerge from the concept cloud and stabilize. Concept definitions are flexible. An attribute value can take a literal or a resource URI and the suggestive range does not constrain the contributors. StYLiD generates unique dereferenceable URIs so that data items can form a linked data web. Structured data is embedded in machine readable form using RDFa. Search and browsing features are provided to utilize the structured data and consolidated concepts.

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Current Research Activity

Debris flows are common in mountainous areas throughout the world. Often triggered as mudflows by torrential rains, debris flows contain varying amounts of mud, sand, gravel, boulders, and water flow down along a stream at high speed. Because of its high density and speed, it has huge destruction power. In mountain torrents, intense and localized storms may cause flash floods with important sediment transport. In steep torrents, the sediment that are the deposited on the alluvial fans, often highly populated in the case of debris flow that transport downstream huge volumes of sediment, the sediment discharge may increase so that the solid concentration often exceeds figures 40-50%. The comprehensive assessment of debris flows countermeasures both structural and non-structural requires the consideration of the various scenarios and involves the evaluation of hydrological, hydraulic, sediment size distribution and topographical parameters. Debris flow modeling and its structural countermeasures by sabo dam can be done with the help of experimental study and numerical models. The main objective of the current research is the study on debris flow and its structural countermeasure.

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Research Interests:	Numerical modeling of multiphase flow, Flood forecasting and simulation, Water disaster management

Current Research Activity

Study of Various Flow Regimes in the Water Intrusion Process into Porous Media under Different Upstream Boundary Conditions

Study of unsteady intrusion process of water into porous media consisting of large grain size is carried out in this paper. The proposed model simulates the storm water storage into pervious road sub-base from side drainage channels, under constant water level and constant inflow discharge conditions. The common fundamental equations for solid-liquid multiphase flows with the inertia term are used as the basic model. The fundamental characteristics of the intrusion process are firstly investigated theoretically using the depth averaged equations with the inertia term and the resistive viscous drag terms in momentum equations. It is pointed out that there are two distinct power law regions with respect to time in the unsteady intrusion process. The theoretical results are verified by carrying out the vertical 2-D numerical simulation and hydraulic experiments. The analytical solutions obtained for the assumed similarity distribution of flow depth and velocity are found to be in good agreement with the numerical and experimental results. The smooth transition from early inertia-pressure flow regime to pressure-drag regime is also reproduced in the simulation.

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Current Research Activity

Residual Strain Measurement in Bone Tissue by X-ray Diffraction Imaging Methods

Inherent stress in bone, which exists as residual stress, is assumed to be one of the important factors, which accelerates the remodeling phenomenon and enables bone to adapt and restructure against additional mechanical environment. Furthermore, bones have naturally occurring holes called 'Foramina' (singular-Foramen) for blood vessels and nerves. These are rarely located as site of crack initiation or growth. From the micro- and macro-structural analysis of bovine vertebral foramen, a regularly organized hydroxyapatite crystals and additional cortical mass around the hole were observed. Our next attempt was to estimate the residual stresses near the foramen region if there exists any, and compare those near the foramina existing in bovine limbs.

From the diffraction data around whole Debye ring obtained from X-ray diffraction, direct relationship between the diffraction cone and lattice plane parameters can be obtained by combining elastic theory and Bragg's relation. Debye rings are distorted because of lattice plane deformation by the stress and the degree of distortion gives the basis for strain measurement. We used two dimensional digital area detector known as Imaging Plate, and measured the distortion of Debye ring from the diffracted image obtained in the imaging plate. The residual stresses at different locations near foramina of bovine femur and metacarpus samples were calculated.

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Current Research Activity

Development of Regional Flood Frequency Relationships for Nepalese River Basins

Design flood (maximum discharge of specified return period) is required in design of various hydraulic structures and planning/management of water resource projects. Regional flood frequency analysis is an effectively applicable method for estimating design flood at both gauged and ungauged sites. This method includes three major steps: 1. delineation of hydrological homogeneous regions, 2. identification of regional distribution/parameter, and 3. determination of index flood or scale parameter. The present research attempts to develop flood frequency relationships for different hydrological homogeneous regions inside the Nepalese territory. Delineation of hydrological regions, which is key step to success of this method, is based on soil type, land cover, land relief and monsoon rainfall pattern information since these factors mainly govern generation of flood. The L-moment based homogeneity test has been used to check the homogeneity of the delineated regions.

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Current Research Activity

Current research is basically a part of project work with Chugoku Electric Power Co. Inc., Japan with an objective to derive operating policy for the reservoir of hydropower plant incorporating number of constraints. Stochastic Dynamic Programming (SDP) model is formulated for the purpose as it can better incorporate the inherent uncertainty associated with the stream inflows. Markov-I (lag-one) and Independent inflow process assumptions find extensive application in the SDP models in deriving operating rules for reservoirs. The use of various inflow process assumptions in a SDP model for the study case is under investigation. A comparative study of Markov-I, Independent and deterministic inflow process assumptions is performed with monthly and ten-day periods. The ultimate goal is to derive the policy for short term perspective incorporating the uncertainties in both the inflows as well as the demand while accommodating the short-time inflow surges and spillage compulsions. The operating rules consist of reservoir operating targets at the end of a period for each combination of beginning of the period storage levels (or corresponding heads) and possible average inflow states during the period.

Forecasting of the inflows is extremely important aspect for the robustness of the derived operating policy. In current study, ARIMA models with appropriate assumptions are formulated and the simulation results are compared for a considerable length of historical record of inflows.

Finally, a performance evaluation scheme is to be devised in order to judge the power plant's standing against its peers and to identify the improvement directions. Weight restriction type Data Envelopment Analysis (DEA) model will be formulated for the purpose incorporating Fuzzy restrictions on weights.

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Current Research Activity

Study of sediment hazard zone focusing on Kyoto, where several important cultural heritages are abundant along with spreading of urban areas towards hilly areas provides several important findings that could be helpful to mitigate sediment hazard in future.

It provides general introduction of trends of sediment hazard in Japan and approach to countermeasure against it from engineering prospective. In this regard the task is more difficult when urbanized areas need to be protected from sediment hazard where important cultural heritages are located.
One dimensional governing equations are helpful to derive debris flow and its conformation with similarity principles that is derived mathematically and proved numerically. In debris flow, particle motion is considered to be laminar flow, so it should follow Reynolds similarity. Contrarily, hydraulic model of debris flow is performed based on Froude similarity. Taking into account of apparent eddy viscosity Reynolds number of debris flow is discussed based on the momentum conservation equations and the constitutive equations, and numerical simulations are conducted to examine those characteristics. The results can be summarized as follows.

Debris flow follows Reynolds similarity in the view of dynamics and at the same time, mathematically it can be seen that for debris flow the formation of Reynolds similarity is same way as that of Froude similarity.
The Reynolds number of a debris flow can be described as a function of Froude number. Mathematically, it is proved that debris flow follows both the similarities simultaneously. It means physical modeling could interpret the real debris flow occurrence when model is designed so that the topography is not distorted and the ratio of mass density of sediment to water/muddy-water is same. *(… contd)*

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Numerical simulation of prototype and scaled models based on the condition as shown in (2) for sediment erosion and deposition conditions show that debris flow follow Froude similarity. The Courant number of the model also needs to be the same value to that of prototype in order to have Froude similarity.

In this research (study of debris flow and landslide) could help to mitigate sediment hazard is being discussed. Knowing occurrence condition of landslide or debris flow, which can be predicted abstractly by accumulated rainfall depth versus rainfall intensity graph, such movement of soil and water mixture is predicted by mass point system when hazard area is to be determined macroscopically and then set of governing equations corresponding to one or two dimensional flow models could be applicable for detail study of such disaster area. Studies related with dynamics of landslides and debris flow and how they can support design of countermeasures against sediment-induced disasters can be summarized as follows. The trend of counter measure against such sediment disaster in Japan is supported substantially by the associated research work.
In order to predict sediment hazard zone, numerical simulation would be optimum tool that can evaluate the inherent flow characteristics caused by internal solid friction, rapid sediment erosion and deposition and then corresponding change of bed elevation.

Finally mass point system has been opted for delineating sediment hazard zone in Kyoto and Miyagawa is chosen for verifying the calculation of mass point system with field results. In order to answer why Kyoto is being chosen for studying sediment hazard area, hydrologic study and study of history of water induced disaster of Kyoto are done. It shows that Kyoto is susceptible for water induced disaster and casualties may occur whenever continuous rain fall exceeds 120 mm and that for Kyoto city is slightly greater. On the other hand, the meteorological data of Kyoto station of last 123 years shows that rainfall event of over the critical value (120 mm) happened to be several times in the past. Thus, water induced disaster may occur any time in Kyoto. The hazard is more severe in Kyoto, because of the spreading of urban areas towards outskirts of the city near the steeper areas of hilly region. The hazard map shows that many such urban areas are under threat of sediment hazard where important cultural heritages are located as well. Therefore countermeasure keeping the cultural value of those areas is essential. However, this study will help to recommend where people suppose to avoid living and how policy could be implemented to make such danger area isolated from public activities before it has been protected sufficiently to prevent any such disaster in future. While implementing structural method to protect the areas, the cultural value of the place needs to be intact and on the other hand non-structural countermeasures are primarily composed of warning systems and hazard maps, where the warning systems are intended to help evacuate people who live or travel in certain steep areas. Hazard maps describe the risk level of such dangerous areas, where such type of warning system could be implemented. However, there are certain public and private matters that may hamper to use warning system effectively. Thus, demand of new law that could support the implementation of such type of warning system is distinct in order to protect such hazard area effectively.

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Current Research Activity

Meandering on the laboratory condition using layered sediments was reproduced in the small flume with small hydraulic conditions. The mixture of cohesive sediment as well the fine sand in different ratios was selected to ensure good meandering, high sinuosity as well to describe the role of cohesion. Experiment results proof the dominant role of cohesion and its sensitivity towards the bed forms. The increasing percentage of the clay on the banks would retain braiding, meandering and the straight channels with many similarities as of natural conditions. Also, the associated phenomenon of the bank erosion with slump failures due to cohesive contents demonstrates unique characteristics. The slump blocks decrease the erosion speed on the outer bank was found to be greatly effected by the clay content in the sediments.

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Current Research Activity

Landslides and roadside slope failures are one of the major geotechnical fields of research and probably the most frequent disaster types in Nepal. The current data indicate that more than 300 people lose their lives in landslides and flash floods every year, and hundreds of million rupees of annual economic loss, particularly in the form of roadway infrastructural damage and vehicular traffic closure is born by the nation. Owing to financial crunches and lack of infrastructure development fund, however, there are insignificant practices of landslide prevention in Nepal. In addition, there are no indications that the government will take any concrete steps soon to deal with landslides and related disasters in the country.

For a long time, the landslide problems have been addressed geologically, but it is the engineers that face tremendous problems due to landslides and slope failures such as in dam construction, roadway railway construction, mountain land development, etc. There are various approaches to deal with landslide behaviors and problems, but in engineering field, the soil mechanics addresses the primary issues such as displacement, stability, prevention, and so on. When it comes to understanding landslide displacement behavior and preventing the landslide, it is all important to understand the failure mechanism, which is best explained by soil strength and soil mineralogy. So, the current topics of my research involve landslide stability, residual strength, landslide creep in residual state, clay mineralogy and its influence in soil strength, landslide hazard mapping, etc., mainly focusing on the landslides along the major national highway group leading to Kathmandu in Nepal. Similar research is also based in Shikoku area of Japan, mainly for the purpose of comparing landslides of Nepal with similar types in Japan.

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Current Research Activity

An integrated approach to predict flood/debris flow hydrograph due to landslide dam failure

Landslide dams are one of the significant natural hazards in the mountainous area all over the world. Landslides and debris flows due to heavy rains or earthquakes may block a river flow and create landslide dam naturally. After the formation of landslide dam, the prediction of outflow hydrograph will serve as an upstream boundary condition for subsequent flood routing to predict inundation area and hazard in the downstream. The outflow hydrograph depends on many factors like inflow discharge, impounded water volume, shape and size of the reservoir formed in the upstream of landslide dam, soil properties of the dam body, mode of failure etc. Peak discharge produced by such events may be many times greater than the mean annual maximum instantaneous flood discharge. The integrated model of the landslide dam failure to predict outflow hydrograph consists of three models. The seepage flow model calculates pore water pressure and moisture content inside the dam body. The model of slope stability calculates the factor of safety and the geometry of critical slip surface according to pore water pressure and moisture movement in the dam body. The model of dam surface erosion and flow calculates dam surface erosion due to overflowing water. Numerical simulation and flume experiments were performed to investigate the mechanism of landslide dam failure and to predict the outflow hydrograph resulted from failure of landslide dam by sudden sliding, overtopping and channel breach through flume experiments and numerical simulations. The movement of moisture in the dam body measured by using WCRs, critical slip surface observed in the experiment and predicted outflow hydrograph is close to the result of numerical simulation. The predicted hydrograph can be used for flood mitigation in the downstream. The model can be further extended to three-dimensions for the better representation of landslide dam failure.

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Current Research Activity

Measurement of Dispersion Coefficient (D) of cohesive soils under Gravitational and Centrifugal fields

Contamination of underground water due to illegal disposal of toxic wastes is a great problem. There are two types of contaminants from their solubility with water. As water soluble contaminants gets easily dissolve in the water, these will affect large area. To understand the contaminated area as well as the behavior of such flow, many numerical analyses are carried out which are based on advection-dispersion equation. This equation consists of retardation term, dispersion term and advection term along with others. Value of the parameters in each term measures the accuracy of the numerical analyses and the reliability of the result. But there are not any standard method developed for the correct measurement of such parameters. In regard, column test has been suggested for dispersion coefficient, D for sandy soils. But for cohesive soils, measurement of D has been thought of difficult and hence no such method has been suggested. Mitachi et al. (2007) has shown the possibility of measurement of D for cohesive soils under centrifugal field. In this paper, measurement of D for cohesive soils is tried under gravitational as well as centrifugal field. Effective stress distribution under gravitational and centrifugal fields is different. Therefore, effect of stresses as well as contamination flow rates is checked. It was observed that D value measured under both fields is almost same and the effect of stress condition is not seen clearly. With the increase in contamination flow rate, dispersion coefficient, D also increases.

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Current Research Activity

(A paper abstract, submitted to DEM Symposium 2008)

A particulate system of calculation, such as Distinct Element Method (DEM) can be a tool to understand macro- or micro-mechanical aspects of particle interaction in granular soils. In this paper, the usefulness of DEM in modeling granular soils with different grain-size characteristics is presented. Specimens prepared with spherical particles of different gradation were compressed and sheared numerically in triaxial loading conditions using the DEM program, PFC3D (Itasca 2003). In total, eight different particle gradations were prepared with varying combinations of mean particle size, D50 and uniformity coefficient, Uc. DEM simulations for triaxial loading on specimens prepared at constant void ratio and constant relative density show that the strength increase of triaxial specimens, as well as compressive volumetric behavior, are associated with an increase in Uc, as well as, a decrease in D50. Although the particle population used in the specimens also affected the results, thereby hinting at a limitation in DEM simulations, the overall scenario of stress-strain variations due to ball-to-ball friction, confining pressure and the aforementioned results confirm that the ideal spherical elements used in simulations can satisfactorily simulate the stress-strain and volumetric change trend for granular soils.

Recent Research Activities of NEA-JC Members

Research Title	Researcher
Social web, web 2.0, semantic web and information sharing	*Er. Aman Shakya*
Debris flow and check dam	*Er. Badri Bhakta Shrestha*
Study of various flow regimes in the water intrusion process into porous media under different upstream boundary conditions	*Er. Bidur Ghimire*
Residual strain measurement in bone tissue by X-ray diffraction imaging methods	*Er. Bijay Giri*
Development of regional flood frequency relationships for Nepalese river basins	*Er. Binay Kumar Mishra*
Optimal scheduling and performance evaluation of hydro-electric plants	*Er. Deependra Kumar Jha*
Study of sediment hazard zone focusing on Kyoto	*Er. Dr. Kaushal Raj Sharma*
Role of cohesion on meandering channel	*Er. Krishna Prasad Dulal*
Geotechnical aspects of landslides and slope failures	*Er. Dr. Netra Prakash Bhandary*
An integrated approach to predict flood/debris flow hydrograph due to landslide dam failure	*Er. Ripendra Awal*
Measurement of dispersion coefficient (D) of cohesive soils under gravitational and centrifugal fields	*Er. Dr. Surendra Bahadur Tamrakar*
Study of laboratory stress-strain responses of granular soils with DEM modeling	*Er. Dr. Tara Nidhi Lohani*

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