Evaluation on the Squeezing and Design of Support System in Headrace Tunnel of Middle Modi Hydroelectric Project

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Abstract

Tunneling through a weak rock possess a great challenge. These challenges depend upon type of rock, excavation method, stress and deformation behavior of the rock etc. Squeezing is one of the major problems which is likely to occur during excavation of tunnel through weak rock. A reliable prediction of the extent of squeezing is essential so that a strategy can be established regarding stabilizing measures and for optimizing the support well in advance. In this paper, Middle Modi Hydroelectric Project located in the Kaski District has been taken as the case study. In this project, huge squeezing problem occurred at about chainage 1+140m. At this section deformation has been recorded well over 65cm. Hence, this paper basically deals with squeezing analysis using different approaches. Rock types along the headrace tunnel alignment are sheared phyllite and fractured quartzite. Mostly, intercalation of phyllite and quartzite has been found in the squeezed section. Rock mass quality found in the squeezed section is extremely poor to exceptionally poor. Four main methods have been used to evaluate the squeezing phenomenon viz.; empirical methods such as Singh (1992) and Goel (2000),semi-empirical such as Hoek and Marinos (2000), analytical method such as (Convergence Confinement Method, 2000) and numerical program Phase2.The main factors that control the squeezing phenomenon are the rock mass parameters and rock stresses. The uniaxial unconfined compressive strength of intact rock has been back calculated from measured deformations using phase2 program and found to be in the range of 10 to 15Mpa in the squeezed section. Deformation was calculated using CCM and Compared with phase2 result. Due to excessive deformation temporary supports were provided at several locations, steel ribs are buckled, and shotcrete lining is also cracked. All these must be removed before application of final lining. Finally, two different approaches have been studied using phase2 program to address the existing problems in squeezed section of headrace tunnel i.e. design of support system considering either circular shape with final lining (shotcrete and steel rib) or reshaping existing D-shaped tunnel into horseshoe shaped and providing final concrete lining.

Keywords: Tunnel; Squeezing; deformation; rock mass; Hydropower projects

Grey to Green Sustainable Urban Drainage Approach to Reduce the Impacts of Urbanization

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Abstract

Stormwater runoff from different types of urban catchments and discharge from LID system applied in urban catchments were monitored since 2009 to 2017 in Kongju National University. The performance of green technology (GI) system was evaluated to mitigate the problem like pollutant treatment and restore natural hydrological cycle. The result showed that the urban catchments were sources of pollutants like sediments, organics, nutrients and heavy metals. Thus, the concentrations of these pollutants are highly dependent on the antecedent dry days and types of catchments. Since, roads and parking lots observed higher concentration of sediment and organics however heavy metals were highly contributed by the rooftop areas. Moreover, the application of green technologies could be a better solution to mitigate the problems associated with urbanization. Similarly, GI technology were highly significant to reduce runoff generated and can restore natural hydrological cycle. Lastly, the pollutant removal efficiency of different system was significant due to application of different media and plants.

Keywords: Green technologies, pollutants, pollutant reduction, urban catchments, volume reduction

Performance of Rubcrete

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Abstract

Nepal, along with the whole world facing a big environmental issue of non-degradable rubber tyre (crumb rubber). Department of Transport Management (DoTM) Nepal, (2014) has said that number of vehicles registered in the country has reached 2,551,138 units and rubber Tyres which cannot be discharged off easily in the environment as its decomposition takes much time and burning produces air pollution with emission of carbon monoxide and the ash produced from burning material that contains plastic and rubber could be hazardous. In such a case, reuse of rubber wastes would be better choice. Paper works on the reuse of rubber in concrete as a fine as well as coarse aggregate in proportion in the concrete and its different index properties like compressive strength, tensile strength, ductility, flexural strength, toughness can be investigated and compared with ordinary concrete and the variation can be studied. Paper focuses on the enhancement on performance of rubcrete by using chemicals with 'OH' ions as admixtures which may result in better bonding between the molecules of rubber and cement in the mix.

Keywords: Environment, Rubber, Aggregate, rubcrete, Index properties

Comparison of Bamboo as Reinforcement in Concrete with Steel as Reinforcement in Concrete

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Abstract

Majority of people in developing countries are living in rural setting. Their houses are in traditional style with locally available material. With increase in accessibility, concrete houses are increasing and the cost of construction getting out of reach of people. This study was conducted to know bamboo as an alternative reinforcement material especially in small residential building to make it structurally safe and functioning under low budget. (Bhonde et. al., 2014) had conducted experimental investigation on bamboo reinforced slab with point load at center and observed that the design moment was less than experimental ultimate moment. Similarly, bamboo in plane cement concrete (PCC) as reinforcement showed that the property shifted form brittle to ductile in nature, which is similar to steel reinforced concrete (Agarwal et. al. 2014). Most of the research considered the bonding between bamboo and concrete and preferred to use suitable sealant to improve the bonding. (Nayak et. al. 2013) had analyzed and found cost of bamboo reinforced concrete can go around one third of the steel reinforced concrete for single storey structure. Replacing the steel rebars from RCC with baboo is not the only way to make the RCC economic, (Siwar Moukatash 2015) paper had shown that introducing bamboo in steel reinforced concrete has enhanced shear, bending and a combination of shear and bending property. From this study, it can be concluded that there is still need of research for the detail specification to use bamboo as reinforcement in concrete alternate to steel in concrete.

Keywords: bamboo; bamboo reinforcement; bamboo composite; bamboo and steel reinforcement

Structural Behavior of RC Column Externally Confined with FRP Composites

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Abstract

Many reinforced concrete (RC) structures in the Nepal are built according to old construction practices which are vulnerable to extreme loading such as earthquake disasters, an accidental impact. Strengthening and retrofitting of existing (RC) structures for enhanced performance under these loadings are deemed necessary and has been an important topic of many researchers for a long time. Among the different retrofitting techniques, external bonding of fiber reinforced polymer (FRP) composites in structural members has been a popular one. This is because of notable properties of FRP such as high stiffness, high strength, low weight, high chemical resistance and so on make it a good material. This paper presents a brief study of recent research on FRP in strengthening RC column under axial and monotonic or cyclic loading.

Keywords
Fiber Reinforced Polymer (FRP), Carbon Fiber Reinforced Polymer (CFRP), Glass Fiber Reinforced Polymer (GFRP), Reinforced Concrete (RC), Column, Retrofitting, Axial Loading, Monotonic or Cyclic Loading

One Dimensional Ground Response Analysis in Patan: Implications to Damage Pattern due to the 2015 Mw 7.8 Gorkha Earthquake

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Abstract

The 2015 Mw 7.8 Gorkha earthquake caused extensive damages in Kathmandu Metropolitan City located about 78 km SE from the epicenter. The damage patterns in the city clearly indicated the subsurface geology of the city had strongly modified the ground motion causing typical damages to tall structures. In this contribution, following one-dimensional approach, a ground response analysis is performed in Patan utilizing the deep bore hole, shear wave profile and dynamic soil properties adopting both equivalent linear and non-linear approaches. The results of the non-linear analysis were compared with the measured ground motions at soil sites. It is found that the non-linear analysis better simulates the deamplification of the peak ground acceleration and strong shaking at longer period. The obtained results confirm that the deamplification of PGA was due to the strong non-linear behavior of the fluvio-lacustrine deposits.

Keywords
Deamplification, one dimensional (1D), peak ground acceleration (PGA), Shear wave velocity,

Reliability Analysis of Bearing Capacity of Soil of Combined Pile Raft Foundation (CPRF) of Historic Dharahara

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Abstract

When the raft foundation alone does not fulfil the design requirement, it may be possible to enhance the performance of the raft by economical addition of piles to transfer the heavy load to soft soil with a rather low total or differential settlement called a combined pile raft foundation (CPRF). The proposed twenty-one storey Dharahara tower at Sundhara, Kathmandu is being constructed with CPRF.This paper focuses on the reliability index, the probability of failure and reliability of Dharahara. Statistical analysis is carried out to determine the mean and variance of log-normally distributed geotechnical uncertainty parameters cohesion, unit weight, friction angle and the normally distributed loading on the foundation. First, the limit equilibrium performance function equation of bearing capacity is prepared using a First Order Reliability Method (FORM) and then solving the value of reliability index by coding on C Programming Language. Obtained value is validated with Euro Code-Basis of Structural Design. The results show that the reliability of the designed foundation system of Dharahara is 0.99999872% and the probability of failure is 0.00000128%. Sensitivity analysis is performed by varying uncertainty parameters and the result shows that friction angle is more sensitive than the other three parameters.

***Keywords*:** Combined pile raft foundation; Historic Dharahara; Reliability Index; Sensitivity Analysis; performance function; uncertainty parameters

Study of Effect of Plant Residue on the Bulk Density and Seven Day Compressive Strength of the 1:3 Cement Sand Mortar

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Abstract

In this research, the effect of plant residue on the seven day compressive strength of the cement sand(C/S) mortar in 1:3 ratio were studied and compared. Stem of nettle plant were grinded and pulverized and the size was maintained below 300μm to mimic organic plant residue. The plant residue were varied from 0% to 2% with an increment of 0.5%. Experimental procedure involved preparation of standard mortar cube samples of size 70.5mm*70.5mm*70.5mm with graded sand of zone II category and fineness modulus 3.08. The compressive strength test was carried out using Aimil Digital Compression Testing Machine (DCTM) with a loading rate of 4KN/sec. The bulk density of the prepared cube decreased with an increase in plant residue content and the compressive strength of prepared cube samples reduced significantly with slight increment of plant residue. Poor bonding between plant residue and cement matrix, plant residue acting as a micro crack in the mortar matrix causing greater void and failure due to internal crack propagation can be attributed to the failure of the cement mortar matrix. Overall the effect of plant residue in cement mortar is undesirable with reduced compressive strength and lower bulk density.

Keywords: Cement Sand mortar, Plant residue, Compressive strength, bulk density

Importance of Local Climate Zones and Urban Heat Island study in Nepal

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Abstract

Various scientific research and literature have documented the effect of urbanization on local climate**.** Urban rural temperature and humidity difference i.e. Urban Heat Island (UHI) and Urban Dry Island (UDI) respectively have been reported for cities and regions worldwide, mostly with local field sites that are extremely diverse in their physical and climatological characteristics. Generally, the UHI study relies on simplistic descriptors such as "urban" and "rural". While these descriptors may be evocative of the landscape, they are insufficient in providing information like its site properties which have direct impacts on the surface layer climate. To fulfil the gap and for the clarity "local climate zone" (LCZ) classification is a very good tool. Each classification is unique in its combination of surface structure, cover, and human activity. The standard framework for each zone helps to classify an area for reporting and comparing field sites and their temperature observations. The LCZ not only helps in UHI and UDI study but also helps in planning smart environment and human friendly cities, landscape and global climate change investigation. Nepal now being a federal state, many states having smart developmental drive of cities focusing only on physical infrastructure without considering UHI effect must incorporate study of cities by LCZ for sustainable urbanization.

Keywords: Urban heat island; Local Climate Zone; Surface Fraction

Soil Erosion its Effects and Mitigation Measures in Hilly Region of Nepal

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Abstract

This study sought to contribute to an improved understanding of soil erosion its effects and mitigation measure. However, where there is flowing water, there is transport of sediments. And these sediments are mainly the result of soil erosion. Soil is an important economic and environmental concern throughout the world. Soil erosion is the most serious problem faced at global and local level. So planning of soil conservation measures has become prominent agenda in the view of water basin managers. To plan for the soil conservation measures, the information on soil erosion is essential. The soil erosion can be reduced by using low cost vegetative technique and/or with combination of civil structure. Sediment in Himalayan Mountain Rivers is derived extensively from mass wasting of riverbank slopes taking place in the form of landslides, mud flows and heaves. The eroded soil is highly undesirable to hydropower development, irrigation project as well as environmental problem. At the place of soil erosion area many settlements are highly affected.

Keywords: Soil erosion, impact, control mechanism, low cost technique

A Comparison Study of NBC 105:1994, IS 1893:2002 and IS 1893:2016 in Context of Design of Reinforced Concrete Structures in Nepal

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Abstract

Construction material, and practices have been similar in neighbouring India and Nepal, and hence, Nepal Building Codes borrow elements from Indian Standard Codes of building design. In interest is seismic design code of both countries. This work aims to compare NBC 105:1994, IS 1893:2002, and IS 1893:2016 for methods and philosophy of seismic design. Differences can be found in method of calculation of base shear, time period of vibration, design acceleration spectra, consideration of masonry infill walls, soft story, use of dynamic analysis, design eccentricity, re-entrant corner, etc. IS 1893:2016 especially has provisions to account for masonry infill walls, and consideration of cracked sections, while also making it more stringent on definition of soft story, re-entrant corners, rigid diaphragms, use of equivalent static load method. IS 1893:2016 also revised damping ratio for dynamic analysis compared to old IS 1893:2002.

Keywords: Base shear, seismic coefficient, period of vibration, design acceleration spectrum, moment of inertia, damping ratio