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# Book of Abstracts

# Contents

# Response of Bridge Pier after Deck Continuity

*Bhesh Raj Chalise [a], Bharat Mandal [b], Arun Paudel [c]*

**Abstract:**

Bridge deck continuity plays a pivotal role in enhancing the structural integrity and seismic resilience of bridges. This research explores the impact of continuous deck systems on the performance of existing bridges, focusing on the Badigad Bridge located in the Gulmi District of Nepal. The study aims to evaluate the structural response of the bridge under seismic loading, particularly in terms of load distribution, moments, shear forces, and displacement before and after implementing deck continuity. Using advanced finite element modeling (FEM) in SAP2000, the behavior of the Badigad Bridge was analyzed both with and without deck continuity under real seismic conditions, employing response spectrum analysis (RSA). The findings reveal that continuous bridge decks offer significant benefits, such as reduced displacement demands and improved structural longevity. However, the redistribution of forces due to the increased stiffness of the continuous deck imposes additional demands on the supporting piers, which can lead to overstressing if not properly addressed. The study also compares the performance of the bridge under various seismic design codes, including NBC 2020, Eurocode, IS 1893, and AASHTO 2012, highlighting the differences in design provisions and their impact on the structural response. Overall, the research underscores the importance of careful design and retrofitting strategies when upgrading bridges with continuous decks, ensuring that the substructure remains adequately reinforced to handle the redistributed forces. Future studies should incorporate factors like temperature effects and material aging to further optimize the seismic resilience of bridges.

**Keywords:**

Bridge Deck Continuity, Seismic Resilience, Response Spectrum

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# Determination of Performance of Different Type of Bailey Bridge of Different Configurations

*Samir Thapa* [a], *Rajan Suwal* [b]

**Abstract:**

This paper provides a numerical determination of the performance of various type of Bailey bridge configurations, in which the main objective is to determine the maximum response of different configuration.Bailey bridges are modular steel structures made up of interlocking panels connected by pins, allowing them to be quickly assembled and easily adapted to different needs. These modular bridge systems are more susceptible to the effects of dynamic loading due to their flexibility.. Four different configurations (Single Truss-Single Storey (SS), Double Truss-Single Storey (DS), Triple Truss-Single Storey(TS), Triple Truss-Double Storey (TD))for 30m span and Five different configuration(Single Truss-Single Storey (SS), Double Truss-Single Storey (DS), Triple Truss-Single Storey(TS), Triple Truss-Double Storey (TD), Double Truss-Double Story(DD))for 60m span were modeled in CSI Bridge and moving load analysis and buckling analysis has been conducted in order to determine the maximum response of bailey bridge members. In order to compare the maximum responses, moving load case is performed for all the structures considering IRC class A vehicle Load. The study shows that TD configuration has higher buckling resistance and increasing number of panels in vertical direction and horizontal direction maximum response mid-span deflection decreases significantly.

**Keywords:**

Bailey Bridge, Moving Load Analysis, Buckling Analysis, Modular Bridge

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# Seismic Performance Assessment for Multi-Span Reinforced Concrete Arch Bridge

*Bashu Dev Timalsina* [a], *Gokarna Bahadur Motra* [b]

**Abstract:**

This study investigates the seismic performance of a two-span reinforced concrete arch bridge using linear time history analysis and modal superposition. The objective is to evaluate the structural behavior of the bridge under earthquake loading, considering various boundary conditions. The model simulates the arch ribs, splender walls, longitudinal and cross beams, and deck slab, using a combination of beam and shell elements in SAP2000. The impact of vertical ground motion on the axial force distribution within the arch ribs is assessed, highlighting the significant influence of this component on the seismic response, which contributes between 21.18% and 41.9% of the total axial force in arch ribs.. Additionally, the study examines the effect of different support conditions, such as fixed-end and hinged-end boundary conditions, on the distribution of axial forces in the arch ribs. The results indicate a substantial change in axial forces with varying boundary conditions, particularly when considering fixed-end supports, emphasizing the importance of accurately modeling support conditions in seismic analysis. This research contributes valuable insights into the seismic design of multispan arch bridges, underscoring the need for considering both vertical ground motion and realistic support conditions in structural assessments for improved safety and performance under seismic loads.

**Keywords:**

Seismic Performance Evaluation, Multi-span Arch Bridge Analysis, Time History Simulation, Axial Force Response, Impact of Vertical Ground Motion

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# Comparison of Performance of Three versus Two Girder Systems of Reinforced Concrete T Girder Bridges

*Sadiksha Kandel* [a], *Rajan Suwal* [b]

**Abstract:**

This study investigates the parametric study of RCC T Girder single span intermediate lane bridge with varying number of girder ( three and two) for a 20 m span. This research incorporates FEM modeling using CSiBridge software to conduct static and dynamic analysis which evaluates structural response in terms of deflection, stresses both compressive and tensile alongside economic implications. The study is conducted by determining the depth based on same deflection criteria for both girder configurations. The findings have revealed that deflection, stresses under dynamic and static analysis are within code criteria (IRC 112-2020) and (IS 456-2000). The results have shown that compressive stress is higher in 3 girders whereas tensile stress dominates 2 girders system. Two girders system seems more dynamically amplified. Economic analysis demonstrates that two girders configuration are cost effective due to reduced concrete volume, despite higher reinforcement requirements. The result suggest that even though 2 girder seems economic based on cost, optimization of bridge should be taken into consideration based on structural performance and cost effectiveness.

**Keywords:**

RCC-T Three and Two Girders, Parametric Study, Static Analysis, Dynamic Analysis, Economic Analysis

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# Long Term Effects of Creep and Shrinkage on the Structural Behavior of Prestressed Concrete I-Girder Bridge

*Rojan Thapa [a], Bharat Mandal [b], Sanjay Kumar Sah [c]*

**Abstract:**

This study investigates the long-term deformation effects of creep and shrinkage on a 40-meter prestressed concrete I-girder bridge through numerical analysis using MIDAS Civil. The research evaluates and compares predictions from four major design codes: AASHTO LRFD, CEB-FIP 2010, Eurocode, and IRC 112:2011. The bridge model incorporates standard precast prestressed concrete I-girders with M50 grade concrete (characteristic strength of 50 MPa) and composite deck slab, designed according to current bridge design specifications. The time-dependent behavior was analyzed over a period of 10,000 days to evaluate the variations in predicted deflections across different code specifications, considering factors such as concrete strength development, relative humidity, loading age, and geometric properties. Results demonstrate significant disparities in the estimated mid-span camber among the different models. The AASHTO LRFD code yielded the most conservative prediction with a camber of +15.62 mm, while IRC 112 produced the highest estimate at +51.2 mm. The CEB-FIP 2010 and Eurocode models showed comparable predictions of +35.16 mm and +36.84 mm, respectively, suggesting a potential convergence in their approach to time-dependent deformation modeling. These substantial variations in predicted deformations highlight the critical importance of model selection in analyzing long-term behavior of prestressed concrete bridges. The findings provide valuable insights for bridge engineers in selecting appropriate design codes for long-term deflection analysis and emphasize the need for careful consideration of time-dependent effects in prestressed concrete bridge design. This study contributes to the understanding of how different design code provisions affect the predicted long-term performance of high-strength prestressed concrete bridges and may assist in the development of more unified approaches to creep and shrinkage predictions.

**Keywords:**

Creep, Shrinkage, Prestress, Deflection

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# Analytical Damage Fragility Assessment of Reinforced Concrete Bridge Piers

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**Abstract:**

Nepal is located in a seismically active region so its civil infrastructure faces high seismic risk, particularly the bridge structures which is crucial for transportation and emergency response. The 2015 Gorkha earthquake revealed the vulnerability of Nepal's bridges, causing widespread damage and highlighting the need for better seismic design methods. One promising approach is the Performance-Based Earthquake Engineering (PBEE) methodology. The focus of this paper is the damage analysis phase of the PBEE framework, which uses fragility functions to estimate the probability of being in different damage states for a given structural response. This research provides an analytical method to develop a fragility function of a reinforced concrete bridge pier. A demonstration example is presented considering material strength uncertainties. The developed fragility function can be used for performance-based design or during retrofitting decisions.

**Keywords:**

PBEE, Damage Analysis, Analytical Fragility Function, Analytical Fragility Curve

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# Breast Cancer Detection with CNN-Based Deep Learning and Explainable Artificial Intelligence

*Sahil Subedi* [a], *Subash Panday* [b], *Nishchal Acharya* [c]

**Abstract:**

Breast cancer is one of the world's most common deadly diseases for women. Early detection of breast cancer is essential to increase survival rates because it significantly improves treatment success. Among the various types of breast cancer, Invasive Ductal Carcinoma (IDC) is the most common type. A convolutional neural network was used in this study on the datasets of 5482 histopathological images. Preprocessing techniques such as data augmentation, resizing, and normalization were employed. The developed model achieved an accuracy of 78% which shows significant improvement in detection. Furthermore, explainable artificial intelligence (XAI) was integrated with CNN to interpret the model's performance. XAI explains how the model decides so that clinicians and other health workers trust the model's outcomes. The study shows the potential of deep learning algorithm in improving the diagnosis of breast cancer and contributing to AI-driven healthcare solutions that are more manageable and efficient.

**Keywords:**

Breast Cancer, Invasive Ductal Carcinoma, Convolutional Neural Network, Histopathological image, Explainable Artificial Intelligence

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# Predictive Modeling for Optimization of LTE Network Quality Using Semi-Supervised Learning on Measurement Report Data

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**Abstract:**

The current approach to analyzing LTE network quality in Nepal relies heavily on Drive Testing (DT). However, because of the challenging geographical landscape of the country and lack of proper transportation infrastructure in all parts of the country, this method is both expensive and labor intensive. It requires significant number of resources, including testing tools and skilled network optimization professionals. In addition, DT struggles to effectively diagnose time-specific quality issues in LTE networks which could lead to persistent challenges for the service quality provided to the customers. This study proposes an alternative approach by leveraging Measurement Reports (MR) obtained from the OSS of the LTE network and applying a self-training method of semi-supervised learning to optimize LTE network quality. The methodology incorporates CatBoost and XGBoost as the supervised component of the semi-supervised learning framework. The MR data was obtained from the OSS of the LTE system, analyzed, cleaned, and preprocessed. Initially, 1,000 rows were manually labeled, followed by 100,000 additional labeled data, which trained CatBoost and XGBoost models. XGBoost outperformed CatBoost by 0.92%, though the result was inconclusive due to limited test samples (¡10 in some classes). Pseudo-labeling was applied to unlabeled data, and models were retrained with predictions above 90% confidence, but performance decreased due to class imbalance, particularly for Class-5, which lacked sufficient samples. Later, 70,000 labeled data were obtained after preprocessing, and random undersampling balanced the dataset with 2,146 samples per class (10,730 total). After training, CatBoost's accuracy dropped from 98.14% to 96.66%, and XGBoost's accuracy decreased from 99.82% to 99.80%, reflecting generalization to diverse pseudo-labeled data from all over Nepal. During Validation on DT data, overall accuracy obtained for CatBoost was 83.98% and that for XGBoost was 96.39%. Validation on Drive Test (DT) data showed poor performance due to misaligned features with MR data, absence of Class-0, and inability to predict Class-3. Aligning MR and DT features or approximating MR data to match DT data is necessary to improve validation results.

**Keywords:**

CatBoost, Drive Test (DT), LTE, Machine Learning, Measurement Report (MR), OSS, Semi-supervised Learning, XGBoost

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# Estimation and Prediction of $PM_{2.5}$ and $PM_{10}$ Concentration in Kathmandu Valley using Remote Sensing and Machine Learning

*Indra Paudel [a], Aayush Chand [b], Ashim Poudel [c], Gaurav Baral [d], Aashish Baral [e], Netra Bahadur Katuwal [f*]*

**Abstract:**

In recent years public health and the environment have been seriously threatened by air pollution, especially in low and middle income nations like Nepal, where the ground-level stations are sparse and thus have limited spatial coverage for monitoring air quality at specific hotspot areas. This study uses machine learning algorithms and satellite data to meet the importunate demand for precise $PM_{2.5}$ and $PM_{10}$ prediction. As the ground station, we used data from the monitoring stations of the Department of Environment covering the period January 2022 to December 2023 and satellite-derived parameters, including Aerosol Optical Depth (AOD), Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI) and soil moisture were processed, analyzed and used to train the models. The Gradient Boosting algorithm performed consistently well with average $R^2$ scores of 0.82 and 0.84 for $PM_{2.5}$ and $PM_{10}$ respectively, proving efficient in catching the non-linear relationships in the air quality data. Likewise, Random Forest also showed reliable accuracy with an average $R^2$ value of scores 0.80 and 0.82 for $PM_{2.5}$ and $PM_{10}$ respectively. Spatial maps created from model predictions highlight pollution hotspots, giving active insights for targeted interventions. This study demonstrates the potential of integrating satellite data with machine learning techniques to predict air quality indices (AQI) accurately. This finding provides valuable insights for developing targeted intervention strategies. Additionally, this approach aids in air quality monitoring in the regions that lack ground-based monitoring stations, ensuring more comprehensive environmental assessments, supporting data-driven policy and informed decision-making in Nepal and similar regions. Future research to incorporate high-resolution datasets and additional metrological variables to enhance model reliability and scalability.

**Keywords:**

$PM_{2.5}$, $PM_{10}$, Remote Sensing, Air Quality, Machine Learning

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# Price Prediction of Petroleum products in Nepal using Machine Learning Algorithms

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**Abstract:**

The economic stability of oil-importing nations such as Nepal is heavily influenced by fluctuations in global oil prices. Nepal imports all its consumption quantity of petroleum products from its neighbouring country India and petroleum products prices of India directly depends on global oil market, world political condition and other economic factors.Precise forecasting of fuel costs is essential for effective governance and economic strategizing. This research investigates the use of machine learning techniques to forecast petrol and diesel prices in Nepal. The study evaluated three models—Holt-Winters, ARIMAX, and Long Short-Term Memory (LSTM)—using historical data on Brent and WTI crude oil prices, U.S. dollar exchange rates, and domestic fuel prices. The analysis revealed that the LSTM model was superior in identifying non-linear patterns, while the ARIMAX model excelled when external variables were considered. These findings suggest that machine learning approaches, especially LSTM, can offer dependable predictions for fuel prices, assisting policymakers and businesses in reducing financial uncertainties.

**Keywords:**

Petroleum price prediction, Machine learning, LSTM, ARIMAX, Holt-Winters

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# AI-Powered Video Editing: Automating Silence and Error Removal for Efficiency

*Rajad Shakya* [a], *Sanjivan Satyal* [b]

**Abstract:**

The evolution of artificial intelligence (AI) is transforming the creative industry by streamlining traditionally time-consuming tasks. In this software, AI automates the editing process by detecting and removing silences and repeated content using T5 model. It begins by extracting audio from a video file and generating a written transcript of the dialogue. The model then refines the text by correcting errors, eliminating fumbles and repetitions, and producing a more concise and polished version. Simultaneously, it performs word-level alignment to synchronize each word with its corresponding timestamp in the video. The cleaned transcript helps filter and remove unnecessary content, ensuring the final output is both contextually relevant and high quality. This approach not only enhances the accuracy and efficiency of video editing but also minimizes manual effort, allowing content creators to focus more on the creative aspects of their work. The integration of AI in this process highlights the potential of automation to make video editing more efficient, precise, and accessible.

**Keywords:**

Artificial Intelligence, Silence Removal, Timestamp Mapping, Bad Takes, Fumbles

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# Coverage Analysis of Digital Mobile Radio using Longley-Rice And Rec. Itu-R P.1812-6 Propagation based on Voice Channel Performance Criterion inside Kathmandu Valley

*Nabin Baniya [a], Bikram KC [b], Milan Dhakal [c], Ram Krishna Maharjan [d]*

**Abstract:**

Two-way radio Communication is reliable means of communication for disaster or emergency situation management for public protection and safety departments.Kathmandu Valley is capital region of Nepal and has faced many major disasters, including landslides, floods, earthquakes, fires, and heavy rain.Primary means of communication (ISP,Telecoms) will be affected as we had faced in 2015 Nepal earthquake.PPDR(Protection and Disaster Relief(PPDR) services are widely used as Emergency communication which is defined in Resolution 646(Rev. WRC-15).It is widely used by security forces as well as public safety departments for Public protection(PP )and Disaster Relief (DP) purpose.One of the Widely accepted narrow band PPDR service is DMR(Digital Mobile Radio). This research work aims to analyzed the radio Coverage area of DMR radios using Longley-Rice and Rec. ITU-R P.1812-6 radio propagation models based on Voice channel performance criterion (VCPC) provided by TIA TSB-88.1 Guidelines inside kathmnadu Valley.Coverage analysis was based on DAQ(Digital Audio Quality ) label provided by VPCP(Voice Chanel performance Criterion). Location,Time and Situation variability for the propagation model was 99%.Fifteen (15) locations were chosen for the comparing predicted measurements by Longely-Rice and Rec. ITU-R P.1812-6 Both radio propagation model: Longley-Rice and ITU-R P.1812-6 predicted nearly similar coverage.Coverage of repeater was analyzed from four location :Chandragiri,Phulchowki,Nagarkot and Jamacho and it was found that both Propagation model predicted better coverage from Jamacho locations.ITU-R P.1812-6 predicted more propagation losses than Longley-Rice by an average value of 2.33 dB for DL and 3.46 dB for UL. RMSE of Predicted RSSI (dBm) between two model prediction were 4.09585156 and 3.899658105 for DL and UL respectively.This research work can provide a reference for radio communication engineers as well as public safety departments for planning DMR radio network inside kathmandu valley. Tools used in this research work were Radio planner 3.0, ArcGIS and Google Earth.

**Keywords:**

DMR, PPDR, RSSI, DAQ, VCPC,Longley Rice, ITU-R P.1812

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# Techno-Financial Analysis of Hybrid Power System of Rural Telecom Sector and Power Optimization using Genetic Algorithm

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**Abstract:**

This study presents a techno-financial analysis of a hybrid power system for rural telecom sectors using the Hybrid Optimization Model for Electric Renewable (HOMER) software and optimization using Genetic Algorithm in MATLAB. The aim is to assess the feasibility and cost-effectiveness of integrating photovoltaic (PV), battery storage, and diesel generator systems to ensure a reliable and sustainable power supply for telecom infrastructure. The analysis is based on the telecom repeater site at Nigalpani, Surkhet, Nepal. The results highlight the optimal system configuration, cost savings, and environmental benefits of hybridizing conventional diesel-based systems. Sensitivity analysis is performed to evaluate system robustness under different operational scenarios. Using HOMER, the net present cost and LCOE per kWh of base system (Diesel Converter system) are found to be Rs 74.5 million and Rs 287.24 respectively. The NPC and LCOE of existing hybrid system are found to be Rs 9.58 million and Rs 36.91 respectively, whereas the NPC and LCOE of optimized hybrid system are optimized to be Rs 6.93 million and Rs 26.72 respectively. Using GA in MATLAB, the LPSP, total system cost, plant size capacity and LCOE of existing system are found to be 0.445, 74072.05$, 8.22 kW and 33.75 cents/kWh respectively, whereas the total system cost, plant size capacity and LCOE of optimized proposed system with LPSP of 0.044 are found to be 120784.4$, 18.08 kW and 24.16 cents/kWh.

**Keywords:**

Hybrid Power System, Techno-Financial Analysis, Rural Telecom, HOMER Software, Genetic Algorithm (GA) Optimization, Photovoltaic (PV) System, Battery Storage, Diesel Generator, Levelized Cost of Electricity (LCOE), Sensitivity Analysis

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# Optimal Multiple Distributed Generators Placement and Recloser – Fuse Co-ordination by using Water Cycle Algorithm in a Radial Distributed Network

*Saurab Bhattarai [a], Deepak Adhikari [b], Akhileshwar Mishra [c], Laxman Motra [d]*

**Abstract:**

This paper proposes an adaptive protection coordination scheme for Recloser and Fuses in radial distribution systems with the integration of multiple Distributed Generators (DGs). The increasing adoption of DGs in distribution networks introduces new challenges in protection coordination due to varying fault currents and voltage profiles caused by the different placements and capacities of DGs. The proposed scheme utilizes the Water Cycle Algorithm (WCA) to solve the optimization problem, ensuring that the protection devices coordinate effectively under fault conditions. The study is conducted on the IEEE 33-bus test system, where the impact of DG placement on protection coordination is examined. Initially, the optimal placement and sizing of DGs are determined using WCA in MATLAB, focusing on both single and multiple DG configurations. The system's performance is evaluated under three distinct scenarios: base, single DG, and multiple DGs case. Following this, short-circuit analysis is conducted in ETAP to obtain fault current data. These data sets serve as inputs for WCA in MATLAB, which is employed to optimize the Time Dial Settings (TDS) of Recloser and the Fuse constants for all Fuses in the system. The analysis reveals that the optimal placement of DGs can significantly reduce distribution losses and improve voltage profiles in the network. For single DG case, optimal location is determined at bus 6, with DG size of 2.229 MW. In case of three DGs, optimal locations are found at buses 6, 14, and 31, with corresponding DG sizes 1.229 MW, 0.604 MW, and 0.686 MW, significant reduction in feeder losses was observed and the losses decreaed by 47.879 %and 62.104 %, respectively, compared to base case. In summary, this research demonstrates that the proposed adaptive protection coordination scheme, based on Water Cycle Algorithm, is an effective method for achieving optimal Recloser-Fuse coordination in distribution systems with DG integration.

**Keywords:**

Water Cycle Algorithm, Distributed Generator, Protection Coordination

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# Dynamic Thermal Rating for Congestion Management in High Renewable Regions: Case Study of Dana-Kushma-New Butwal 220 kV Line

*Khil Nath Aryal [a], Sanjaya Neupane [b], Shahabuddin Khan [c]*

**Abstract:**

The excessive loading of equipment in the transmission grid, which prevents power generated by generators from loading, is referred to as transmission grid congestion. Unplanned penetration of distributed renewable energy generators on the transmission grid along with penetration of electrical vehicles and cooking loads are introducing congestion on the Nepalese grid leading to larger congestion management costs. In addition, the static thermal rating of the transmission line conductor is designed by a conventional approach of low wind speed and the highest possible ambient temperature approach leading to under-utilization of existing transmission grid capacity. Dynamic Line Rating (DLR) is a capability assessment of transmission line conductors using real-time meteorological conditions and provides normally higher line capacity as compared to the traditionally used static rating method. Implementing DLR in transmission lines helps in congestion management as additional capability is available using the same existing assets. This study will provide a scheme for dynamic line rating application for transmission grid congestion management introduced by renewable energy resources. A DLR forecasting model is designed to forecast the real-time thermal rating. The result obtained is used for congestion management for a transmission line of the Integrated Nepalese Power System (INPS). Testing of the proposed model on the Dana-Kushma-New Butwal 220 kV transmission line results in an additional 20-30% average availability of transmission line capability for renewable energy generators. Additional renewable energy of about 737 GWh can be evacuated using the same existing transmission line, which may cost approximately about 40 million USD in Nepal.

**Keywords:**

Transmission Grids, Congestion Management, Dynamic Line Rating, Renewal Energy, INPS

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# Long Term Analysis of Generation Adequacy of INPS

*Pawan Karki [a], Upendra Bhattarai [b], Ashish Oliya [c], Dhiraj Kumar Yadav [d], Sochindra Kumar Roy [e], Dinesh Kumar Ghimire [f]*

**Abstract:**

The generation adequacy analysis determines how well a power system provides projected demand levels under random equipment failures. This analysis evaluates the INPS generation capacity to determine if it provides sufficient power to serve consumers despite unpredictable factors. The hierarchical reliability assessment begins at the HL-I level to evaluate generation capacity adequacy by disregarding transmission limitations. The methodology applies probabilistic calculations over deterministic methods to handle power system randomness by combining Loss of Load Expectation (LOLE) and Expected Energy Not Supplied (EENS) reliability metrics. Load forecasting is performed through econometric models using GDP per capita and population data. The modeling system includes projects from multiple development stages which operate at different time intervals. The representation of seasonal variations uses Annual load curves. Monte Carlo simulation is the primary analytical instrument that generates random generation state samples from Forced Outage Rates to determine available capacity against demand. Multiple economic growth scenarios are assessed through an iterative process that generates reliability indices consisting of LOLE and EENS to determine system adequacy.

**Keywords:**

Energy Security, Generation Adequacy, Reliability Analysis, Monte Carlo Simulation, Loss of Load Expectation (LOLE), Integrated Nepal Power System (INPS), Nepal Electricity Authority (NEA), Power System Planning

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# Impact Assessment of BESS on frequency response of power system with high DG penetration

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**Abstract:**

With the increasing penetration of renewable energy into the existing grid, conventional synchronous generators are being displaced, raising various concerns about grid stability and security. Unlike synchronous generators, converter-interfaced DGs don't have inherent inertia, reducing the overall system inertia and leading to significant frequency deviations and high rate of change of frequency (ROCOF) during imbalance conditions. This paper analyzes the applicability of Battery Energy Storage System (BESS) in enhancing the frequency response of a grid with high DG penetration. This paper also presents a strategy for determining the appropriate size of a BESS to effectively limit the ROCOF and frequency deviations within prescribed limits. The proposed method is applied to a 5-bus test system simulated in DIgSILENT Power Factory software. The system was tested under various contingency scenarios, such as generator failure and increased or decreased loading conditions. The results show that the modelled droop-controlled BESS successfully improved the system's frequency response in all contingency cases.

**Keywords:**

battery energy storage system(BESS), primary frequency response, frequency response characteristics .

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# Optimal Distributed Generation Allocation and Optimal Network Reconfiguration to improve the performance of Distribution System

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**Abstract:**

The radial power distribution network suffers from high power losses and frequent under-voltage issues, especially during peak loads, due to improper network configuration and high resistance-to-reactance ratios. To mitigate these challenges, this study employs Particle Swarm Optimization (PSO) for simultaneous distribution network reconfiguration and optimal Distributed Generation (DG) integration. Five additional tie-switches were strategically placed to optimize reconfiguration, considering geographical and electrical constraints. A resource assessment with PV is taken as the preferable DG source, injecting only active power. Using PSO, the optimal DG size and location were determined. Backward/forward load flow analysis evaluated power losses and voltage profiles. The proposed method, tested in MATLAB on the IEEE-69 bus and Sahid Chowk feeder, improved the system voltage, reducing active and reactive power losses.

**Keywords:**

Distributed Generation, DG Placement, Network Reconfiguration, PSO

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# Investigation of barriers to the adoption of BIM (Building Information Modeling) in Nepal: Multi-case Study Approach

*Bibek Himalaya* [a], *Sunil Suwal* [b]

**Abstract:**

Building Information Modelling (BIM) holds significant potential for revolutionizing the construction industry by addressing longstanding challenges such as cost overruns, communication inefficiencies, and information disparities. Despite its benefits, BIM adoption remains sluggish, particularly in developing countries like Nepal, due to multifaceted barriers at individual, organizational, and institutional levels. This study aims to empirically identify and analyze these barriers within Nepal's construction sector with help of case studies of projects which implemented BIM and validating them through quantitative research methodologies. By focusing on real-world BIM implementation experiences, the research seeks to fill existing gaps in literature that predominantly discuss theoretical advantages and limitations without detailed exploration of practical adoption challenges. Key objectives include identifying the level of BIM implementation; level of detail (LOD) and dimensions of BIM usage in Nepalese projects, alongside identifying strategies to overcome adoption barriers. Ultimately, the findings aim to inform policymakers, industry stakeholders, and practitioners about effective pathways for promoting BIM integration and expediating BIM adoption, thereby enhancing project efficiency and performance in Nepal's construction landscape.

**Keywords:**

Building Information Modelling (BIM), Level of Detail (LOD), Barriers, BIM Dimension, Strategies

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# Assessment of Factors Causing Delay in Commercial Building Construction Projects in Kathmandu Valley, Nepal

*Alok Raj Chaudhary [a], Santosh Kumar Shrestha [b], Nagendra Bahadur Amatya [c]*

**Abstract:**

Delays in construction projects are a significant issue worldwide. Commercial building construction projects in the Kathmandu Valley, Nepal, have also faced widespread delays. The objective of this study is to assess the major factors causing delays in commercial building construction projects in the Kathmandu Valley through literature reviews, structured Key Informant Interviews (KII), and a questionnaire survey. A total of 48 delay-causing factors were identified and categorized into eight groups: client, contractor, consultant, labor, material, equipment, contract, and others.The Relative Importance Index (RII) was used to evaluate and rank the impact of the identified factors on delays in commercial building construction projects. Key Informant Interviews were conducted to further explore the factors contributing to delays. Findings reveal that client-related factors such as change in design and project specifications, delay in payment by the client, lack of experience or technical knowledge of the client, etc. Were the major contributors for delay in commercial building construction projects. Ineffective project planning and scheduling, insufficient labor mobilization, incomplete or ambiguous contract, unreliable subcontractors, etc. also contributed to delay of commercial building construction projects in the Kathamnadu Valley. Client related group of delay factors ranked first among the different groups with RII score of 0.683 followed by contractor related group of factors with RII score of 0.511. Labor related group of factors ranked third with RII score of 0.456. Identification of the delay factors can help in formulation of strategies to minimize delays and complete the project on the scheduled time frame. The study recommends adopting advanced project management tools (MS Project, Primavera, etc.), standard form of contract documents and execution, stable design practices (Building Information Modeling-BIM, VR visualization, etc), and improved financial planning, to ensure timely project completion and enhanced construction efficiency.

**Keywords:**

Commercial Building Construction Projects, Delay, Relative Importance Index (RII), Key Informant Interview (KII)

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# Risk Management in Selected Building Construction Projects within Kathmandu Metropolitan City, Nepal

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**Abstract:**

Any construction project is a complex and risky.High rise building construction projects are vulnerable to various risks during their life cycle. These risks may negatively affect the project cost and duration, time, quality, safety and decreased stakeholder satisfaction. Therefore, the main objective of this study is to assess the risk factors and its management in selected building construction projects in Kathmandu metropolitan city. The methodology is based on review of the literatures available and relevant to the study. The four completed high rise building construction projects were selected for the study by severity, probability and exposure (SPE) model analysis. Questionnaire survey as well as interviews were conducted among the clients and Contractors representatives of the selected projects. The method used in data analysis is primarily focused on calculating risk score and degree of risk. After calculating risk score through SPE model the risks factors are ranked based on their degree of risk. To achieve the study goal, risk matrix table, severity, probability, exposure mean values and frequency charts are used as data analysis tools. The findings of the study revealed that out of total 30 risks factors, the Contractor and The Client both considered Strike as the very high degree of risk and then Blockade and Defective design, Similarly Undefined scope of work, Inflation, Delayed payment on contract, Acts and regulations, Adverse weather conditions and Occurrence of accidents and Poor safety procedures are the major risk factors identified. In this study, it is found that Plan alternative method as standby is the most significant preventive measure for the very high degree of risk from both Client and Contractor's perspectives. The most significant mitigation measure suggested from this study is the closed supervision of works for the risk management. This study recommends to halt the construction works in the case of the very high degree of risk and to correct the involved risk factors immediately and continue the execution.

**Keywords:**

Severity, Probability, Exposure, Risk Score, Degree of Risk, Risk management, Construction

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# Assessment on Adoption of Alternative Building Materials in Nepal

*Rupak Gautam* [a], *Mahendra Raj Dhital* [b]

**Abstract:**

The construction industry of Nepal relies heavily on materials like cement and concrete, bricks, contributing to high carbon emissions. Although various alternative building materials (ABMs) like rammed earth, bamboo, hempcrete etc. exist in abundance in their very raw form in Nepal, their adoption remains minimal despite their significant potential. This study evaluates the feasibility of rammed earth, bamboo, hempcrete, compressed earth blocks, and wattle and daub, ranking them in order of viability based on expert insights and survey analysis. A mixed-methods approach was employed, integrating literature review, expert interviews, and questionnaire surveys. The study identifies key barriers to adoption, with resistance to change, lack of information, regulatory gaps, limited industry involvement, and low client demand emerging as the most significant. Exploratory Factor Analysis (EFA) has been used to cluster these barriers and assess their impact. Increased awareness, technical training, and targeted incentives are crucial for wider acceptance. Strengthening institutional frameworks and enhancing stakeholder collaboration can drive market confidence. Promoting these materials can mitigate environmental impacts while preserving Nepal's architectural heritage and fostering a sustainable built environment.

**Keywords:**

Alternative Building materials, Sustainable Building materials, Green House Gases, Exploratory Factor Analysis

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# Optimizing Construction Scheduling through Building Information Modeling (BIM): Advancing Project Efficiency in Nepal

*Sushil Basnet [a], Suman Dhakal [b], Prabin Basnet [c], Sunil Suwal [d]*

**Abstract:**

The construction industry in Nepal faces significant challenges in project scheduling, often resulting in delays, cost overruns, and inefficiencies due to the continued reliance on traditional methods such as bar charts and the Critical Path Method (CPM). Building Information Modeling (BIM), particularly 4D BIM, which integrates scheduling with 3D visualization, has emerged as a transformative tool for enhancing project management efficiency. This study examines the role of BIM in optimizing construction scheduling in Nepal through a mixed-methods approach, incorporating a structured questionnaire survey of 141 professionals from the Architecture, Engineering, and Construction (AEC) industry. The findings reveal that BIM significantly improves visualization, real-time monitoring, and resource allocation, thereby minimizing scheduling conflicts and enhancing project coordination. However, several barriers impede its adoption, including high implementation costs, limited awareness, resistance to change, and a shortage of trained professionals. Additionally, the absence of government regulations and standardized frameworks further constrains its widespread implementation. The study recommends policy interventions such as mandatory BIM adoption in public projects, integration of BIM training in academic curricula, and capacity-building initiatives to foster industry-wide adoption. These findings underscore the potential of BIM to modernize Nepal's construction sector, offering a structured and efficient approach to project scheduling and management.

**Keywords:**

BIM, Construction Scheduling, 4D BIM, Project Management

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# Artificial Neural Network Model for Predicting Construction Duration of Building Projects in Nepal

*Sarun Bhomi* [a], *Sujan Tripathi* [b]

**Abstract:**

Considering the limited project information during the initial stage of any project, accurately predicting the duration required for construction poses a significant challenge. The present scenario of estimating the duration of the construction based on judgment and experience can be made more efficient and reliable by using advanced tools like machine learning, which utilize historical data. This study aims to develop a feed-forward Artificial Neural Network (ANN) model to predict the construction duration of building projects in Nepal. Using historical data from 398 completed projects by DUDBC, the model incorporates predictors that are known during the project appraisal stage. After preprocessing the data and fine-tuning the model with K-fold cross-validation, the optimal ANN model (20-32-16-1) achieved a $R^2$ and MAPE of 0.665 and 23.23% for validation set and 0.581 and 21.91% for test set respectively. The findings of this research can enhance project planning, improve financial management, and reduce risks by accurately predicting the construction duration of building projects in Nepal.

**Keywords:**

Duration Estimation, Building Construction,Artificial Neural Network (ANN)

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# LSTM-Based Weather Forecasting for Dharan, Nepal: A Machine Learning Approach

*Mandip Rai* [a], *Pukar Karki* [b], *Bishnu Choudhary* [c], *Pravin Sangroula* [d]

**Abstract:**

Accurate and timely weather forecasting is crucial for disaster preparedness, agriculture, and resource management. In Nepal, the Department of Hydrology and Meteorology primarily relies on numerical weather prediction (NWP) models, which require significant computational resources and often lack real-time efficiency. This study explores the use of deep learning, specifically Long Short-Term Memory (LSTM) networks, to improve short-term weather forecasting for Dharan meteorological station.

The primary objective of this study is to forecast the next day's maximum temperature, minimum temperature, average temperature, precipitation, and humidity at 12 p.m. and 3 p.m. using historical weather data. The dataset consists of daily temperature, humidity, and precipitation records over the last 10 years. Data preprocessing involved handling missing values, detecting outliers using the Interquartile Range (IQR) method, and applying log transformation for skewed precipitation values. The LSTM model was trained and evaluated using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and $R^2$ metrics.

The results indicate that temperature predictions achieved higher accuracy compared to precipitation and humidity. RMSE values ranged from 1.3 to 1.87 for temperature, 4.4 to 4.6 for precipitation, and 6.9 to 9.2 for humidity. MAE values were lowest for temperature (1 to 1.51) and highest for humidity (4.77 to 6.46). The $R^2$ values varied between 0.1 and 0.93, showing a strong correlation between predicted and actual values in certain cases. These findings suggest that LSTM-based forecasting provides a computationally efficient alternative to traditional NWP models while maintaining competitive accuracy.

**Keywords:**

LSTM, Machine Learning, Nepal, Time Series Prediction, Weather Forecasting

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# How crop water requirements are projected to change with climate change in Chandra Mohan Irrigation Project in Nepal?

*Sandesh Rai [a], Jeet Chand [b], Khem Narayan Poudyal [c], Aatiz Ghimire [d]*

**Abstract:**

This study focuses on knowing the future crop water requirements under two climate scenarios ssp245 and ssp585 for the Chanda Mohana Irrigation Project in Sunsari, Nepal. The ACCESS-ESM1-5 CMIP6 GCM had been used, the research applies bias correction methods to decrease the uncertainties and CROPWAT 8.0 model to find the future water requirement of crops. This study covers three time periods: near-future (2025-2049), mid future (2050-2074) and far future (2075-2100). The findings show the increasing trend in both precipitation and temperature, with raising max temperature by 0.5°C more in ssp585 as compared to ssp245. According to CROPWAT 8.0, the crop water requirement until the observed date (1990-2014). March month has a highest requirement and December has the lowest crop water requirement. The percentage change of Crop Water Requirement from the baseline line to near, mid and far future for ssp245 are 44.37%, 46.58% and 53.02% respectively and the % change of Crop Water Requirement from baseline to near, mid and far future for ssp585 are 44.98%, 48.68% and 56.81% respectively. This change underscores the importance of implementing climate – adaptive irrigation planning strategies to ensure agricultural productivity in the region.

**Keywords:**

ACCESS-ESM1-5; Agriculture; Chanda Mohana Irrigation Project; Climate change; Crop water requirement

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# Assessing the Climate Resilience of High-Mountain Hydropower Under Varying Demand and Shifts Induced by a Decarbonized Transportation Sector.

*Sujit Upaddhaya Regmi* [a], *Khem Gyanwali* [b]

**Abstract:**

This study investigates the climate resilience of Nepal's hydropower sector under diverse climate scenarios and rising electricity demand from a decarbonized transportation sector. By coupling a glacio-hydrological model (SPHY) with an hourly power grid model (OCEM), the research examines how Climate change affect water availability, hydropower generation, and power system expansion strategies from 2020 to 2050. Nepal, with a hydropower potential of 83 GW, predominantly relies on run-of-river systems. The analysis incorporates electric vehicle (EV) adoption, projecting transport sector demand to increase from 11,110 GWh in 2020 to 96,738 GWh by 2050. Findings show that drier scenarios require greater reliance on solar PV, hydro storage, and hydrogen infrastructure, raising costs billion USD in Scenario CD, and WD, while wetter scenarios favor run-of-river hydropower, lowering costs billion USD in Scenario WW. Hydropower remains the primary energy source across all scenarios, underscoring the importance of adaptive planning. The study advocates for diversified energy portfolios and cross-border electricity trade to optimize costs and resilience. It offers policymakers a framework for cost-effective energy planning, supporting Nepal's net-zero emissions target by 2045.

**Keywords:**

Decarbonized Transportation Sector, OCEM, Climate Resiliency

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# Enhanced Stream Flow Prediction Using Ensemble Learning and LSTM Techniques on Time Series Data: A Case Study of the Bagmati River at Sundarijal

*Bikram KC* [a], *Arun Kumar Timalsina* [b], *Nabin Bania* [c]

**Abstract:**

Streamflow prediction varies from region to region and it is a complex physical process that depends upon multiple factors such as seasonal variations, water surface area and elevation, and the impact of climate change. Accurate streamflow prediction is very crucial for water resource management including agriculture, hydropower development, and water-induced disaster management. This study evaluates the performance of two ensemble learning models (Random Forest Regressor and XGBoost Regressor) and a deep learning model (LSTM) for streamflow prediction in the Bagmati River at Sundarijal Station using daily climate data. These models are compared by evaluating the performance metrics such as RMSE, MAPE, and $R^2$ score. Initially, the RFR model outperformed others for the 1-day prediction task. However, The LSTM model stands as a top performer for long-term forecasting on 3-day and 7-day forecasts. The findings highlight the potential of ensemble learning methods and deep learning methods for streamflow prediction and their viability to assist stakeholders in making informed decisions for water management in Nepal and similar contexts.

**Keywords:**

Streamflow prediction, RFR, XGBoost, LSTM, Bagmati River

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# Analyzing the Future Flooding and Flood Hazard Mapping under CMIP6 Climate Projection Using HEC-RAS 2D Modelling of Kamala River Basin

*Yogesh Paudel* [a], *Pawan Kumar Bhattarai* [b]

**Abstract:**

Floods around the world are the most destructive natural disasters, as they not only cause property destruction, but also great loss of life and extensive economic damage. The Terai region of Nepal has experienced extreme flooding as a direct result of climate change. The research project will analyze future flood scenarios and create flood hazard maps for the Kamala River basin in Nepal through HEC-RAS 2D modeling based on CMIP6 climate projections. The analysis investigated five global climate models (GCMs) in the SSP585 scenario of this study. This study included hydraulic and hydraulic reviews developed from the development of the Snyders Unit Hydrograph (SUH). Satellite image validated the simulation of flood floods with HEC-RAS 2D model, achieving an accuracy level of 87.5%. Result shows that the downstream of the Kamala Basin is more affected. This study analyses the hazard class into four classes symbolizing that High-Hazard zone area increases the most with return period increases. This study shows how climate change increases flood risk in the Kamala Basin, and at the same time shows how important flood hazard is to effective risk management. These findings provide valuable insights into flood hazard management and infrastructure development, contributing to improved understanding and potential applications in management of flood risk.The results support decision-making to support decision-makers, support flood preparation, minimize socioeconomic damage in the region, and guide reduction.

**Keywords:**

Climate, Flood, Return, Period, Mapping, Hazard

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# Tracing the Potential Transport Pathways of Wildfire-Related Air Masses to the Khumbu Glacier Using HYSPLIT Backward Trajectories

*Aashutosh Paudel* [a], *Dhiraj Pradhananga* [b]

**Abstract:**

Forests are critical for carbon sequestration, biodiversity conservation, and ecosystem regulation. Still, wildfires' black carbon (BC) can travel great distances to Himalayan glaciers, accelerating their melt and impacting regional climate and water supplies. This study employs HYSPLIT backward trajectory analysis for 120 hours from the Khumbu Glacier, tracking possible wildfire events along the trajectory with a focus on the year 2021 and a 500-meter planetary boundary layer (PBL). Results indicate that pre-monsoon southwesterly airflows facilitate long-range BC transport from biomass-burning locations in South Asia, with peak contributions occurring between March and May. During the monsoon season (June-September), increased precipitation and wet scavenging reduce BC deposition. However, post-monsoon months (October-December) witness a resurgence in BC transport, notably from the Indo-Gangetic Plain, where stable air conditions and widespread biomass burning lead to increased deposition hazards. These findings emphasize the significance of air circulation in influencing BC transport and its implications for glacier melt in the Himalayas. This study explores the transport pathways of wildfire-derived BC to the Khumbu Glacier during the pre-monsoon season using HYSPLIT backward trajectory analysis. This technique enhances understanding of how regional and long-transport wildfire emissions contribute to BC accumulation in the Khumbu region.

**Keywords:**

HYSPLIT, Backward trajectory, Black Carbon, Wildfires

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# Image Forgery Detection Using Capsule Network based on VGG19

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**Abstract:**

Digital images play a crucial role in media and scientific fields but can be forged easily, posing a risk of misinformation. CNN model uses more parameters consuming more memory and computation power and also require more training data as this model is not viewpoint equivariant. This paper is concerned on using capsule network based on VGG19 to overcome the limitations of CNN. The superiority of the capsule-forensics network is the use of pretrained feature extractor, statistical pooling layers, and a dynamic routing algorithm. This enables it to outperform similarly designed CNNs while being much smaller than CNNs with comparable performance. FaceForensics++ datasets are used for training and testing in this proposed model for binary and multiclass classification. An accuracy of 99.23% has been achieved in the binary classification of real and forged images, with a precision of 99.53%, recall of 99.64%, and an F1 score of 0.99. The multiclass classification of real, irregular swap, and deepfake image categories has achieved accuracy and precision above 90% for all categories. Recall values have been observed at 75.99% for deepfake images, 99.51% for irregular swap images, and 83.6% for real images. The highest F1 score of 0.93 has been achieved for the irregular swap category, followed by 0.87 for real images and 0.83 for deepfake images.

**Keywords:**

CNN, VGG19, Viewpoint equivariant, Statistical pooling, Dynamic routing algorithm

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# Image Colorization using Conditional Self Attention GAN

*Anudit Adhikari* [a], *Anku Jaiswal* [b]

**Abstract:**

The paper investigates the use of Generative Adversarial Networks (GANs) for the automatic colorization of grayscale images. Image colorization is a challenging task that involves predicting plausible colors for each pixel of a grayscale image, often requiring significant domain knowledge and manual effort. An approach is proposed, utilizing a self-attention conditional GAN (cGAN) to learn the mapping from grayscale to color images. The generator in this GAN framework is conditioned on grayscale input and enhanced by a self-attention mechanism, enabling it to focus on important regions of the image and capture long-range dependencies. The discriminator assesses the realism of the generated color images by comparing them with true color images. This method automates the colorization process while producing high-quality, visually convincing results across various images.

**Keywords:**

GAN, Generator, Discriminator, Self-Attention, gray scale images, colourize

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# Real Time Flight Scheduling at TIA using Classical Optimization Techniques

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**Abstract:**

This study investigates real-time flight scheduling at Tribhuvan International Airport (TIA) using classical optimization techniques. As air traffic increases, challenges such as flight delays, gate assignment complexities, and bay congestion necessitate innovative solutions. Machine learning models, including XGBoost and LSTM, are employed for flight delay prediction, while Mixed-Integer Linear Programming (MILP) optimizes bay and gate assignments under TIA's specific constraints.The study utilizes ATC communication data obtained from TIA, CNAD, and Avibit Air Traffic Solutions, along with METAR data sourced from DHM. The primary objective is to classify flights as delayed or non-delayed, with these predictions informing solutions for bay and gate assignment complexities, ultimately improving the overall flight scheduling system at TIA. Experimental results demonstrate that post-tuned XGBoost models achieve a more balanced performance in terms of precision and recall, with an AUC of 0.78, compared to the pre-tuned model (AUC = 0.77). The LSTM model, with an AUC of 0.70, performs comparably in accuracy but underperforms in recall and F1-score, indicating class imbalance issues. Confusion matrix analysis reveals that XGBoost more effectively distinguishes between delayed and on-time flights, whereas LSTM frequently misclassifies non-delayed flights. Additionally, weather conditions significantly impact flight delays, with non-clear skies leading to more frequent disruptions. Bay and gate assignments initially faced feasibility challenges due to strict constraints; however, integrating time-based adjustments, soft constraints, and towing options improved overall feasibility. In summary, XGBoost demonstrates superior reliability in flight delay prediction, while LSTM requires enhancements to improve recall. Future studies will focus on exploring advanced optimization methods to enhance scalability and efficiency.

**Keywords:**

XGBoost, LSTM, ML, MILP

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# Airport Visibility Prediction Using Supervised Machine Learning Algorithms

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**Abstract:**

Airport visibility is a critical factor in aviation safety and operational efficiency. This study focuses on predicting visibility conditions at Pokhara International Airport (PIA) using supervised machine learning algorithms. Meteorological data, including pressure, temperature, humidity, wind speed, and precipitation, were analyzed and used to train machine learning models. A stacking ensemble approach, incorporating Support Vector Machine (SVM), Random Forest, and XGBoost as base models, was employed. Logistic Regression and Multi-Layer Perceptron (MLP) were evaluated as meta-models to refine visibility predictions. Feature importance analysis was conducted to identify key meteorological variables influencing visibility. The results demonstrate that the MLP-based stacking model outperforms individual classifiers, achieving superior accuracy. This research provides valuable insights for aviation professionals, contributing to enhanced flight safety and operational decision-making at PIA.

**Keywords:**

Airport Visibility, Machine Learning, Supervised Learning, Pokhara International Airport, Stacking Ensemble, Feature Importance

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# Nepali Music Genres Classification Using Convolutional Neural Network

*Prabin Lamichhane [a], Hom Nath Tiwari [b], Ramesh Thapa [c]*

**Abstract:**

There are very few works done by researchers in the domain of Nepali Music database. In fact it is very hard to find a collection of Nepali Musical database to begin the work on machine learning or deep learning algorithms. Music genre classification can build a strong recommendation system applying the power of machine learning. One way to classify data is through Neural Networks(NN) because they usually take in some sort of image representation. Here to feed audio to neural network we first make visual representation of each training audio file. In this research, first a proper Nepali music database of 1000 Nepali songs representing 5 Nepali music genres, namely: 'lok-geet', 'aadhunik-geet', 'lok-dohori', 'deuda-geet' and 'pop-geet' is created then an algorithm based on convolutional neural network (CNN) architecture incorporating the music features such as 'Spectrogram', 'Mel-Spectrogram' and 'MFCC' is developed and trained. These features contain fine details of music components such as frequency and temporal properties, which are then used catch trends of spectrogram and Mel-spectrogram in both time and frequency scale. Considering the successful results of deep neural networks in the audio and music domain, our aim is to develop a deep learning algorithm that can classify 5 different Nepali music genres with high accuracy. Upon the completion of research work highest accuracy of 73.5% is achieved when the CNN model is trained with the Spectrogram features as input to the model. Adam optimizer, Categorical Crossentropy loss function, Relu and Softmax activation functions are used to tune the CNN model parameters. Confusion matrix of each feature model is also produced for model evaluation.

**Keywords:**

Music genres, Neural Network, Convolutional Neural Network, Spectrogram, Mel-Spectogram, MFCC, Activation function, Loss function, Accuracy, Confusion matrix

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# Hybrid Approach to NEPSE Index Prediction: ARIMA, LSTM, and Transformer Models

*Dhurba Subedi* [a], *Nabin Lamichhane* [b], *Sitaram Pokhrel* [c] *Nabaraj Subedi* [d]

**Abstract:**

Stock prediction is crucial in analyzing financial markets, providing investors with data insights to enhance decision-making and reduce risks. This research presents a new hybrid stock forecasting model that combines the advantages of traditional statistical techniques and modern machine learning systems to tackle the complexity and non-stationarity of financial time series data. The hybrid architecture combines ARIMA (AutoRegressive Integrated Moving Average), LSTM (Long Short-Term Memory) networks, Transformer-based attention mechanisms, and Extreme Gradient Boosting (XGBoost) to identify linear patterns, short and Extended temporal dependencies and complex non-linear relationships, focusing on the Nepal Stock Exchange (NEPSE) index. The model utilizes technical indicators (RSI, MACD, Turnover), sentiment an alysis, and lagged time-related features to guarantee a thorough assessment of market trends. The model is assessed using key performance metrics, achieving MAE: 0.0123, MSE: 0.00028, RMSE: 0.016, and $R^2$ Score: 0.9873, indicating outstanding precision and reliability. The SHAP (SHapley Additive exPlanations) analysis is conducted to comprehend feature significance, indicating that time-lagged features exert the most influence, while financial indicators provide additional predictive power. The findings indicate that incorporating sentiment analysis with technical indicators enhances forecasting accuracy. This study progresses the area of computational finance by showcasing how hybrid models, enhanced with diverse data inputs, can connect theoretical accuracy and actual market volatility, providing investors with a strong instrument for effective portfolio management.

**Keywords:**

ARIMA, LSTM, NEPSE, SHAP, Stock Prediction, Transformer, XGBoost

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# Rolling Bearing Fault Diagnosis on Vibration-Based Condition Monitoring of Induction Machines Using Machine Learning

*Prakash Dahal [a], Anil Kumar Panjiyar [b], Bishal Silwal [c], Muhammad Usman Sardar [d], Hadi Ashraf Raja [e], Toomas Vaimann [f]*

**Abstract:**

Induction machines play a vital role in modern society due to their convenience, safety, reliability, efficiency, power density, and cost-effectiveness. If left undetected, a failure in the rolling bearings can lead to increased vibration, deterioration in machine performance, and eventual catastrophic failure. The most common technique for monitoring induction machine health is Motor Vibration Spectrum Analysis. This paper is dedicated to the investigation of fault detection and diagnosis for rolling bearing of a squirrel cage induction machine based on motor vibration signals at various loading conditions. In this paper, an MLP neural network has been applied to detect outer race, inner race, and cage damage faults. The diagnostic performance of the model is investigated through feature domain optimization and by neglecting the loading condition datasets. The current study extends the application of MVSA to enhance the reliability and efficiency of condition monitoring in induction machines using advanced machine learning techniques.

**Keywords:**

Induction Machine, Bearing faults, Condition Monitoring, Multilayer Perceptron

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# An Intelligent Deep Convolutional Neural Network Based Islanding Detection for Multi-DG Systems

*Om Prakash Jaiswal [a], Susmita Poudel [b], Bhrigu Raj Bhattarai [c], Krishna Dhakal [d]*

**Abstract:**

Unintentional islanding poses a significant challenge in electrical distribution networks, particularly within non-detection zones. This study presents a novel intelligent islanding detection technique with zero non-detection zone, designed for hybrid distributed generation systems. The proposed method combines short-term Fourier transform for frequency spectrum analysis and convolutional neural networks (CNNs) for pattern recognition. The approach involves monitoring three-phase voltage at the point of common coupling and collecting time-series data for various islanding and non-islanding events. These data undergo frequency computations on a scaled timeseries, with complex numbers separated into magnitude and phase components. A modified CNN with forward propagation is then employed to distinguish between islanding and non-islanding occurrences. A test system is modeled that serves as the foundation for generating diverse scenarios to train the CNN. The model's performance is evaluated using 5-fold cross-validation. The CNN model achieved a mean accuracy of 99.9 % for category categorization after training and testing. Thus the results demonstrate that islanding detection can be done with high accuracy and selectivity among the islanding and non-islanding conditions using CNN model.

**Keywords:**

Distributed Generation(DG), Islanding Detection, Non-Detection Zone (NDZ), Hybrid Distributed Generation (DG), Short-Term Fourier Transform (STFT), Modified CNN Model

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# Distribution System Power Quality Improvement Using STATCOM in IEEE 14 bus system

*Govinda Kumar Jaiswal* [a], *Sochindra Kumar Roy* [b]

**Abstract:**

The project is responsible for improving the power quality in distribution system using STATCOM. Because of the use of the non-linear loads, renewable energy sources along with the rapid industrialization, modern power systems face significant challenges such as voltage instability, harmonic distortions, reactive power imbalance, power factor degradation. These are responsible for causing poor power quality which results in higher energy losses, reduced equipment lifespan, and operational inefficiencies. In this paper, reactive power compensation is being carried out at the 13th bus of the IEEE-14 bus system to maintain voltage stability and improve the system performance. Reactive power is injected or absorbed from the distribution network by using STATCOM which further helps in stabilizing voltage levels, improving power factor and mitigating power quality disturbances like voltage sags, harmonic distortions and voltage swells.

**Keywords:**

STATCOM, Reactive power, IEEE 14 bus system

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# Deep Neural Network-Based Optimal Power Flow and Security Assessment Under Critical Contingencies

*Panas Bhattarai* [a], *Anil Panjiyar* [b], *Mahammad Badrudoza* [c]

**Abstract:**

The increasing complexity of modern power systems necessitates advanced tools for efficient operation and security assessment. This paper proposes a Deep Neural Network (DNN)-based framework to solve the Optimal Power Flow (OPF) problem and assess power system security under critical contingencies. A comprehensive dataset is generated under varying load conditions, serving as the foundation for training and validation. Critical contingencies are identified by simulating line and generator outages, with the three most severe line outages and two most severe generator outages selected based on their impact on system violations.

Two sets of DNNs are developed: the first set comprises five DNNs that has bus real and reactive loading as input and are trained to predict key system variables—real and reactive power generation, bus voltages, bus angles, and line loadings—under normal operating conditions. The second set includes five DNNs that incorporate the status of critical lines and generators as additional inputs, enabling accurate OPF solutions and security assessments during contingency scenarios. The proposed DNN-based approach offers a computationally efficient alternative to traditional OPF solvers, facilitating real-time decision-making and enhancing system resilience.

The results demonstrate the effectiveness of the DNN models in providing reliable OPF solutions and identifying security risks under both normal and contingency conditions. This work highlights the potential of machine learning techniques in advancing power system operation and planning, paving the way for smarter and more adaptive grid management strategies.

**Keywords:**

Deep Neural Network, Power Flow, Optimal Power Flow, Security Assessment, Contingency Analysis

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# Stator Inter-Turn Fault Detection by Analyzing Impedance Using Frequency Response Analysis Technique

*Manju Koirala* [a], *Bishal Silwal* [b], *Anil Kumar Panjiyar* [c], *Toomas Vaimann* [d], *Muhammad Usman Sardar* [e]

**Abstract:**

Stator short-circuit faults accounts near about one-third of the total faults that occurs in Induction Machine. With increased automation of the industrial sector and reduced man-machine interface, the importance of condition monitoring of electrical machines is increasing day by day. The stator short circuit faults often occur due to insulation breakdown as a result of overloading, insulation aging, and mechanical stress, with a local inter-turn fault which creates a supplementary thermal stress and, if not diagnosed, results in phase-to-phase and phase-to-ground faults. For inverter-fed machines, these problems are more frequent and cannot be diagnosed using classical methods. The frequency response analysis technique is suitable for such cases due to its high dynamic range, high accuracy, high sensitivity, and safety.

**Keywords:**

Induction Motor, Condition Monitoring, Frequency Response Analysis

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# Optimal Relay Coordination Scheme for Active Radial Distribution Network using hybrid Salp-Swarm Algorithm and Linear Programming

*Basant Raj Tiwari* [a], *Suraj Shrestha* [b], *Shankar Karki* [c]

**Abstract:**

The recent advancement in distributed energy resources and their integration with the utility grid or distribution networks has led to a power system network that is complex and intricate from the conventional one. The penetration of such DERs have created new challenges for the existing power infrastructure. New fault current sources, new fault levels, false tripping, blinding of protection, and bi-directional current sources are some key changes in the existing power system network. During network abnormalities, these changes in the network structure can cause protection systems to fail, potentially leading to system control problems. The paper presents a protection scheme based on standard and user-defined over current-based relay characteristics which are utilized to find the minimum operating time of relays that comply with coordination constraints. To optimize protection coordination, a hybrid algorithm called Salp-Swarm Algorithm-Linear Programming is applied. The optimized relay settings are tested on the active radial distribution network with synchronous-based DGs and inverter-based DGs. The results of the relay coordination optimization analysis are presented in this paper. Based on the results obtained, SSA-LP optimization based on User-Defined Characteristics reduces the relay operating time by 9.34 % and 9.79 % for grid connected and islanded mode respectively in comparison to standard characteristics based optimization approach.

**Keywords:**

Directional Over-Current Relay, Hybrid SSA-LP, User-Defined Relay Characteristics, Relay Coordination

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# Seismic Performance Evaluation and Retrofitting of Stone Masonry Building

*Bipin Thapa* [a], *Kshitij Charana Shrestha* [b]

**Abstract:**

Stone masonry houses are a common construction type in rural Nepal but these structures are highly vulnerable to various earthquake-induced damage. most of these damaged structures could be retrofitted to restore their functionality and improve their seismic resilience. This study evaluates the effectiveness of GI wire mesh retrofitting in stone masonry buildings with cement mortar. A numerical model of a typical stone masonry building was developed in DIANA FE 10.5 software, both with and without GI wire mesh reinforcement. A pushover analysis was performed to assess the structural response under seismic loading, and the results were validated against experimental data. To accurately represent a damaged structure for using in retrofitting, the model incorporated a 50 % reduction in the tensile strength of the masonry before applying the retrofitting measures. The findings indicate that retrofitting with GI wire mesh significantly enhances seismic performance in terms of base shear by 56. 87 % for the retrofitted model compared to the un-retrofitted model. The study showed that GI wire mesh is a practical, cost-effective, and efficient retrofitting solution to increase the earthquake resistance of stone masonry buildings. Furthermore, the numerical modeling approach used in this research provides a reliable framework for future seismic retrofitting studies, contributing to the development of resilient construction techniques in earthquake-prone regions.

**Keywords:**

Stone Masonry, SMC, U-SMC, Pushover Analysis, Retrofitting, DIANA

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# Seismic Performance Evaluation of Dressed Stone Masonry

*Sumit Paudel* [a], *Prem Nath Maskey* [b], *Rabindra Adhikari* [c]

**Abstract:**

This study evaluates the seismic performance of dressed stone masonry buildings through laboratory testing and numerical modeling. Laboratory tests, including hydrometer analysis, compressive strength, and diagonal shear strength tests, were conducted to determine the mechanical properties of stone, mortar, and masonry walls. These properties were incorporated into numerical analysis using SAP2000, where a pushover analysis was performed to assess the building's ductility, strength, deformation capacity, and failure mechanisms. A fragility curve was then developed to quantify seismic vulnerability. The results indicate that dressed stone masonry significantly enhances compressive strength, modulus of elasticity, and ductility, leading to better energy dissipation and controlled failure mechanisms compared to rubble masonry. While pushover analysis shows improved load-carrying capacity, fragility analysis reveals continued vulnerability under moderate to severe seismic loading. The presence of gables negatively impacts structural performance, highlighting the need for careful design considerations. Despite variations in material properties and workmanship, dressed stone masonry exhibits improved seismic resilience and a lower probability of structural collapse, making it a viable option for earthquake-prone regions.

**Keywords:**

Dressed Stone Masonry, Seismic Performance, Pushover Analysis, Fragility Curve, SAP2000

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# Seismic Response of Multistorey RC Buildings on Sloping Grounds

*Abhinav Paudel* [a], *Prem Nath Maskey* [b]

**Abstract:**

With population growth and urbanization of hilly areas, buildings are being constructed on sloping grounds as plain land area become scarce. Such buildings on hill slopes are more vulnerable to seismic events as they possess inherent irregularities in mass and stiffness. Seismic response of buildings on sloping grounds for different configurations are compared and the effect of soil-structure interaction (SSI) are analysed in this study. SSI effect is considered following the equivalent spring model. The effect of keeping two footings/column bases at the lower foundation level and at the upper foundations level was also studied. Consideration of SSI effect significantly affected the response parameters of the building models.

**Keywords:**

Sloping ground, Step Back building, Spring model, Soil Structure Interaction (SSI), Seismic analysis

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# Comparative Analysis of Seismic Performance of a 12 story RC Building with Shear walls and Viscous wall dampers

*Anish Maharjan* [a], *Gokarna Bahadur Motra* [b]

**Abstract:**

The growing population in urban cities like Kathmandu demands taller and more flexible buildings. The increase in the height of the buildings also increases the displacement and vibration during earthquakes. There are different methods to reduce the vibrations during the seismic events. Introducing shear walls is one of the methods of controlling the response during seismic excitation. The addition of shear walls increases the stiffness of the building and reduces the time period of the building which results in increased seismic demand. Energy dissipation devices like Viscous Wall Dampers (VWDs) are alternative methods of controlling the seismic response of buildings. This study compares the seismic responses of a 12 story Reinforced Concrete building for three cases viz, with bare frame, with shear walls, and with VWDs using ETABS software. Fast Non-Linear Analysis (FNA) was performed for the three cases and the responses like story drifts, story displacements, and base shears were compared. The study shows that both shear walls and VWDs are effective in reducing story displacements and story drifts. The results also show that the base shear decreases by adding VWDs whereas the base shear increases by adding shear walls.

**Keywords:**

Viscous wall damper, Reinforced concrete, Shear wall, Fast Non-Linear Analysis

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# Nonlinear Seismic Evaluation of Multi-storey Reinforced Concrete Frame Structures

*Srijal Kunwar* [a], *Hari Ram Parajuli* [b]

**Abstract:**

This study presents a nonlinear seismic evaluation of a 21-story reinforced concrete (RC) frame structure using pushover analysis and nonlinear time-history analysis in compliance with ASCE 41-17 and IS 1893:2016 (Part 1). The structural model, developed in ETABS, incorporates material nonlinearity to assess the seismic performance under lateral loading. Pushover analysis provides insights into the global capacity, plastic hinge formation, and displacement demands, while time-history analysis, using the El Centro 1940 earthquake record, evaluates the structure's dynamic response. The results indicate that the structure exhibits adequate ductility and meets drift limitations, with plastic hinges forming primarily in beams, ensuring a favorable failure mechanism. However, higher mode effects significantly impact upper-story accelerations, necessitating further assessment for localized vulnerabilities. The findings contribute to the understanding of seismic resilience in high-rise RC frames and offer recommendations for performance-based seismic design improvements.

**Keywords:**

Earthquake, standards and specifications, Base shear, storey shear, pushover analysis ,seismic performance; finite element models;Time History Analysis

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# Effect of Soil Structure Interaction on Seismic Response of RC Structure: A Case Study of Pre-Existing Hotel Building at Kathmandu Valley

*Sushmita Dahal*[a], *Hari Ram Parajuli*[b]

**Abstract:**

In seismic-prone regions like Nepal, where soil conditions vary widely, understanding soil-structure interaction is essential for accurately evaluating the seismic response of R.c.c buildings. However, the current design practice rarely utilizes soil structure interaction effect to check response of structure. For lightweight, flexible structures on stiff rock, it's reasonable to assume structures fixed at their base. However, for massive, rigid structures on softer foundations, soil parameters can play a crucial role for the change in the behavior of seismic response of a building. Past researches mainly focus on the SSI behavior of buildings in shallow foundations while research on building with deep foundations is too less. In this research, the effects of soil flexibility are evaluated in seismic response of one pre-existing building with piled raft foundations. The building is a 18 stories hotel building. This study used SAP2000 to perform three-dimensional finite element analyses, comparing the seismic performance considering SSI with fixed base model. Direct Method Approach have been used to analyze seismic response of structure. The actual soil condition of the building site is used for understanding soil structure interaction behavior. Time period, story displacements, story drift,etc are compared with conventional modeling approach by response spectrum analysis and pushover analysis.

**Keywords:**

Soil Structure Interaction (SSI), Direct Modelling, Interface Elements

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# MLR Model for Prediction of Construction Duration of Bridge Projects in Nepal

*Ashesh Ghimire [a], Mahendra Raj Dhital [b], Nagendra Bahadur Amatya [c]*

**Abstract:**

Bridge construction in Nepal serves as a critical infrastructure component that directly improves transportation connectivity between remote communities and urban centers. By facilitating smoother movement of goods and people, these bridges stimulate economic growth through enhanced trade opportunities and access to markets. Additionally, they contribute to social welfare by connecting rural populations to essential services like healthcare, education, and emergency response. Reliable bridge infrastructure also reduces isolation, promotes regional development, and strengthens disaster resilience in Nepal's challenging mountainous terrain. However, frequent delays and schedule overruns in bridge projects lead to increased costs, logistical inefficiencies, and prolonged disruptions in connectivity. Accurate time estimation is crucial for effective project planning, budget control, and optimal resource allocation. To address this challenge, this study develops a Multiple Linear Regression (MLR) model to predict construction duration for local road bridges, enabling stakeholders to make faster and more reliable decisions. The research analyzes 70 completed local road bridge projects, considering key variables such as bridge length, width, number of spans, substructure and superstructure types, project location, and actual construction duration. Using stepwise regression in SPSS, a predictive model was formulated with an $R^2$=0.545. Model validation yielded a Mean Absolute Percentage Error (MAPE) of 13.66%, demonstrating reasonable accuracy in duration forecasting. The findings can provide a practical tool for project planners, contractors, and policymakers to optimize scheduling, minimize delays, and enhance construction efficiency. By improving time management in bridge projects, this research aims to contribute to more sustainable infrastructure development in Nepal.

**Keywords:**

Construction Duration Estimation, Bridge Projects, Multiple Linear Regression

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# Assessing Key Factors Affecting Labor Productivity in Construction Site

*Sanish Maharjan* [a], *Mahendra Raj Dhital* [b], *Nagendra Amatya* [c]

**Abstract:**

The construction industry faces significant challenges due to inefficiencies in labor productivity, leading to project delays, cost overruns, and quality issues. This study proposes a comprehensive framework to identify and evaluate labor productivity on construction sites, with the aim of developing standardized measurement methodologies, identifying key influencing factors, and exploring the role of emerging technologies and motivational strategies. Using a mixed-methods approach, including surveys, interviews, and on-site observations, the research investigates factors such as worker skills, task complexity, and management practices. Statistical and thematic analyses are employed to derive insights. The outcome is a practical framework offering actionable recommendations to improve productivity and resource allocation, enabling data-driven decisions and enhancing project outcomes in the construction industry.

**Keywords:**

Construction industry, Labor productivity, Productivity measurement, Emerging technologies, Resource allocation

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# An Analysis of Association Between Project Size, Project Duration and Percentage Below Engineers estimate of Bridge Construction Projects in Nepal

*Sujan Shrestha* [a], *Shakil Manandhar* [b]

**Abstract:**

This paper analyzes the relationship between project size, project duration (Actual and Estimated), and percent below engineers estimate on the basis of historical data obtained from DOR for bridge construction projects in Nepal. Quantitative analysis is performed, where data are categorized as per contract size i.e. up-to 2 Crore and above 2 crore. Multiple regression analysis approach has been used to develop a relation between actual cost as dependent variable and percent below engineers estimate and estimated cost. And, relationship between those categories with time and cost overrun is developed. The results show that although larger projects have major delays despite more stable bid variations, smaller projects draw extremely competitive low bids but are finished on schedule. The relationship between bid deviation, time extension and cost overrun suggests that both parameters tend to increase with larger bid deviation. The study concludes low bidding impacts project's cost and time but its impact varies with project size. Therefore, necessity of process required for implementation of alternative bid selection method should be explored to resolve the issue brought forth by low bidding.

**Keywords:**

procurement, bid price, time Overrun,cost overrun, low bidding

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# Examining the Effectiveness of PPR Amendments in Ensuring Construction Project Completion Success Rates in Nepal: A Case Study of Postal Highway

*Anupras Niraula* [a], *Shakil Manandhar* [b]

**Abstract:**

Public procurement has a vital role in infrastructure development of Nepal, yet public construction projects often face delays. To address this, the Nepal government introduced the 12$^{th}$ and 13$^{th}$ amendments to Rule 120 of the Public Procurement Regulation (PPR), allowing greater flexibility in project time extensions. Rule 120 of the PPR outlines the procedure for contract extensions based on section 56 of the Public Procurement Act (PPA). This study evaluates the effectiveness of amendments on projects extended under 12$^{th}$ and 13$^{th}$ amendments to the PPR, specifically examining whether these changes have effectively improved project delivery rates. The research employs quantitative method to analyze project data from Department of Roads (DOR) Postal Highway Directorate examining project status, amendment applied for extension, total no. of extensions and delay days. Project completion rates under extended deadlines are assessed to determine whether the amendments facilitated successful project delivery or just prolonged delays. The study reveals that despite providing extensions, significant portion of projects still failed to meet extended deadlines. The low success rates of projects indicate time extensions by rule 120 of PPR is not sufficient to resolve project delays. The findings contribute to better understanding of how time extensions policies influence project outcome in Nepal.

**Keywords:**

Public Procurement, PPR Amendments Nepal, Rule 120 PPR, Project Time Extension, Project Success

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# Analyzing Competition with Bidding Trends and Relationships between Project Size, Number of Bidders and Percentage below Estimate in Public Construction Procurement

*Bhugol Khanal* [a], *Mahendra Raj Dhital* [b]

**Abstract:**

This study explores and analyzes bidding dynamics and project cost saving from competitive bidding through historical bid data within the public construction sector under National Competitive Bidding. Data from 530 public construction projects from Kathmandu Metropolitan City were analyzed to examine relationship between project size, number of bidders, and type of contractor (JV or solo) and cost savings relative to original engineers estimate. Data were analyzed using various methods such as descriptive statistics, normality tests, correlation matrices, regression models and visualizations. Key findings reveal growing construction market size in Kathmandu Metropolitan City while the average number of bidders with overall 5.76 bidders per tender and number of unique contractors remaining consistent over the years indicating the possible existence of barriers to enter into the market. Joint ventures (JVs) participation was found to be dominating in larger projects (72.88% above NRs 20 million) with sharp increase from prequalification threshold. Correlation analysis showed that the bid awarded to joint venture did not increase the cost discounts from estimate with a weak negative correlation (r=-0.096). Other findings from correlation showed larger projects attracting slightly more bidders, discounted bidding with increased bidder participation and minimal impact of project size on bid discounts. Regression analysis identifies a logarithmic model as the best fit ($R^2$=0.363), indicating diminishing returns in cost savings as the number of bidders increases. Overall, the study underscores the need for balanced bidder participation and policy adjustments to optimize competition, particularly for smaller contractors.

**Keywords:**

Public Construction, Bidding Dynamics, Bid Discounts, Prequalification, Bidders Participation

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# Assessing whether existing bid capacity formula restricts competition in Nepal's Public Procurement

*Bishwash Parajuli* [a], *Shakil Manandhar* [b], *Nagendra Bahadur Amatya* [c]

**Abstract:**

Public procurement plays a vital role in Nepal's economy, accounting for about 60% of the national budget. To ensure fairness and efficiency, the government uses a bid capacity formula to evaluate whether contractors have the financial strength and resources to complete projects. The bid capacity formula, amended in 11th amendment of Public Procurement Regulation coincided with a significant decline in bidders per project, raising concerns about its potential role in restricting competition. This study critically evaluates the impact of Nepal's new formula for bid capacity on public procurement competition. Through mixed-methods analysis, based on contractor data and analysis of government projects, we analyze whether the new formula restricts participation. Findings indicate that while most contractors meet bid capacity requirements, the regulatory restriction on project participation serves as a significant barrier to competition than the bid capacity formula. Furthermore, international comparisons highlight Nepal's formula as conservative compared to neighboring countries like India, Sri Lanka, Bhutan, and Bangladesh. The study finds that competition in Nepal's public procurement is more constrained by the five-project limitation than by the bid capacity formula itself. To enhance market participation, policy reforms should prioritize revising project allocation rules while considering a more dynamic bid capacity formula that incorporates project duration and recent financial performnace. Recommendations are proposed to align Nepal's procurement practices with international standards to promote fair competition and efficient resource allocation.

**Keywords:**

Public Procurement, Bid Capacity formula, Contractor capacity, Competition

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# Line Detection Algorithm

*Gulshan Bhagat Chaurasia* [a]

**Abstract:**

In order to obtain the 3D model from 2D images in my Masters Project "Object detection with 3D model reconstruction using machine learning", the 2D coordinates of the edges of the object need to be determined. Initially, the Hough line function of OpenCV was used, but it returned lines that were not aligned exactly with the edges returned by Canny Edge Detection. The accuracy of the 3D model depends on the accuracy of the 2D coordinates. Thus, an algorithm that could detect the end points of line segments on the Canny edges was required. In order to obtain lines from the canny edges, I came up with a new Algorithm for detecting lines with endpoint coordinates. Any line segment is made up of pixels. These pixels are joined in either horizontal or vertical direction, forming miniature horizontal or vertical lines. These miniature lines connected together form any horizontal, vertical, or oblique lines. Tracing those miniature lines, we can obtain the 2D coordinates of the end points of the lines on the Canny Edges. This is the basis of the proposed line detection algorithm explained in this paper.

**Keywords:**

line detection, edge detection, pixel, 2D coordinates

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# Accelerating Image Enhancement Through Advanced Layout Designs: A Performance Study of Fast ACE

*Suman Shrestha* [a], *Sanjeeb Prasad Panday* [b]

**Abstract:**

This study evaluates the performance of the Fast ACE (FACE) algorithm by designing and testing various layout structures. Fast ACE is an optimized version of the Automatic Color Equalization (ACE) algorithm, reducing its quadratic computational complexity to a linear one. This efficiency is primarily achieved through the layout structure, which determines how neighboring pixels influence a given pixel in an image. To further enhance Fast ACE, this research explores alternative layout designs, replacing the original structure to assess their impact on performance.

Experimental results reveal that layouts with linearly expanding rectangular regions achieve lower RMSE and $\Delta E$ values while yielding higher PSNR and SSIM scores, albeit at an increased computational cost. In contrast, layouts with exponentially expanding rectangular regions exhibit lower PSNR and SSIM values but reduce computation time, at the expense of higher RMSE and $\Delta E$ values. These findings suggest that linear layouts are preferable when prioritizing image quality, despite their higher computational cost. However, if reducing computation time is the primary objective and a slight trade-off in image quality is acceptable, exponential layouts provide a viable alternative.

**Keywords:**

Automatic Color Equalization, Computational Efficiency, Contrast Enhancement, Error-Bounded Approximation

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# Image Captioning in Nepali using CNN-Transformer Architecture

*Sagar Paudel [a], Sitaram Pokhrel [b], Prasant Adhikari [c], Nishchal Pokhrel [d]*

**Abstract:**

The advancement in the field of image recognition and language processing has been rapidly changing in the field of artificial intelligence. Despite improvements and results being analyzed in different languages, few works have been done in the context of the Nepali language and its relevant datasets. In this paper, CNN-Transformer architecture is used to analyze the datasets of images with its relevant Nepali captions. The model involves InceptionV3 and EfficientNet-B7 as the CNN pre-trained model while encoder-decoder architecture with attention mechanism is the novel approach to relatively unexplored areas in Nepali language. The model is trained on the Flicker8k datasets where the captions are generated by translating the English captions into Nepali using Google Translate. This paper contributes to Image captioning in the Nepali Language. BLEU-1 and METEOR have used metrics with results of 0.583 and 0.382 respectively. Further work will emphasize large efficient Nepali datasets and enhanced algorithms.

**Keywords:**

Inceptionv3, EfficientNetB7, Transformer, Image Captioning in Nepali, Flickr8k, BLEU, METEOR

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# A Comprehensive Study on Addressing Source Target Domain Mismatch in Segregation of Fruits Using Deep Neural Network

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**Abstract:**

Fruit detection, classification, and grading are essential for industrial sorting, quality assessment, and automated harvesting. Traditional machine learning approaches often face challenges in real-world environments due to variations in lighting, background clutter, and fruit occlusions. To address these limitations, this study presents a deep learning-based framework that integrates fruit segmentation and classification into a single pipeline, ensuring efficient and accurate processing.

The proposed system utilizes Mask R-CNN for instance segmentation, enabling precise fruit localization and separation from complex backgrounds. Following segmentation, ResNet is employed as a feature extractor and classifier, effectively distinguishing different fruit categories. The model is trained on a diverse dataset to enhance its ability to generalize across various environmental conditions and fruit appearances.

The performance of the system is evaluated using precision, recall, F1-score, and classification accuracy, demonstrating high reliability in fruit identification. This research provides a scalable and efficient solution for automated fruit sorting and grading, contributing to advancements in agriculture, food processing, and industrial automation.

**Keywords:**

Deep Learning, Fruit Segmentation, Mask R-CNN, ResNet, Domain Adaptation

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# Nepali Handwriting Word Synthesis using a Progressive GAN

*Dhruba Thapa [a], Ramesh Thapa [b], Santosh Pantha [c], Surendra K C [d]*

**Abstract:**

The advancements in deep learning, particularly Generative Adversarial Networks (GANs), have significantly improved image synthesis capabilities. This research focuses on generating Nepali handwritten words using Progressive GANs trained on Devanagari script. The model utilizes a deep convolutional architecture, progressively refining image quality through multiple upsampling layers. The dataset consists of Nepali 95K IIIT-HW-Dev handwritten words ensuring diverse character generation.

The generator network employs transposed convolutional layers with batch normalization and Leaky ReLU activation, generating images from a 100-dimensional latent space initialized with noise. The discriminator, designed with progressive convolutional layers and dropout, classifies real and synthetic samples. The model is trained adversarially, optimizing both networks simultaneously using binary cross-entropy loss and Adam optimizer.

**Keywords:**

Generative Adversarial Networks (GAN), Devanagari Script, Latent Space

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# Ranjhana Lipi Handwritten Character Generation Using Conditional Generative Adversarial Network

*Nagendra Lal Karn* [a], *Subodh Nepal* [b]

**Abstract:**

Ancient scripts like Ranjana Lipi must be preserved and digitised in order to preserve culture and history. This study uses Conditional Generative Adversarial Networks (cGANs) to generate handwritten Ranjana Lipi characters in an innovative way. Spoken words can be smoothly converted into written script thanks to the model's ability to synthesise handwritten characters of superior quality conditioned on voice input. The process includes training deep learning models, such as VGG16, ResNet50, and InceptionV3, for quality assessment and recognition after augmenting the dataset via rotation, flipping, and scaling to increase variety. The suggested method exhibits identification accuracy of 88.00%, precision of 90.12%, recall of 86.35%, and F1-score of 88.20%, while achieving a structural similarity index (SSIM) of up to 0.5501. The findings show that while maintaining computational economy, cGANs are capable of producing realistic handwritten Ranjana Lipi characters. This study broadens the use of deep learning in linguistic and cultural heritage conservation while also aiding in the preservation of digital scripts.

**Keywords:**

Ranjana lipi, Deep Learning, Handwritten Character, cGAN

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# Hybrid MPPT for PV Converter: Integrating Long Short-Term Memory (LSTM) Networks with Perturb and Observe (P&O) Technique for Real-Time Optimization

*Rachhak Shahu* [a], *Yuba Raj Adhikari* [b]

**Abstract:**

Solar PV generation has significant role in charging the battery, helping in grid tied application and so on. To strengthen the output power of a solar photovoltaic arrangement, it is crucial to obtain the maximum possible energy output from the photovoltaic panel. The research targets an analysis of MPPT control in PV converter systems through the combination of P&O method with LSTM networks for tracking the maximum power points. The hybrid method combines the predictive capability of LSTM networks to handle the sequential data with the simple and stable features of the P&O technique. The aim of this research is to design a hybrid LSTM-P&O MPPT algorithm evaluating its performance in changing environment conditions like fluctuating irradiance and temperature. Performance assessment of the proposed methodology includes training the LSTM model using the historical data and simulation testing of the proposed design for different irradiance conditions. It is found that the proposed hybrid LSTM-P&O MPPT algorithm is able to track the maximum power point efficiently under changing environmental conditions and also performs better than the traditional MPPT method P&O.

**Keywords:**

LSTM, MPPT, Hybrid MPPT, P&O, Photo Voltaic System, Artificial Intelligence (AI), Machine Learning (ML)

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# Sensor-less Commutation of Brushless DC Motor Based on Zero-Crossing Detection of Line Voltage Differences

*Aashish Acharya [a], Devara Vijaya Bhaskar [b], Jeetendra Chaudhary [c], Madhusudan Nyaupane [d]*

**Abstract:**

In this paper, an electronic commutation strategy for Permanent Magnet Brushless DC motors without using position sensors is presented. Harnessing the difference of the line voltages measured across stator terminals, the proposed method precisely senses the zero-crossing instants of the back-electromotive forces indirectly by detecting their change in polarities with time as the motor rotates. This information is processed to generate appropriate switching pulses for the inverter switches, which in turn, facilitates electronic commutation without the need for position sensors. Furthermore, the method used omits the need for the motor neutral potential and does not involve mathematical steps such as derivatives and integrations. The validity of the method is examined in MATLAB Simulink where the results verify its accuracy and robustness describing the expected electrical and mechanical characteristics of the motor. The key contribution of the paper is proposing a less redundant design and improving the reliability of motor commutation through the replacement of the physical position sensors with virtual ones.

**Keywords:**

Brushless DC (BLDC) motor, sensor-less commutation, back-electromotive force (EMF), zero-crossing point (ZCP), Pulse Width Modulation (PWM)

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# High-Efficiency Gallium Nitride-Based LLC Resonant DC-DC Converter for Electric Vehicle Charging Systems

*Amrit Ghimire [a], Jeetendra Chaudhary [b], Rajesh M. Pindoriya [c]*

**Abstract:**

This article presents the design and analysis of a isolated LLC (Transformer Primary Inductor, Magnetizing Inductor and Capacitor) resonant DC-DC converter for electric vehicle (EV) charging application. It includes a Power Factor Correction (PFC) converter unit as a power supply module to the DC-DC converter. Single phase 220 Volts 50 Hertz supply is provided to the critical boost PFC unit, which rectifies and boost the voltage level to 400 Volts DC output which is supplied to the DC-DC converter where a half-bridge inverter modulates it to square-wave signal with frequency of 110 kHz. The alternating signal is passed through the LLC resonant network in combination with High Frequency Transformer (TFT). The secondary side is connected with rectifier circuit and to the output terminal which records a voltage of 12 Volts in average. The emerging revolutionary semiconductor Wide Band Gap (WBG) device Gallium Nitride (GaN), GS16616T is implemented as switching device which has high operating voltage of 650 Volts, good thermal performance and very high switching frequency (MHz range). The half-bridge inverter is put in practice to facilitate natural Zero Voltage Switching (ZVS), this helps to reduce the switching loss, is cost-effective, enhances power density of the converter and above all enhances the overall efficiency of the converter.GaN based switching converters result in a superior substitute for traditional converters using Silicon based switches. This design and the simulation work attains a peak efficiency of 95.887%.

**Keywords:**

Electric Vehicle Charging, LLC Resonant Network, DC-DC converter, High Frequency Transformer, High Power Density, Wide Band Gap Devices, Gallium Nitride

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# Discrete Wavelet Transform Based Fault Distance Estimation Scheme For Transmission Line

*Ranjit Kumar Sah* [a], *Basanta Kumar Gautam* [b]

**Abstract:**

This paper describes a fault location estimation technique for transmission line based on the Discrete Wavelet Transform (DWT). The method is based on wavelet-scale-based signal processing in order to extract fault data from current signals and a decision tree classifier for more accurate estimation. The algorithm,validated in simulation under a wide range of faults, provides accurate estimates with small error, which contributes to enhanced power system stability and faster fault restoration. The algorithm has been tested on the IEEE-9 bus system and also implemented in Integrated Nepal Power System(INPS).

**Keywords:**

Discrete Wavelet Transform, Fault Distance Estimation, Classification Tree

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# Voltage Impact Analysis for VSC-Based DGs Connected to the Primary Distribution System

*Upendra Bhattarai* [a], *Sujan Adhikari* [b]

**Abstract:**

This paper investigates the voltage regulation challenges posed by Voltage Source Converter (VSC)-based Photovoltaic (PV) Distributed Energy Resources (DERs) in primary distribution systems, focusing on voltage rise and rapid voltage changes (flicker). Utilizing the IEEE 8500-node test feeder, the study analyzes the impacts of PV placement (near the substation, $G_{NS}$, and far from the substation, $G_{FS}$), loading conditions (Peak, Normal, and Off-Peak), and feeder impedance (R/X ratio) under steady-state conditions. Key findings reveal that voltage rise is most severe during Off-Peak loads at $G_{FS}$, reaching 130.15 V and exceeding ANSI C84.1 limits, while flicker peaks at 10.85% under Peak loads at $G_{FS}$, breaching IEEE Std 1547-2018 thresholds. The analysis highlights the heightened vulnerability of $G_{FS}$ due to higher R/X ratios (0.55 versus 0.19 at $G_{NS}$), underscoring the importance of PV placement and loading conditions in grid stability. These insights recommend interconnecting DERs closer to substations to lower the chances of voltage disturbances in the primary distribution system.

**Keywords:**

Voltage Source Converter (VSC), Distributed Energy Resources (DERs), Distributed Generations (DGs), Photovoltaic (PV) Systems, Battery Energy Storage Systems (BESS), Voltage Rise, Voltage Flicker, Rapid Voltage Change (RVC), Volt-VAR Optimization (VVO), Smart Inverter Control, Primary Distribution System, Power Quality, Reactive Power Control, Point of interconnection (POI), IEEE 8500-Node Test Feeder.

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# Design and Anticipated Performance of Proposed 10 MW Solar Power Plant

*Sanjeev Kunwar* [a], *Mrigendra Mahara* [b], *Padam Bahadur Thapa* [c]

**Abstract:**

The limited presence of fossil fuels and their impact on global climatic change has uplifted the development of the renewable energy sector. The number of hydropower, solar, and wind plants is rapidly growing globally. Nepal, currently dominated by hydropower, aimed to increase the number of solar plants to reduce power outages in the winter season and prevent the threat of energy security. Due to the abundant sunlight, cost-effective construction, and predictable energy source; solar energy is an optimal alternative to maintain stable energy production. The aim of this paper is to provide a conventional procedure followed during the design of a grid-connected solar plant. A plot of land in the Khairahani municipality is taken and its irradiance and temperature data are used to simulate in PVsyst along with a suitable tilt angle and shadow analysis that provides monthly electricity generation and performance analysis that can be anticipated from the plant. The simulation also provides loss analysis and calculates the final amount of energy that can be injected into the grid. The paper also outlines the layout of the solar plant from the source of energy to the conversion of electricity and the point of termination where electricity is supplied through the transmission line. The plant operates at an annual ambient temperature of 24.95°C. Although the annual effective energy produced by the array (Earray) is 17.188 GWh; due to several losses, only 17.009 GWh (Egrid) is annually injected into the grid. Similarly, the overall performance ratio (PR) of the proposed plant is 81.9% which indicates that the plant operates with an efficient system performance.

**Keywords:**

Grid-connected solar plant, PVsyst, Single line diagram

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# Flood Fragility Analysis of RC Residential Building

*Kalyan Adhikari* [a], *Rabindra Adhikari* [b]

**Abstract:**

Nepal's diverse topography and monsoon-driven climate make it highly susceptible to frequent and severe flooding, leading to substantial structural damage in urban and rural areas. Recent floods in Melamchi and Kathmandu have exposed the vulnerability of Reinforced Concrete (RC) residential buildings to flood-induced forces, necessitating a systematic fragility analysis. This study evaluates the structural performance of a 3-story RC residential building under varying flood conditions using empirical data and advanced modeling tools such as ETABS. The analysis considers flood heights ranging from 0.5m to 6m in 0.5m intervals, assessing the impact of hydrostatic and hydrodynamic forces on infill walls, columns, and foundations. Key damage mechanisms, including column failure, infill wall collapse, and overturning due to foundation scour, are investigated. A fragility curve is developed to quantify the probability of structural failure at different flood intensities. The study integrates relevant design codes, including IS 456:2000 for concrete structures and FEMA Hazus guidelines for flood load considerations, ensuring methodological reliability. The findings contribute to improving flood resilience strategies and guiding safer construction practices for RC buildings in flood-prone regions of Nepal. Fragility curves were developed following the FEMA Hazus Tsunami guideline and 3 damage states were defined; Moderate damage, Extensive damage and Complete Damage to obtain the probability of exceeding certain damage state on varying flood conditions. With variation in inundation depth, the probability of exceeding Moderate, extensive and complete damage states for 3 story RC residential building with two story inundation (6m) is 75%, 48% and 36% respectively.

**Keywords:**

Flood fragility, Reinforced Concrete (RC) buildings, hydrostatic force, hydrodynamic force, foundation scour, structural vulnerability, fragility curve, Nepal floods, FEMA Hazus Manual, ETABS modeling, flood resilience

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# Performance of Outrigger Building System due to Axial Shortening Effects

*Saugat Upreti* [a], *Gokarna Bahadur Motra* [b], *Prem Nath Maskey* [c]

**Abstract:**

In case of urban areas, like Kathmandu, where land area is limited and population residing is growing every year, there is no option but to go for vertical expansion of building, with sufficient livable space. As chances of occurrence of large earthquake in Nepal is high, tall building has to be structurally safe and serviceably livable. As the structure gets taller, ensuring the stability and performance becomes increasingly complex. Among the various structural systems employed to enhance the performance of tall buildings, the outrigger system stands out for its effectiveness in improving lateral stiffness and reducing structural sway. Due to the fact that horizontal displacement of high rise building increases with increasing height, there has to be some solution to limit displacement and drift to acceptable limit as specified in different building code like NBC: 105-2020, American Building code, IS1893-2016. Provision of outrigger system at certain location could be an option for this. A number of past researches have shown that use of outrigger system is an option for high rise to control seismic drift. However, axial shortening effects, due to time-dependent properties of concrete, are very likely to lead to a large amount of force concentration at the outrigger junction demanding a very large outrigger section, making the system uneconomic. Causes of axial shortening of concrete may be due to the following three phenomenon: Elastic Shortening, Shortening due to Creep and Shrinkage. Various numerical finite element modeling of the building has been carried out using ETABS 2019, in order to capture the time-dependent behavior of the overall building system. For this a comprehensive Non-linear Construction Sequence Analysis feature in ETABS has been carried out. It is observed that taking axial shortening effects into account, the intensity of force accumulation on the RCC outriggers at long term is very high in comparison to the system avoiding the shortening effects.

**Keywords:**

Outrigger, Axial Shortening, Elastic Shrinkage, Creep, Shrinkage

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# Investigation of Bridge Responses and Differential Settlement Subjected to Dynamic Excitation

*Suraj Shrestha* [a], *Hare Ram Parajuli* [b]

**Abstract:**

A study has been carried out to investigate the structural responses, stresses and differential settlement in bridge foundation considering soil pile interaction under earthquake motion. Using OpenSEES programming platform, three dimensional finite element model of bridge system is developed. Non-linear spring element is used in the model to simulate pile soil interaction. Twelve different ground motions are selected on the basis of spectral shape comparable to the target response spectrum. Acceleration time histories of those selected earthquake ground motions are normalized after matching them with the design spectrum recommended by NBC 105:2020. The normalized acceleration time histories along with their vertical component is applied to the FE model of bridge scaling the motion from 0.025g to 1.5g. The responses of the incremental dynamic analysis have been recorded in terms vertical displacement of the foundation, lateral displacement, curvature and stress in the pier and pile and compared them with the result obtained from bridge structure considering rigidity at the pile base. It is found that the pile foundation undergo notable settlement due to seismic effect and the stresses absorbed in the pier is comparatively more in the model considering rigid base than in the flexible base making it more susceptible to undergo plastic deformation causing failure of the structure.

**Keywords:**

Pile Foundation, Settlement of Foundation, Dynamic Analysis, Performance Based Earthquake Engineering, Incremental Dynamic Analysis, Nonlinear Element

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# Response Modification Factor (R) for RC Bridge in Mountainous Region of Nepal

*Badal Budha [a], Jagat K. Shrestha [b], Nitesh Bhandari [c]*

**Abstract:**

The majority of the bridge design uses different versions of codes derived in other countries. Response modification factors (R) recommended for usage in these codes are primarily for bridges derived from conditions and bridges in those countries. In this research we intend to derive R -factor for Nepali Mountainous conditions. Three real Bridge Model will be studied with the help of CSI Bridge 2023 software. Non-linear static pushover analysis is performed to derive seismic capacity curves for these bridges, which are used to compute response modification factors. The average R factor is calculated for the bridges in the longitudinal and transverse directions. The results of this work may serve as input in developing the seismic design code of bridges in Nepal.

**Keywords:**

Response modification factors, Pier, CSI Bridge, Pushover analysis, Seismic design code

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# Comparative Multi-Objective Optimization of Pratt, Howe, and Warren Truss Bridges for a 60m Span Using Genetic Algorithms

*Nripesh Poudel* [a], *Rajan Suwal* [b]

**Abstract:**

Truss bridges are popular because of efficiency of material use and high load-bearing capacity, but still optimization under competing constraints is a challenging job. This study tries to employ integration of Finite Element Modeling(FEM) in ANSYS and Multi-Objective Genetic ALgorithm(MOGA) to compare the performance of Pratt,Howe and Warren truss bridges for a constant span of 60m. The optimization objectives consist of minimizing mass adhering to safety and serviceability constraints. Cross-section of top chord is modeled as I-section while diagonals and verticals are modeled as channel section. Use of symmetry and parametric modeling reduces computational complexity. Results indicate Pratt Truss having lowest optimized mass and lowest compressive stress. Similarly, Warren truss exhibits superior performance in tensile stress and deflection because of effective triangulation and provision of redundant load paths. Howe truss having compressive diagonals that are prone to buckling didn't perform best in any of these criteria. The trade-offs obtained from this findings include that Pratt is best in economic design and out of the optimized sections, Warren performs best in stiffness and stress distribution while Howe lags in performance due to inefficient compressive paths. This study uses MOGA's effectiveness while handling various discrete variables and non-linear constraints for optimization of truss bridges. Future work could contain various hybrid algorithms and cloud-based scalability. This research helps in providing insights to designers prioritizing economic and astructural performance criteria in bridge design.

**Keywords:**

Truss optimization, Genetic algorithm, Finite element analysis, Structural performance, Multi-objective optimization

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# Pounding Effect on Adjacent Reinforced Concrete and Steel Framed Structure

*Binaya Thakali*[a], *Sujan Tripathi*[b]

**Abstract:**

A thorough evaluation exists on the seismic pounding consequences that develop between neighboring reinforced concrete (RC) and steel frame structures. The research implements ETABS 21 software to analyze multiple building adjacency scenarios which include 3-story RC with 3-story steel as well as 6-story RC with 3-story steel and 3-story RC with 6-story steel structures. The research performed networked nonlinear analysis of time history events by applying spectrally matched ground motion records from the 2015 Gorkha, 1995 Kobe and 1999 Kocaeli earthquake series. Pounding forces cause dramatic changes in adjacent structure dynamics during earthquakes according to the separation distance between 0 to 100 mm. This analysis shows different results based on building heights and material types. The research establishes minimum required seismic separations needed for pounding control and evaluates different response scenarios between concrete and steel structures with various spacing configurations. This study advances seismic pounding knowledge of structurally different building systems in proximity while assisting designers to develop improved approaches for urban buildings

**Keywords:**

Structural pounding, Separation distance, Dynamic response, Nonlinear analysis

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# Feature Analysis of Key Parameters Influencing Groundwater Levels in Bara, Nepal

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**Abstract:**

Groundwater is a vital resource globally. However, exploitation in unsustainable manner to meet industrial demand, intensive irrigation, municipal and increasing population demand resulting in depletion of groundwater level. Feature analysis shows the good relation between groundwater and other parameters like climate parameters, landuse landcover, population demand and irrigation demand for bara district. The study conducted to analyze groundwater monitoring data of three years and satellite extracted data-Land use land cover, Land surface temperature for spatial trend over the years. Moreover, the study majorly focuses on feature analysis of above key parameters influencing groundwater levels in Bara District using Random Forest (RF) machine learning techniques. Understanding Groundwater levels are crucial for sustainable water management for bara which is one of mostly dependent madhesh district in groundwater for different purpose. fluctuations influenced by LULC, climate, population, and irrigation trends The Random Forest model revealed that groundwater levels are significantly influenced by land use changes, climate change, population water demand, and irrigation demand. The most important factors identified is Land Surface Temperature (40.12 percent), followed by Irrigation Area (11.09 percent) and Water Bodies (10.88 percent), highlighting the impact of both climatic and human-induced factors on groundwater dynamics. Other key contributors included Average Monthly Rainfall (10.38 percent) and Built-up Area (10.24 percent). The model's performance, with an R-squared ($R^2$) score of 0.7272, suggests that about 73 percent of the variance in groundwater levels is explained by these factors. The Mean Absolute Error (MAE) was 0.1825 meters, with an RMSE of 0.2185 meters, demonstrating the model's effectiveness in predicting groundwater.In conclusion, this study highlights the key parameters responsible for groundwater fluctuation using machine learning. However, The limited dataset may have affected the model's accuracy and generalizability, and its performance could improve with more extensive data.

**Keywords:**

Groundwater level, Random forest, Feature importance, LULC, Machine learning

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# Design and Simulation of a Complete Mix Activated Sludge System for Itahari Sub-Metropolitan City Using GPS-X Software

*Sudesh Limbu* [a], *KajiRam Karki* [b], *Yugdeep Luitel* [c]

**Abstract:**

The rapid urbanization of Itahari Sub-Metropolitan City in Nepal has led to escalating wastewater management challenges due to insufficient infrastructure, contributing to environmental degradation and public health risks. To address these issues, this study aims to design and simulate a Complete Mix Activated Sludge (CMAS) system tailored for the city's needs using GPS-X software. The parameters tested for samples were Total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia nitrogen. The results showed that the values of TSS,BOD,COD and NH4-N in the effluent wastewater were;11.4 mg/l,5.088 mg/l,18.87,and 0.4012 mg/l respectively for base model.These values of effluent wastewater were with the acceptable limits of Nepal effluent standard values(i.e TSS¡60 mg/l and BOD¡50 mg/l). The findings indicate that the CMAS system, when properly implemented, could substantially mitigate the environmental impact of urban wastewater in Itahari, offering a replicable model for similar urban centers in Nepal.

**Keywords:**

Itahari Sub-Metropolitan City, Complete Mix Activated Sludge (CMAS) System, GPS-X Software,Simulation,Mathematical Modeling,Biochemical Oxygen Demand (BOD),Chemical Oxygen Demand (COD),Total Suspended Solids (TSS)

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# PET-dust bricks: A Sustainable Approach to Solid Waste Management

*Nitesh Thakur [a], Sweta Shrestha [b], Bidur Aryal [c], Suvarna S. Raut [d], Sishir Dahal [e]*

**Abstract:**

Polyethylene Terephthalate (PET) waste and air borne particulate matter are significant causes of environmental contamination in urban areas. The suspended particles settle down after a certain time forming dust. The study investigates the potential use of PET waste along with broomed dust of Kathmandu Metropolitan City (KMC), Nepal to manufacture bricks (PET-dust bricks) and their engineering properties. Brick samples with dimensions 240 mm×115 mm×57 mm with size variations within ±10% were prepared using PET waste melted at 250℃ and mixed continuously with gradual addition of broomed dust in 1:2, 1:3, and 1:4 ratios by weight. The bricks were compacted through manual compaction by tamping and cured for 8 hours. Among the compositions examined, the 1:3 PET-dust brick had optimal performance with minimum water absorption (0.653%), lowest weight (2.371 kg), and highest compressive strength (24.457 N/mm$^2$) and therefore proved to be superior to regular high-quality clay bricks. The research proves that PET-dust bricks have the capability to serve as an eco-friendly substitute for building construction and thereby support efficient waste management techniques and minimize environmental pollution. Cost-effectiveness and life-cycle assessment are areas that require future study.

**Keywords:**

PET plastic, broomed dust, sustainable construction, solid waste management, compressive strength

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# A Geospatial Approach To Soil Erosion And Sediment Yield In The Seti Gandaki River Basin, Nepal: A Case Study of Madi Watershed

*Sambridhi Karki [a], Aditya Dhakal [b], Bishnu Prasad Shrestha [c], Saroj Kumar Yadav [d]*

**Abstract:**

Soil erosion and sediment yield are two serious global issues that has detrimental effect in environment. Soil erosion in Madi Watershed and sediment deposition in Seti Gandaki river basin has negative effect in ecosystem. Madi river basin is mainly characterized by steep slopes, fragile geometry and intense monsoon rainfall which makes it easily prone to soil erosion. The RUSLE and Sedimentary delivery ratio (SDR) model were integrated with ArcGIS and remote sensing to estimate soil erosion in Madi watershed. The spatial variability of soil erosion exposed due to slope, soil types and different land use and land cover was computed using RUSLE, digital soil map and ArcGIS. The result obtained from RUSLE model indicated that Madi Watershed experiences spatial variability in soil loss, with annual loss between 0 and 193.91 ton/ha/yr. Agriculture and forest were primary contributors for soil erosion according to land use. The western part of watershed experienced high intensity rainfall (1497 MJ/mm/ha/h/yr) making it highly erosive. The soil BD with areal extent of 634.58 Sq. Km in Southern part was highly susceptible to soil erosion. The Sediment yield delivered to Seti Gandaki river basin was 0-172.77 ton/ha/yr, which is 89% of the total soil loss. The result of study demands the need for effective soil conservation practices particularly in areas with minimal vegetation cover and steep slopes. This research becomes source for future studies on soil erosion and sediment flux in watershed of Himalayan region.

**Keywords:**

BD: Dystric Cambisols, I: LITHOSOLS, BK: Calcic Cambisols, Dystric Gleysol SL: Soil Loss, SDR: Sediment Delivery Ratio, SY: Sediment Yield

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# Activated Carbon from Jacaranda Seed Pods for Energy Storage

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**Abstract:**

Activated carbon (AC) is a multifunctional material widely used in various applications such as energy storage, water purification, skincare, and other industrial operations. Locally available biowaste is a low-cost resource for AC. This study focuses on synthesizing AC from Jacaranda Seed Pods (JSP) - lignocellulosic biomass and testing its electrochemical properties. JSP powder was activated using phosphoric acid at 850 °C. As-prepared AC was characterized via Field Emission Scanning Electron Microscopy (FESEM) and Fourier transform Infrared Spectroscopy (FTIR). Additionally, electrochemical properties for energy storage were tested with Cyclic Voltammetry (CV) and Galvanostatic Charging Discharging (GCD). The FESEM image verified the prepared activated carbon is highly porous. The electrochemical study shows that as-prepared AC exhibits good energy storage capacity. Hence, activated carbon prepared from JSP could be a promising candidate for energy storage applications.

**Keywords:**

Activated carbon, biowaste, Jacaranda, electrochemical study, energy storage

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# Malware Classification in a Multicontroller SDN Environment

*Utkarsha Shukla* [a], *Binod Sapkota* [b]

**Abstract:**

With the rapid advancement of the Internet of Things, the number of connected devices and their applications has grown exponentially. This expansion has also led to an increase in the frequency and sophistication of malware attacks, posing significant security and network management challenges. Traditional solutions often struggle to adapt to evolving threats and dynamic network conditions, necessitating more intelligent and autonomous approaches.

This paper proposes a comprehensive framework that integrates Q-Learning for dynamic load balancing and REINFORCE, a policy gradient reinforcement learning algorithm, for adaptive malware mitigation in Software-Defined Networking enabled Internet of Things environments. Q-Learning optimizes resource allocation by dynamically balancing network loads in real-time, preventing congestion and ensuring efficient data flow.The REINFORCE algorithm adapts to emerging malware patterns, refining its policy based on network behaviors to enhance classification and strengthen defense mechanisms in dynamic environments.

By combining these reinforcement learning techniques, the proposed framework enhances both security and network efficiency, ensuring a swift response to malicious activities while maintaining network stability and integrity. This research aims to demonstrate the effectiveness of reinforcement learning in automating and optimizing both load balancing and malware classification, ultimately reinforcing the resilience and security of IoT infrastructures. The experimental results confirm the effectiveness of the approach, with the proposed algorithm attaining an accuracy of 0.93.

**Keywords:**

Internet of Things,Q-Learning, REINFORCE Algorithm, Reinforcement Learning, Software-Defined Networking

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# Web Attack Detection and Classification using Long Short Term Memory

*Prayash Mishra* [a], *Niraj Neupane* [b], *Ashim Karki* [c], *Aarati Mahato* [d], *Nabin Lamichhane* [e*]

**Abstract:**

Due to the increased use, dependency and popularity in everyday tasks, web applications are frequently targeted by hackers and malicious attackers. These systems are not perfectly fail-safe in nature and their inherent vulnerabilities can lead to unauthorized access to personal, financial and other sensitive information. Hackers can use common attack techniques like Cross-site scripting (XSS) on legitimate or trusted websites, SQL Injection(SQLi), Shell injection, Server-Side Request Forgery (SSRF) and so on to exploit various data. Artificial Intelligence (AI) makes it easier for hackers to create sophisticated attacks and create advanced payloads. For the defensive measure, A Long Short-Term Memory (LSTM) based model can effectively and accurately detect and classify different types of web attacks, with its ability to analyze long sequences of textual data with special symbols and characters. Our model achieved high accuracy of 99.12%, precision of 99.27%, recall of 99.25%, and an F1-score of 99.26% with a cross-entropy loss of 0.0351. LSTM has performed very well in detection and classification of web attacks. For the future improvement, the model can be deployed to filter HTTP requests before they reach the main server, with potential improvements through more diverse data and handling multiple types of HTTP requests.

**Keywords:**

SQL, XSS, SSRF, AI, LSTM, HTTP

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# Network Intrusion Detection System With Cross-Domain Adaptability Using BERT Masked Language Model

*Ritu Ratnam* [a], *Bibha Sthapit* [b]

**Abstract:**

Intrusion Detection Systems (IDS) are crucial in identifying and mitigating potential threats to network security. Conventional Network Intrusion Detection Systems (NIDS), often based on Machine Learning (ML) algorithms, have been widely used for detecting intrusions by analyzing network flows. However, these systems typically face challenges when applied across different domains due to poor adaptability. In this project, we propose the development of an advanced NIDS with cross-domain adaptability by leveraging the sequence of flows in network traffic. This approach makes use of natural language processing (NLP) techniques using the Bidirectional Encoder Representations from Transformers (BERT) framework, to model sequences of network flows and capture the contextual relationships between them. The project utilizes BERT's powerful sequence modeling capabilities, leveraging hybrid attention model, to improve its ability to adapt to varying domains without significant performance degradation. The project compares the performance of the model under two different sequence lengths of 128 and 256 and demonstrates an F1 score of 85.88% and 86.77% respectively for the two sequence lengths.

**Keywords:**

Intrusion Detection System, Cross-Domain Adaptability, BERT, Sequence of Flows, Hybrid Attention

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# Adversarial Attacks on Malware Classification Models

*Gita Gurung [a], Hari Prasad Pokhrel [b], Umesh Kanta Ghimire [c], Bhupendra Gurung [d]*

**Abstract:**

It is important to know that no one is immune, and everybody could be infected from specialists to end users. One kind of cyberattack that is getting more frequent every day is malware. The conflict between security researchers and malware developers never ends since malware is evolving at a rapid pace due to advancements in technology. In recent years, Vision Transformers has shown impressive performance in a range of computer vision applications, such as malware classification. Despite their performance, ViTs remain vulnerable to adversarial attacks, which pose significant security risks. In this research, we designed a model for generating adversarial samples against a vision transformer based malware classification model. Two adversarial attack methods, FGSM and PGD, are used to produce adversarial examples.The experiment highlights how vulnerable malware classification models are to adversarial attacks, as evidenced by the significant accuracy drops shown: just 21% accuracy with the PGD attack and 30% accuracy with the FGSM accuracy attack, in comparison to the baseline accuracy of 80%. The research demonstrates that ViTs' classification accuracy is significantly decreased by both FGSM and PGD, underscoring the vulnerability of these models to adversarial perturbations.

**Keywords:**

Adversarial Attacks, FGSM, PGD, Malware classification, ViT

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# URL Based Website Phishing Detection System Using SVM, KNN and XGBoost Algorithms

*Nanumaya Kafle* [a], *Subarna Shakya* [b]

**Abstract:**

Phishing attacks target people and organizations in an attempt to acquire sensitive data that poses a danger to cybersecurity. Phishing is a growing cybercrime that exploits the widespread use of the internet and its applications. It involves creating fake websites that mimic legitimate ones to deceive users into revealing sensitive information. The goal of this project is to create a system that uses cutting-edge machine learning algorithms specifically Support Vector Machine (SVM), K-Nearest Neighbors (KNN) and XGBoost algorithm to detect phishing URLs effectively. This study utilizes a dataset of 11055 samples with an 80:20 split for training and testing. The main objectives are to identify and categorize URLs as authentic or phishing and to compare the performance of SVM, KNN and XGBoost models and find out the best model. The results indicate that XGBoost outperformed the other models, achieving a top accuracy of 97.2%. These models were evaluated using metrics including accuracy, precision, recall and F1-score also comparing the model with cross-validation accuracy plot and accuracy, precision, recall and f1-score data.

**Keywords:**

Phishing detection, Machine Learning, Support Vector Machine, K-nearest neighbors, XGBoost, URL Classification

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# Multimodal Approach For Malware Classification

*Sachin Koirala [a], Sajal Poudel [b], Unique Shrestha [c], Utsav C. Kayastha [d], Anku Jaiswal [e]*

**Abstract:**

Malware analysis and detection are critical in cybersecurity to mitigate evolving threats. This research proposes a multimodal approach to malware classification by integrating static and dynamic analysis techniques. The method involves extracting byte-level data from malware samples and converting it into images for feature extraction using Convolutional Neural Networks (CNNs). Simultaneously, API call sequences are extracted and analyzed to capture behavioral patterns. The extracted features from both modalities are then fused to enhance classification performance. A deep learning-based classification head is employed to determine whether a given sample is benign or malicious. This approach leverages the strengths of image-based and sequence-based malware representations, improving detection accuracy and robustness against obfuscation techniques. The model presented in this paper achieves an accuracy of 84%, precision of 84%, F1-score of 84%, and Recall of 83%.

**Keywords:**

Malware analysis, Static analysis, Dynamic analysis, Convolutional Neural Networks (CNNs), API call sequences, Multimodal approach

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# Gap Acceptance Behavior of Two wheelers of Minor Road at Unsignalised T-Intersection under mixed traffic condition: A Case study of Pulchowk Intersection

*Aashray Mahat [a], Rojee Pradhananga [b]*

**Abstract:**

Gap acceptance is a key component of microscopic traffic characteristics, used to determine capacity and delay at uncontrolled intersections. It defines the extent to which drivers utilize a gap of a specific duration. Most studies on critical gap estimation have been conducted in developed countries with homogeneous traffic and adherence to priority rules. However, in developing countries like Nepal, heterogeneous traffic and weak priority rules create conflicts at intersections. This study analyzes the gap acceptance behavior of minor road two-wheeler drivers at an unsignalized T-intersection in Pulchowk, Lalitpur. Data was collected for three hours (8-11 AM) through videography. The straight-going flow was considered the major stream, while others were minor. Two methodologies were used to determine the critical gap, assuming independence between the arrival times of minor and major stream vehicles. The critical gap obtained from Raff's definition was 4.4 seconds, while the Clearing Behavior Approach (CBA) resulted in 5.7 seconds. Aggressive behavior of minor stream vehicles attempting to merge into the major stream was also analyzed. Gap acceptance behavior was compared based on gender, age, clearance time, aggressiveness, and gap/lag using a logistic regression model. A cumulative percentage plot showed aggressive drivers required less gap for right turns than ideal drivers. The developed logit model revealed the probability of gap acceptance varies with significant variables, including age, gap duration, lag, and major traffic speed.

**Keywords:**

Two wheelers; Gap Acceptance; Clearing Behavior Approach(CBA); Critical Gap; Raff;s Method; Unsignalised Intersection.

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# Evaluating Pelican Crossings: An Assessment of Awareness,Utilisation and Compliance

*Merina Shrestha* [a], *Anil Marsani* [b]

**Abstract:**

Pedestrian safety remains a significant concern globally, particularly in developing countries like Nepal, where road fatalities disproportionately affect Vulnerable Road Users (VRUs).This study evaluates the utilisation, compliance, and awareness of Pelican crossings—signal-controlled pedestrian crossings equipped with push-button activation.Videographic survey techniques and questionnaires served as the research methods for this study to investigate factors including gender, age, group number and traffic flow and waiting time duration,education level,participation in awareness or educational programs. The analysis through binomial logistic regression reveals that female pedestrians along with younger people in larger groups show higher compliance but low traffic volume reduces both their usage and adherence. The public showed different levels of system knowledge according to their demographics and youth groups displayed higher awareness about the system as a result of their participation in educational campaigns. The research concludes that public education and better pedestrian infrastructure,with suitable traffic signal timings must be implemented since they help both reduce accidents and boost roadway adherence.

**Keywords:**

Pedestrian safety, Pelican crossings, Compliance, Awareness, Logistic regression, Utilisation.

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# Behavioral Dynamics of Vehicle Pedestrian Interaction at Unsignalized crosswalk: A PET based Study of Shantinagar–Aloknagar Crosswalk

*Sandesh Lamsal* [a], *Rojee Pradhananga* [b]

**Abstract:**

This study investigates pedestrian-vehicle interactions through the analysis of Post-Encroachment Time (PET), a critical surrogate safety measure, in a high-conflict urban area. Using a combination of statistical modeling and behavioral analysis, the research identifies key factors influencing PET, including vehicle type, pedestrian behavior, and conflict dynamics. The findings reveal that larger vehicles (e.g., buses, trucks) and SUVs-Cars are associated with longer PET due to their slower maneuverability, while two-wheelers exhibit the shortest PET, reflecting higher risk due to their agility. Younger pedestrians (¡20 years) face the highest risk, with the lowest median PET 1.05 seconds, likely due to impulsive crossing behavior. Assertive pedestrian behavior (61.41%) and multi-stage crossings (27.39%) further increase exposure to risk, particularly in Aloknagar Side (75.69% of conflicts). Hybrid conflicts, involving simultaneous speed and path adjustments, pose the highest risk with PET 1.00 seconds, while maneuver conflicts are relatively safer with PET 1.60 seconds. A multiple linear regression model, validated through statistical tests, explains 22.5% of the variance in PET ($R^2 = 0.225$), which is consistent with previous studies on behavioral interactions, where low $R^2$ values are common due to the stochastic nature of human behavior. Despite its moderate explanatory power, the model identifies key predictors, such as vehicle type and conflict dynamics, that align with theoretical expectations and provide actionable insights for traffic safety analysis.

**Keywords:**

Vehicle-Pedestrian Interaction, Post-Encroachment Time, Pedestrian Behavior, Multiple Linear Regression

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# Calibration of Social Force Model Parameters in VISSIM: A Case Study of Signalised Crosswalk at Madan Bhandari Road, Civil Service Hospital, Kathmandu

*Pragyan Shrestha* [a], *Pradeep Kumar Shrestha* [b]

**Abstract:**

Walking is an essential mode of transportation in urban areas like Kathmandu, and pedestrian movement study is a crucial aspect of urban transport planning. However, it remains under-explored in Nepal, particularly in the context of pedestrian simulation. This study has addressed this gap by focusing on calibrating the Social Force Model (SFM) parameters in VISSIM for accurate simulation of pedestrian movement at a signalised crosswalk in Kathmandu. The model's parameters were calibrated to match the simulated crossing speed distribution with the observed crossing speed distribution. A genetic algorithm was employed for dynamic calibration by controlling VISSIM through a python script, to achieve optimised parameter values. The results showed improvement in representation of observed pedestrian behaviour, with the calibrated parameters providing significantly accurate simulation of pedestrian speeds than with the default parameters.

**Keywords:**

Pedestrian Simulation, Social Force Model, VISSIM, Calibration, Genetic Algorithm

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# Study of the Platooning Condition in Two-Lane Intercity Highway: A case study of Muglin-Narayanghat Road (NH44-004)

*Kshitiz Dhakal* [a], *Anil Marsani* [b], *Moti Ram Giri* [c]

**Abstract:**

Since the performance evaluation of two-lane roads, particularly the level of service (LOS), relies on measures that require identifying following vehicles or platooning vehicles, this study analyzed gaps and speed differentials (SD) to distinguish between free-flow and platooning conditions using field data from NH44-004. Free-flow conditions were first identified by examining the relationship between gap and SD. Then, the best-fit probability density curve of SD in free-flow conditions was superimposed onto the SD histogram for all vehicles to determine followers conditions. The analysis established an 8-second gap threshold for free-flow conditions. Vehicles with a gap of less than 8 seconds and an SD between −6 km/h and +6 km/h were classified as follower vehicles, with leading and following vehicles together forming a platoon.

Based on this criterion, 37% of the total traffic volume was influenced by platooning, with heavy trucks primarily acting as platoon leaders and two-wheelers as followers. Although most platoons consisted of 2 to 3 vehicles, their impact was significant: under platoon conditions, the 50th percentile speed decreased by 7.46 km/h, and the 85th percentile speed dropped by 8.42 km/h. These findings provide a basis for evaluating the LOS of two-lane roads, particularly for NH44-004.

**Keywords:**

Free-flow, Platoon, Two lane roads, Distribution fitting, Level of service (LOS), Superimposition, Heterogeneous traffic

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# Study on Fundamental Traffic Flow Diagram in Heterogeneous Traffic Flow Condition along the Prithivi Highway

*Rabindra Paudel* [a], *Ramesh Banstola* [b], *Sabina Paudel* [c]

**Abstract:**

Urban traffic management is a complex challenge, particularly in developing countries where heterogeneous traffic conditions prevail. In Nepal, vehicles of varying sizes and speeds share road space without strict lane discipline, making traditional traffic models inadequate for accurate analysis. This study aims to develop a Fundamental Traffic Flow Diagram tailored to such heterogeneous conditions along the Prithivi Highway. Data was collected using video recording methods, capturing real-time traffic flow parameters such as speed, density, and vehicle composition. The study employs regression techniques to model the relationships between these parameters, leading to the development of an improved fundamental traffic flow diagram. The findings provide critical insights into traffic flow dynamics, enabling better traffic management strategies, optimization of road capacity, and reduction of congestion. This research contributes to the adaptation of traffic flow theories to heterogeneous environments, benefiting infrastructure planning and policymaking in developing regions.

**Keywords:**

Traffic Flow, Fundamental Diagram, Heterogeneous Traffic

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# Experimental investigation of the surface dielectric strength of insulating tubes supporting air terminals of electrically insulated lightning protection systems under standard lightning impulse voltages

*Akrit Acharya*[a], *Basanta Kumar Gautam* [b]

**Abstract:**

Lightning Protection Systems (LPS) safeguard structures, electrical systems, and personnel from lightning strikes. A critical component, insulating tubes, provides electrical isolation and directs current properly. These tubes must withstand extreme lightning-induced shocks, often reaching hundreds of kilovolts, while retaining insulating properties. Evaluating their performance under standardized lightning impulse voltages (1.2/50 µs) is essential due to their transient, high-voltage nature. Key factors influencing performance include voltage polarity, material composition, tube geometry, and environmental conditions. Unlike steady voltage tests, lightning impulse conditions reveal distinct behaviors, necessitating specialized assessments to ensure reliability. Failure of these tubes can compromise the entire LPS, highlighting the need for rigorous testing. This study investigates the dielectric properties of insulating tubes under both positive and negative lightning impulses, analyzing their response to rapid voltage escalation. By assessing surface dielectric strength, the research enhances understanding of system reliability in real-world lightning scenarios, aiding in the selection and optimization of insulating materials for robust lightning protection.

**Keywords:**

Lightning Protection system, insulating tubes, air termination, Marx Generator

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# Experimental Investigation of the dielectric strength of the insulating standoffs of electrically insulated lightning protection system under standard lightning impulse voltages

*Gyanendra Kumar Kurmi* [a], *Basanta Kumar Gautam* [b]

**Abstract:**

Electrically insulated lightning protection systems (LPS) utilize insulating standoffs and insulated conductors to maintain the required separation distance from grounded objects. This paper investigates the dielectric strength of insulating standoffs in electrically insulated lightning protection systems (EILPS) under standard lightning impulse voltages. These standoffs are crucial for protecting structures, electrical equipment, and personnel from lightning strikes. The study aims to assess their ability to maintain insulation properties during real-world lightning events. The dielectric strength of these standoffs is influenced by factors such as material properties, geometry, environmental conditions, and applied voltage waveforms. By testing the dielectric strength of these standoffs, it is possible to minimize the risk of failure and ensure that the system remains functional in the event of a lightning strike. This paper presents laboratory experiments to assess the effect of polarity on 25 cm standoffs under standard lightning impulse voltage (1.2/50 µs) conditions, and analyze experimental data to predict breakdown voltage, discharge current, and flashover time.

**Keywords:**

Insulating standoffs, flashover, Lightning impulse voltage, Electrically insulated protection system, dielectric strength

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# Regenerative Energy Utilization of PMSM for Elevator Rescue System

*Alok Yadav* [a], *Bishal Silwal* [b]

**Abstract:**

With the rise of multi-story buildings, the demand for elevators is also increasing, leading to a higher energy requirement. An elevator operates by hoisting its carriage up or down by supplying the necessary torque to balance the weight difference between the carriage and counterweights. Due to varying carriage loads, the elevator sometimes operates in regenerative mode, converting gravitational potential energy into electrical energy. The amount of regenerated energy depends upon the height of building and the capacity of elevator. Traditionally, this regenerated energy was dissipated in braking resistors. However, with the implementation of regenerative control, this energy can be harnessed for various purposes. This paper explores the potential of regenerative energy recovery in elevator systems and its storage for backup and additional power needs, ultimately improving overall system efficiency, reliability, and sustainability.

**Keywords:**

Field Oriented Control, Regenerative Braking, Counterweights, Pulse Width Modulation

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# Contingencies Based Strategy for Transmission System Upgradation

*Sujeet Mahato [a], Nava Raj Karki [b], Basanta Kumar Gautam [c]*

**Abstract:**

A stable and dependable power system is crucial for ensuring uninterrupted electricity supply. The growing demand for electrical energy has led to power systems operating beyond their design limits, resulting in various transmission constraints. A secure power system is one that can withstand unexpected disruptions without significant consequences. Contingency analysis helps assess the impact of transmission line outages on system performance and the effects of transmission line failures on the power grid. This paper presents a contingency analysis of Integrated Nepal Power System network, evaluating its resilience under different outages scenarios. Load flow analysis is a fundamental aspect of power system planning, operation, and expansion. This study employs the Newton-Raphson method using DIgSILENT Power Factory simulation software to compute performance Index-Active Power Performance Index (PIP) for single transmission line outages. The results identify critical lines in the INPS network, suggesting necessary upgradation of existing transmission lines or the installation of compensatory devices. The results highlight system vulnerabilities and suggest measures to enhance overall grid reliability.

**Keywords:**

Contingency, INPS, Newton-Raphson, Performance Index

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# Assessment of Optimal Feeder Configuration Integrating EV Loads and Solar PV Generation for Urban Nepalese Distribution Network

*Shekh Maquesood Alam* [a], *Mahammad Badrudoza* [b], *Akhileshwar Mishra* [c]

**Abstract:**

With Nepal's ongoing transition to renewable energy sources and the increasing adoption of electric vehicles, the existing distribution networks are encountering critical challenges, including power losses, voltage instability, and inefficiencies in energy usage. This work investigates the optimization of radial-loop configurations for urban distribution networks in Nepal, focusing on the integration of Electric Vehicle (EV) charging loads and solar Photovoltaic (PV) systems. The most efficient radial-loop configurations that minimize line losses, reduce voltage fluctuations, and improve overall system performance is proposed and tested for an urban distribution network at Nepal Electricity Authority (NEA), Nuwakot Distribution Center (NDC). Through advanced simulation and modeling techniques, this study evaluates the impact of various configurations on the power flow, line losses, and voltage profile of the distribution system. Additionally, it explores the potential benefits of incorporating solar PV systems and EV charging infrastructure, aiming to optimize power distribution while enhancing reliability and minimizing operational costs. The results of the study present an effective control strategy for radial and loop distribution feeders by utilizing optimal tie switch operations for utility operators. Also, the findings of this research will provide valuable insights and practical recommendations for policymakers, utility operators, and engineers, supporting the design of more sustainable, resilient, and efficient urban power distribution networks in Nepal.

**Keywords:**

Radial-Loop Configuration, Electric Vehicle (EV), Solar Photovoltaic (PV), Urban Distribution, Power Losses, Voltage Stability

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# A Robust Method of Fault Classification and Localization in Nepalese Distribution System

*Awnish Kumar Thakur* [a], *Anil Kumar Panjiyar* [b], *Basanta Kumar Gautam* [c]

**Abstract:**

Ensuring an uninterrupted power supply in developing countries like Nepal is challenging due to factors such as geographical terrain, vegetation, aging infrastructure, manual fault clearing, long feeder lengths with limited switch deployment, and the use of bare conductors. This paper introduces a robust method for fault localization in Nepalese distribution systems along with a novel approach to fault classification. The proposed fault classification method requires only two synchronized time measurement units, positioned at the start and end of a lateral. For fault localization, smart meters are needed at the end of all laterals. By utilizing voltage sag data from synchronized time measurement units, a two-nodal current source is calculated and injected at each node, then compared with the system's actual voltage sag. The effectiveness of the proposed method is validated using OpenDSS and Python on the Solati distribution feeder.

**Keywords:**

Fault Classification, OpenDSS, Python, Synchronized Time Measurement, Voltage Sag, Fault Localization

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# Soil-Structure-Structure Interaction (SSSI) Based on Substructure Configurations

*Buddha Dahal* [a], *Ram Chandra Tiwari* [b]

**Abstract:**

Traditional seismic design approaches often disregard the interaction between adjacent structures, soil, and foundations, which can lead to underestimation of forces and displacements, particularly on soft soils. During an earthquake, adjacent structures influence one another through their shared soil foundation, giving rise to structure-soil-structure interaction (SSSI). This interaction can occur in two ways: (1) the alteration of input ground motion caused by the presence of nearby structures, referred to as kinematic or wave-based SSSI, and (2) the restriction of foundation movement due to the proximity of another building or foundation, known as localized SSSI. The study of structure-soil-structure interaction is limited, primarily due to the scarcity of experimental or field-based case studies that illustrate its impact on structural behavior. The research considers three scenarios: (1) a single structure under fixed base conditions, (2) a single structure with soil-structure interaction (SSI) effects, and (3) the influence of a nearby heavy structure on the seismic response of the primary structure, incorporating SSSI effects. The results focus on comparing top-story responses (acceleration and displacement), Base Shear, etc. under these scenarios, providing valuable insights into the importance of SSSI effects in seismic analysis and design. The findings from this research indicate that considering soil-structure interaction (SSI), the time period increased, displacement amplified, and base shear reduced compared to the fixed-base condition. With an adjacent structure at medium separation, the response showed a slight reduction without significant differences. However, in the SSSI_No_Gap case, where structures were closely spaced, the response was notably amplified.

**Keywords:**

Soil-Structure-Structure Interaction, Spectral Amplification, LS-DYNA, Hysteretic Soil

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# Numerical Validation of Different Strengthening Techniques as Reinforcing Methods for Rammed Earth Structures

*Rujan Pokharel* [a], *Kshitij Charana Shrestha* [b]

**Abstract:**

This study validates the use of various strengthening techniques as a feasible method to reinforce rammed earth structures. The strengthening techniques applied involve use of RC dowels and wedges in rammed earth layers and steel anchorage systems for the beams. Using DIANA software, this study validates experiment conducted by Shrestha et. al, employing solid element modelling for both unreinforced and reinforced rammed earth structures. The simplified model adequately captures the peak behaviour of both the experimented systems. Results confirm that strengthening techniques significantly improve the performance of rammed earth structures under out-of-plane loading. The modeling approach employed proves suitable for future research.

**Keywords:**

rammed earth, floor diaphragm, strengthening techniques

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# Rock Slope Stability Assessment of the Cut Slope: A case study at the Dam Site of Tanahun Hydropower Project

*Dipak Lamichhane* [a], *Naba Raj Neupane* [b], *Hare Ram Timilsina* [c]

**Abstract:**

Rock slope stability assessment is essential in engineering construction projects, particularly for high cut slopes, where failures pose significant risks to infrastructure and human safety. This study integrates multiple approaches, including kinematic, empirical, analytical, and numerical modeling techniques, to provide a comprehensive understanding of potential failure mechanisms. Kinematic analysis assesses structurally controlled failure modes such as planar, wedge, and toppling failures. Empirical methods classify rock masses based on geomechanical indices, while analytical techniques offer quantitative stability assessments under varying conditions. Furthermore, numerical modeling is utilized to simulate slope behavior and validate analytical findings. This paper examines the stability of a rock cut slope in the Tanahun Hydropower Project (Upper seti hydropower project), located in the Lesser Himalayan zone near Damauli of Tanhun District in Gandaki Province, Nepal. The study aims to identify the stabilizing factors influencing rock slope stability, which are critical in preventing failures during the construction of engineering projects such as hydropower facilities and roadways. To evaluate slope stability and design, kinematic analysis and finite element modeling were used. Stereonet plots revealed wedge, toppling, and planar failure patterns, while RS2 software was used to develop a finite element model for critical slope sections. By combining these approaches, the reliability of the stability predictions is improved, which supports the development of effective mitigation strategies. The findings of this study contribute to improved slope design and stabilization measures, ensuring long-term safety and sustainability in engineering projects involving high-cut rock slopes.

**Keywords:**

Lesser Himalaya, High-cut slope, Slope stability analysis, Factor of safety, Numerical modeling

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# Settlement Analysis in Weak Rock Mass Due to Underground Excavation: A Case Study of Kathmandu University Research Tunnel

*Sujeet Dhakal* [a], *Santosh Kumar Yadav* [b]

**Abstract:**

This study focuses on settlement analysis in weak rock mass due to underground excavation. Using the research tunnel of Kathmandu University as a case study, the research evaluates the settlement of building using numerical modeling in PLAXIS 2D of two bore hole and tunnel settlement analysis, support evaluation in a site where bore hole is not drilled in RS2 software.This settlement analysis is applicable in a place where there is shallow underground structure for determining surface structure subsidence.

**Keywords:**

Weak Rock Mass, Settlement,shallow tunnel, Numerical Modeling, PLAXIS 2D, RS2

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# Impact of Embankment Loading on Liquefaction Behavior of Underlying Soil: A Plaxis 2D Study

*Reymond Khadka* [a], *Santosh Kumar Yadav* [b]

**Abstract:**

Liquefaction is a phenomenon by which saturated-soil temporarily turns into liquid like state during seismic events.Liquefaction is likely to cause huge damage to life and property mainly in earthquake prone regions like Nepal.So it is highly necessary to understand liquefaction behaviour in Nepal's seismic context for designing safer infrastructure in vulnerable areas. This study aims to analyze liquefaction potential of an existing soil profile and analyse the change that occurs due to construction of an embankment over such liquefiable soil.The liquefaction potential of base soil is analyzed using both analytical method and numerical simulation using plaxis 2D. Similarly, the liquefaction potential after the construction of the reinforced geogrid embankment was analyzed using Plaxis 2D. 2015 Gorkha earthquake data was used for seismic loading. The study showed that the base soil was highly liquefiable due to the presence of granular soils in most of the soil layer. However, after construction of a 27-m high embankment the deformation and pore water pressure increased. The excess pore pressure ratio (Ru) and deformation patterns were studied to evaluate liquefaction. This study provides important information on the interaction between the embankment and the soil and can be used to suggest mitigation measures to reduce the risks of liquefaction in embankments. The findings can help in designing and constructing embankments in areas prone to liquefaction.

**Keywords:**

Liquefaction, Seismic loading, Plaxis 2D, Embankment, Geogrid reinforcement, Excess pore pressure ratio (Ru), Numerical modeling, Soil-embankment interaction, 2015 Gorkha earthquake

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# Rock slope stability analysis of Chunpahara hill at Bimalnagar, Tanahun in Western Nepal

*Sunisha Tiwari* [a], *Krishna Kanta Panthi* [b], *Abhay Mandal* [c]

**Abstract:**

This study focuses on the stability analysis of the rock slope in the Bimalnagar of Tanahun district in Nepal.This near vertical rock slope adjoining the Prithivi highway has large number of long persisting joints, loosely hanged rock blocks and rock-mass effected by extreme weathering effect, which poses the threat of slope instability.Different approaches of slope stability have been considered like kinematic approach, empirical approach and numerical modeling approach.Rock quality assessment by Rock mass rating method gave the rock mass as fair to good quality in most slope sections.Different mode of slope failures(Plane,Wedge and Toppling) are evident in the slopes obtained by stereo-graphic pole plotting of dip and dip direction in DIPS software.Empirical approach like SMR determined the potential stability condition and probability of failure for each failure modes observed in the slope section.The Q-slope has determined the safe slope angle for slope stability.Further assessment of slope carried out by using numerical modeling methods evaluated the potential critical zone, calculated the least possible critical FOS and provided appropriate stabilization measure.

**Keywords:**

Slope stability analysis,Factor of safety, RMR, SMR, Q-SLOPE,DIPS,SLIDE 2.

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# Nepali Handwritten word recognition using Vision Transformer

*Vaishnavi Saud* [a], *Arun K. Timalsina* [b]

**Abstract:**

Handwritten word recognition is a rapidly growing field in computer vision and image processing. Although handwritten word recognition has been extensively studied in languages like English, research in the Nepali language remains limited due to the lack of datasets, the complex script structure, variations in handwriting styles, and the presence of compound characters. This research explores the use of the Vision Transformer (ViT) as an encoder for recognizing Nepali words using a custom dataset through various experiments.Inspired by the success of Transformers in NLP, a standard Transformer model was directly applied to images by splitting them into patches and treating these patches as tokens. The linear embeddings of these patches were used as input to the Transformer model, which demonstrated significant improvements compared to CNN architectures like VGG16 and Alexnet.After classifying the image using the Transformer model, additional post-processing steps, such as line removal, segmentation, and concatenation, were performed to reconstruct the word. Furthermore, decoding and post-processing techniques further enhanced the accuracy and efficiency of word reconstruction.Through multiple experiments, ViT achieved an accuracy of 98.08% .

**Keywords:**

Word Recognition, ViT, Transformer model, Decoding, Postprocessing

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# An Encoder Decoder Model for Grammatical Error Correction of Nepali Text

*Dhiraj Bashyal* [a], *Shailesh Pandey* [b]

**Abstract:**

The Nepali language has limited resources, making grammatical error correction in Nepali text so challenging. Despite significant progress in GEC systems for major linguistic groups, Nepali remains largely unexplored.Limited annotated resources along with linguistic complexities work as barriers to exploring the Nepali language for this task. This paper introduces a character-based encoder-decoder Transformer model for Nepali grammatical error.A syntactic method is used to generate various errors, including insertions, omissions, substitutions, transpositions, and word-spacing errors. Errors are introduced based on a proportion of the sentence length.The encoder learns contextual character-level representations, while the decoder generates corrected sequences using attention mechanisms to maintain context. The model performance is evaluated using metrics that include accuracy, precision, and recall. The model computes attention scores to determine the importance of each character in the input sequence. This helps in accurately correcting errors by focusing on relevant context.The proofreading method serves both for determining the ground truth and measuring predictive output from the model.This approach significantly enhances the accuracy of Nepali text correction, contributing to its overall effectiveness in NLP research for low-resource languages. By addressing key grammatical challenges, this study lays a strong foundation for developing more robust and scalable GEC models, ultimately benefiting Nepali language processing.

**Keywords:**

Encoder, Decoder, Attention, GEC

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# Implementation of Neural Nepali TTS Based on Fastspeech 2

*Prajwal Bhandari* [a], *Basanta Joshi* [b]

**Abstract:**

This paper discusses the implementation and analysis of a Neural Nepali Text-to-Speech (TTS) system using the FastSpeech 2 architecture. As the Neural approach has been proven to be more suitable for generating natural sound than traditional approaches, such as concatenative, formant, articulatory, and parameterized methods, we evaluated a neural approach called FastSpeech 2, an architecture designed by Microsoft for directly synthesizing Nepali speech from given Nepali text. There have been investigations into the Neural approach using Tacotron 2, FastSpeech, and FastPitch for the Nepali Language. Here, we investigated how FastSpeech 2 would perform for a low-resource language like Nepali. In this experiment, we trained the model to generate the mel-spectrogram in two phases: the Aggressive Training Phase and the Fine-tuning Phase, at the character level without transliteration. In the first phase, we aggressively trained Google's dataset to find the tentative weight for the model. Later, in the second phase, we fine-tuned the model's weight using Khadka's dataset. The model's performance was evaluated based on MOS, with an average score of 3.556, indicating a good result for character-level utterances and suggesting an area for further analysis of the character-level approach, which eliminates the need for transliteration. This experiment demonstrates that, with FastSpeech 2 utilizing a two-phase pipeline, it is possible to develop a high-quality text-to-speech (TTS) system for Nepali text using a sufficient dataset without transliteration.

**Keywords:**

Text-to-Speech, Neural Synthesis, FastSpeech 2, Non-Autoregressive Model

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# Nepali Speech Transcription and Summarization using Whisper and T5

*Priyanka Ojha* [a], *Praches Acharya* [b]

**Abstract:**

The development of an automated speech transcription and summarization system for the Nepali language involves a combination of speech processing, natural language understanding, and deep learning methodologies. This research aims to create a structured pipeline for transcribing and summarizing Nepali parliamentary speeches using Whisper for speech-to-text conversion and T5 for text summarization. The study is divided into multiple stages, including dataset preparation, fine-tuning the models on domain-specific data, hyperparameter optimization, and validation. A specialized dataset is curated from National Assembly parliamentary recordings, preprocessed to align audio and text transcriptions, and further utilized for training and evaluation. Whisper, a robust speech recognition model, is employed to transcribe Nepali speech into text, while T5, a transformer-based text generation model, is fine-tuned to summarize the transcriptions. The research explores model performance on real-world parliamentary speech data, analyzing the impact of dataset quality, fine-tuning, and hyperparameter optimization on transcription accuracy and summarization coherence. Evaluation metrics reveal that Whisper achieves an average Word Error Rate (WER) of 0.3425 on the test dataset, indicating near-exact transcription for common words but challenges with domain-specific terms, pronunciation variations, and background noise. Similarly, the mT5 model for summarization attains a BERTScore of 0.9232 in precision, 0.8880 in recall, and an F1 score of 0.9051, demonstrating strong performance in capturing key discussion points while occasionally exhibiting contextual misinterpretations. Further improvements through dataset expansion, full-scale fine-tuning, and systematic hyperparameter optimization are essential to enhance model accuracy.

**Keywords:**

NLP, Nepali Speech Transcription, Summarization, T5, Whisper

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# End to End Automatic Speech Recognition in Sanskritam from Raw Waveforms and its Adaptation to Nepali using Second Pass (Text-to-Text) Language Model

*Siddhant Baral* [a], *Hari Prasad Baral* [b]

**Abstract:**

Automatic Speech Recognition in the field of Low-Resource Language is an open field of Research. New methodology and domain specific adaptations are expected to challenge the problems of small data. Our model is attempting to develop a robust ASR system for Nepali language using Sanskritam. Both of these are Low Resource Languages, and use of Sanskritam instead of Nepali itself for developing an ASR in Nepali is counterintuitive. But we are relying on the tightly bound grapheme-phone features of Sanskritam. Given that Nepali has phonetic and grapheme subset of Sanskritam, this approach can be valuable. Additionally, use of Second pass text-to-text rescoring model will help correct the deviations Nepali Language has seen in contrast to Sanskritam. This model can prove to be a single shot solution for many Indic Languages since the second pass language features can be plug and play without requiring any training in the acoustic model.

**Keywords:**

Sanskritam ASR, Nepali ASR, Two Pass, Raw Waveform ASR

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# Transformer Based Data Extraction From Nepali Citizenship Document

*Shreekrishna Timilsina* [a], *Kiran Chandra Dahal* [b]

**Abstract:**

AI and machine learning have revolutionized document processing by overcoming the limitations of traditional rule-based methods. This research uses the Layout transformer model to explore a transformer-based approach for the semi-structured extraction of data from Nepali citizenship documents. Due to document formats and quality variations, effectively extracting data from Nepali citizenship documents presents a significant challenge. The collected dataset comprised raw images in multiple formats, including JPG, JPEG, PDF, and PNG. Data are collected under a Non-Disclosure Agreement (NDA) to ensure confidentiality. Given the complexity of document layouts, extensive manual preprocessing was performed, which involved converting formats, trimming excess white space, standardizing to PNG, and using an Ubiai tool to annotate text sections. These dataset preparation tasks consume significant time because it is necessary to create a well-labeled dataset suitable for training the model. Leveraging this semi-structured data, the Language Independent Layout Transformer(LiLT) model was fine-tuned to enhance its capability to identify and extract crucial fields, including name and citizenship number, from the citizenship document. The experiment evaluates the model's performance using accuracy, precision, and recall metrics to assess its effectiveness. This study helps automate document processing in administrative and governmental work. The findings highlight the LayoutLM and LiLT model's capability to handle documents in the low-resource Nepali language effectively.

**Keywords:**

Devanagari Script OCR, Document Data Extraction, Layout Model, Transformer

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# Mittigation of Over Voltage issue in Manang 33/11 KV Syarku S/S

*Raju Mahato [a], Sandeep Dhami [b], Menaka Karki [c]*

**Abstract:**

Due to advance development of distributed energy resources and their integration into power grid led to voltage rise in the system. So, the Voltage stability analysis of a power system is a necessity, particularly in the planning phase of the development or expansion of a power network. The ultimate goal of this project is to mitigate voltage rise in Manang 33/11KV Syarku Substation. Due to light load and integration of distributed energy resources in the power system, there was a maximum voltage rise of 35.9 KV, which is about 10 percent in the system. In this project to mitigate over-voltage different methods are presented like using Static Var Compensator device, On Load Tap Changing transformer by optimal placement (pso)method in the weak bus system. The analysis of over voltage compensation in 14 bus system is carried out in MATLAB. Voltage Stability index is carried out in 14 bus system to find how close the actual system's operating point is from the voltage stability limit. The rating of SVC is obtained 9.205 MVAR. Similarly, in OLTC transformer for tap setting ± 5 percent of reference bus Damauli the voltage deviation is obtained below percent.

**Keywords:**

Over voltage, VSI, SVC, OLTC

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# Assessment of the Optimal Approach for Short-Term Load Forecasting at Nuwakot Distribution Center Utilizing Smart Meter AMI Data

*Saroj Kumar Sah* [a], *Anil Kumar Panjiyar* [b], *Sochindra Kumar Roy* [c]

**Abstract:**

Precise short-term load forecasting (STLF) is essential for efficient electricity distribution, supporting effective demand-side management, tariff structuring and grid stability. With advancements in smart meter technology and Advanced Metering Infrastructure (AMI) utilities can collect extensive energy consumption data enabling improved analysis of usage patterns and more accurate demand predictions. This study evaluates the optimal STLF approach for the Nepal Electricity Authority (NEA) at the Nuwakot Distribution Center (NDC) using smart meter AMI data. The training data is sourced from the AMI system consisting of 1,100 three-phase smart meters which includes two years hourly energy consumption data. Consumers in the rural areas of Nuwakot district display irregular and distinct peak load consumption patterns compared to those in small urban areas. The Nuwakot distribution center predominantly caters to domestic load demand, followed by industrial, commercial, non-domestic, irrigation, and non-commercial categories. Consequently, the variations in peak energy demand and load curve patterns across different consumer categories create a unique consumption trend, highlighting a distinct research gap for further study. Four predictive modeling techniques—Linear Regression, Random Forest (RF), Artificial Neural Networks (ANN) and Extreme Gradient Boosting (XGBoost) are applied to develop and assess forecasting models. Factors influencing forecasting accuracy include deterministic variables like time of day energy,demand and weather related variables such as temperature. Each model is trained on hourly energy consumption data from the AMI system, with performance measured using Mean Absolute Percentage Error (MAPE) and Mean Squared Error (MSE). The findings indicate that tree based aggregation methods particularly Random Forest and XGBoost outperform Linear Regression and ANN in terms of accuracy. Among these Random Forest has the lowest MAPE (10.45%) yields the lowest forecasting error highlighting its effectiveness in predicting peak demand and enhancing load management strategies.

**Keywords:**

Advanced Metering Infrastructure, Artificial Neural Network, Random Forests, Extreme Gradient Boosting, Demand Forecasting

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# Coordinated Operation of Virtual Synchronous Machines in Interconnected system Using Droop Control Mechanism

*Prakash Pandey* [a], *Sandeep Dhami* [b], *Nimesh Risal* [c]

**Abstract:**

Research has demonstrated that the transient stability of a PV-Hydro microgrid can be enhanced by implementing a virtual synchronous machine (VSM), which injects virtual inertia into the system. In an interconnected system with multiple PV-Hydro microgrids, several VSMs must operate in parallel. These VSMs should distribute the transient load proportionally to their respective capacities; otherwise, one VSM's storage battery may discharge more than others. This paper introduces a control logic for parallel-operated VSMs to ensure proportional load sharing based on their capacities. The proposed control logic employs a frequency droop control approach to achieve balanced load distribution. Simulations conducted in MATLAB/Simulink confirm that the frequency droop control method is effective for the parallel operation of VSMs.

**Keywords:**

Energy storage, PV-Hydro micro-grid, Power system stability, Power electronic controller

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# Application of ANN in Enhancing Power System Reliability through HIF Detection

*Abinash Kshatri* [a], *Amrit Bhatta* [b], *Basant Bahadur Thapa Kshetri* [c]

**Abstract:**

The High Impedance Fault occurs rather frequently in distribution lines (3-35kV); they are not detected by conventional relays because of the magnitude of impedance involved in the fault path, and the nature and characteristic of the fault current is special and different from the conventional fault current profile. Each type of high impedance fault exhibits distinct characteristics in terms of current magnitude, waveform, and harmonic content.Phase-to-phase elements can also be affected by high impedance faults, which are primarily single phase to ground faults.Traditional protection systems fail to detect high-impedance faults, leaving conductors energized and posing safety risks. As can be expected, this presents a serious risk to human life as well as that of wildlife. Because they directly affect the size and characteristics of the fault current, atmospheric and geographic factors are important in the high-impedance phase to ground faults High impedance faults are the main reason for conductors breaking down, or contact with an unsafe high-impedance surface. A detection model based on the Artificial Neural Network (ANN) technique was developed using the MATLAB Neural Net Fitting feature to quickly recognize HIFs and accurately discriminate them from other faults.

**Keywords:**

Artificial Neural Network, High Impedance Faults, overhead transmission lines, harmonics, distribution systems

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# Hybrid AI Model for TL Fault Identification

*Suresh Prajapati* [a], *Bishal Silwal* [b]

**Abstract:**

Accurate fault detection in power systems is crucial for reliability and efficiency. Traditional Machine Learning (ML) and Artificial Neural Network (ANN) models face limitations in accuracy. This literature proposes an effective, cost-effective and fault-detecting model that detects fault type and location with a high accuracy about 95%. Rather than only using traditional machine learning models, it uses a hybrid model which combines some AI models with powerful optimization techniques, in which optimization techniques will weigh and tune the AI models used for better accuracy. In this proposed method, three different ML Algorithms (RF, SVM and GB) are unified with the PSO optimization technique. Power system failures are simulated in MATLAB/SIMULINK and the AI model is developed using the Python programming language. In this feature selection and data tuning are not performed, the whole model is trained and developed with raw bus data like voltage and current etc. It is tested with fault data using performance metrics (RMSE and CV) without any precomputation. The model performs well on different topologies and data sets of the system, validating its robustness and adaptability, making it a promising approach for monitoring and maintenance of real-world power systems.

**Keywords:**

Fault Detection, Hybrid AI Model, PSO Technique, Machine Learning, Random Forest Classifier (RF), Gradient Boosting (GB), Support Vector Machine (SVM), Cross Validation (CV), Root Mean Squared Error (RMSE), TL Fault, Artificial Intelligence, MATLAB/SIMULINK, Python, IEEE 14 Bus

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# Design and Performance Analysis of Dual Stage Multifunctional PV Inverter for Non-Active Current Compensation Using ANFIS Controller

*Dev kumar kalwar [a], Sujan Adhikari [b], Laxman Maharjan [c], Jeetendra Chaudhary [d]*

**Abstract:**

The increasing integration of renewable energy sources, particularly photovoltaic (PV) systems, into the power grid has highlighted the need for advanced inverters capable of not only injecting clean energy but also improving power quality. This thesis presents the design and performance analysis of a dual-stage multifunctional PV inverter that combines maximum power point tracking (MPPT), active power filtering (APF), and non-active current compensation using an Adaptive Neuro-Fuzzy Inference System (ANFIS) controller. The proposed system addresses the challenges of harmonic distortion, reactive power, and unbalanced currents caused by nonlinear and unbalanced loads in grid-connected PV systems. The dual-stage topology consists of a boost converter for MPPT and DC-link voltage regulation, followed by a three-phase voltage source inverter (VSI) for grid integration and power quality improvement. The Instantaneous Reactive Power Theory (IRPT) is employed to generate reference currents for non-active current compensation, while the ANFIS controller replaces traditional PI controllers to enhance dynamic performance and robustness. The system is designed to maintain a stable DC-link voltage of 750 V and inject 67.5 kW of PV power into the grid.

Simulation results demonstrate the effectiveness of the proposed system in compensating for harmonic, reactive, and unbalanced currents, achieving a total harmonic distortion (THD) of less than 5% and a power factor close to unity. The ANFIS controller outperforms conventional controllers in terms of response time and adaptability to varying load and grid conditions.This work contributes to the field of renewable energy integration by providing a comprehensive solution for power quality improvement in grid-connected PV systems. The proposed dual-stage multifunctional inverter, combined with advanced control strategies, offers a cost-effective and efficient approach to enhancing grid stability and power quality in the presence of nonlinear and unbalanced loads.

**Keywords:**

Multi-Functional Inverter, MPPT, ANFIS Controller,THD

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# Multi Query Optimization in a Database by Implementing Quantum Annealers

*Kushal Bhattarai* [a], *Nanda Bikram Adhikari* [b]

**Abstract:**

Query optimization in DBMS helps to execute queries efficiently by selecting optimal execution plans, optimizing resources like CPU, I/O, and memory. Multi Query Optimization (MQO) enhances this by optimizing batches of queries simultaneously, utilizing the concept of shared subexpressions to reduce redundancy and improve performance. Quantum annealing,a quantum optimization technique, can solve such complex optimization problems more effectively by finding global minima. Integrating quantum annealing into MQO can significantly advance the efficiency of handling large and complex query workloads.

This work leverages the D-Wave Advantage 4.1 quantum computers, equipped with over 5600 qubits, and hybrid solvers to address Multi-Query Optimization (MQO) problems in databases. The approach involves formulating MQO problems into mathematical models, initializing them as Quadratic Unconstrained Binary Optimization (QUBO) problems, and converting them into Binary Quadratic Models (BQMs). These models are then processed using quantum annealers, which provide results in milliseconds. This work compares the performance of quantum annealing with simulated annealing and hybrid annealing methods. The findings indicate that quantum annealing generally delivers superior results at a faster pace. Hybrid annealing excels at handling high-complexity problems by integrating classical and quantum computing, while simulated annealing relies solely on classical hardware and is slower.

**Keywords:**

MQO, QUBO, BQM, QPU

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# Leveraging Quantum Support Vector Machines for Enhanced Multiclass Classification of Interstitial Lung Diseases

*Pradip Sapkota* [a], *Nanda Bikram Adhikari* [b]

**Abstract:**

The integration of classical and quantum computing presents new opportunities for multi-class classification in medical image analysis, particularly for High-Resolution Computed Tomography (HRCT) scans. In this work, a modified VGG-16 convolutional neural network (CNN) was fine-tuned on a custom dataset, achieving 96.69% accuracy in distinguishing five ILD conditions: Emphysema, Fibrosis, Ground-Glass Opacity (GGO), Honeycombing, and Nodules. The extracted deep features were processed through dimensionality reduction and quantum kernel estimation using a 5-qubit quantum simulator, generating kernel matrices for training and testing. These matrices were then used in a classical Support Vector Machine (SVM), leading to an improved classification accuracy of 98.16%. The results highlight the potential of quantum-enhanced machine learning in medical image analysis, demonstrating how hybrid quantum-classical models can enhance classification performance. This study validates the feasibility of combining quantum and classical techniques, offering a promising direction for future research in quantum-assisted medical diagnostics.

**Keywords:**

VGG-16, SVM, QSVM, image-classification

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# Quantum Transfer Learning For Enhanced Brain Tumor Segmentation in Medical Imaging

*Shiv Shankar Sah* [a], *Ganesh Gautam* [b]

**Abstract:**

Brain tumor segmentation plays a crucial role in medical image analysis, enabling accurate diagnosis and treatment planning. In this work, we propose a hybrid deep learning model that integrates a pretrained VGG16 encoder, a quantum circuit in the bottleneck layer, and a U-Net decoder to enhance feature extraction and segmentation performance. The VGG16 backbone leverages transfer learning to capture hierarchical spatial features from MRI scans, while the quantum circuit, implemented using PennyLane, processes global feature representations in an enriched Hilbert space. The U-Net decoder reconstructs fine-grained tumor structures with high precision. Our approach is evaluated on the BraTS 2020 dataset, achieving an accuracy of 99.81% after 50 epochs. Experimental results suggest that the incorporation of a quantum layer enables enhanced feature representation and generalization, though further training and optimization are needed to fully exploit quantum advantages in medical image segmentation.

**Keywords:**

Quantum Transfer Learning, Brain Tumor Segmentation, Quantum Machine Learning (QML), Hybrid Quantum-Classical Models, Medical Image Segmentation

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# Optimization of Link Fidelity in Quantum Repeater Network

*Arjun Neupane [a], Baburam Dawadi [b], Ranju Kumari Siwakoti [c]*

**Abstract:**

The upcoming quantum internet is set to enable global users to create shared secure keys and perform distributed quantum computations. To make this possible, entanglement must be spread among distant users. One way to achieve this is by transmitting photons through optical fiber, allowing for the reuse of existing infrastructure. However, the chance of photon absorption in optical fiber increases exponentially with distance, making it impractical to establish entanglement over distances greater than urban areas. To extend entanglement over larger distances, we can use quantum repeaters, which could potentially reduce fiber loss by breaking the total distance into smaller segments. Despite recent progress, the required technology is still being developed; we aim to accelerate the deployment of fiber-based quantum-repeater networks. Our approach combines quantum-network simulations with genetic algorithm optimizations to determine the necessary hardware for quantum repeaters. This strategy will transform performance metrics from quantum network applications into specifications for the quantum repeaters needed in their execution. To support specific applications, advanced hardware must be enhanced in targeted ways. We suggest exploring the impact of using current fiber networks to quickly develop quantum networks. This could be a cost-effective method for building them. However, the existing infrastructure has constraints, especially regarding the location of quantum hardware. We plan to evaluate how these limitations affect quantum-network performance and how they might be mitigated by optimizing the placement of repeaters.

**Keywords:**

entanglement, quantum repeaters, quantum network, genetic algorithm

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# 3D Convolutional Neural Network-Based Lipreading with Connectionist Temporal Classification (CTC)

*Kushal Adhikari* [a], *Subarna Shakya* [b]

**Abstract:**

Lipreading, or visual speech recognition, is an emerging technology with applications in assistive communication, human-computer interaction, and security systems. This paper presents a deep learning-based approach for automatic lipreading by leveraging a combination of 3D Convolutional Neural Networks (3D CNN) and Bidirectional Long Short-Term Memory (BiLSTM) networks. The model was trained on a dataset containing 11,000 video samples to predict spoken sequences from visual lip movements. The use of 3D CNN enables the extraction of spatiotemporal features, while BiLSTM enhances temporal pattern recognition, improving prediction accuracy. The model achieved an accuracy of 87.41%, with a Character Error Rate (CER) of 0.136 and a Word Error Rate (WER) of 0.1666 on unseen test data. A comparative analysis showed that while BiLSTM improved temporal dependencies and accuracy, the 3D CNN-only model also performed well, achieving an accuracy of 82.78%. Despite the smaller dataset, the results are comparable to existing state-of-the-art models that used larger datasets. Future work will focus on improving generalization using larger datasets, advanced techniques, and dynamic lip detection methods.

**Keywords:**

Lipreading, 3D Convolutional Neural Network, Bi-LSTM, CTC Loss, Sequence-to-Sequence Modeling, Deep Learning

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# Spam Detection in SMS using AI based Spam Filter

*Pabitra Tiwari [a], Shruti Ranjan [b], Unish Shakya [c], Ishwor Badu [d], Binod Sapkota [e]*

**Abstract:**

Spam refers to unsolicited messages, often used for advertising, phishing, or spreading malware. With the increasing prevalence of SMS spam, machine learning has become a key tool for effective detection. This project presents an approach to distinguish between spam and legitimate (ham) messages using algorithms such as Gradient Boosting, Naive Bayes, Random Forest, and Logistic Regression. The dataset, consisting of both spam and ham messages, is carefully collected, cleaned, and preprocessed for model training. A comparative analysis is then conducted, revealing that Gradient Boosting outperforms the other algorithms in terms of accuracy, precision, recall, and F1-score, providing the most effective solution for SMS spam detection.

**Keywords:**

Comparative analysis, Detection, Gradient Boosting, Logistic Regression, Machine learning, Naive Bayes, Random Forest, SMS spam

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# Landslide Susceptibility Assessment of Jajarkot and West Rukum, Nepal using Weight of Evidence and Frequency Ratio Method

*Puja Maharjan* [a], *Basanta Raj Adhikari* [b]

**Abstract:**

Jajarkot and Rukum West in Nepal's Karnali Province are highly prone to landslides due to steep terrain, seismic activity, and heavy rainfall. The Mw 5.7 Jajarkot Earthquake on November 3, 2023, triggered many landslides in those districts and increased the risk of future landslides. This study assessed landslide susceptibility, using overall inventory data from different periods (pre-earthquake, post-earthquake post-monsoon). A 70/30 data split was used for model training and validation, considering 11 conditioning factors like as elevation, slope, aspect, plan and profile curvature, rainfall, PGA, geological formation, distance to drainage, distance to roads, and NDVI. Two models, Weight of Evidence (WoE) and Frequency Ratio (FR), were applied, with WoE performing better with an AUC of 0.877, compared to 0.865 for FR.

**Keywords:**

Landslides, Landslides Susceptibility, Jajarkot, West Rukum, Weight of Evidence (WoE), Frequency Ratio (FR), Post earthquake

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# Spatial and Temporal Analysis of Landslide Disaster in Karnali Province, Nepal

*Lokendra Rawat* [a], *Basanta Raj Adhikari* [b], *Sanjaya Devkota* [c]

**Abstract:**

Nepal's complex topography and monsoon climate make it highly vulnerable to natural disasters, particularly landslides, which cause significant loss of life, infrastructure damage, and economic hardship. This study focuses on the spatial and temporal analysis of landslides in Karnali Province from 2011 to 2024, using data from the Ministry of Home Affairs and the Department of Hydrology and Meteorology. A total of 422 landslides were recorded, resulting in 238 deaths, 194 injuries, and economic losses exceeding Rs. 12.69 crore. The study reveals a strong correlation between landslide occurrences and seasonal rainfall, with the highest incidents reported during the monsoon months (June–September).

Geospatial analysis using GIS and Kernel Density Estimation (KDE) identified high-risk districts such as Kalikot, Rukum West, and Jajarkot, where steep terrain and fragile geological conditions contribute to frequent landslides. In contrast, districts like Jumla and Mugu, with relatively stable landscapes, recorded fewer incidents. The study also highlights an increasing trend in landslide occurrences since 2018, peaking in 2024, underscoring the growing risk of disasters in the region.

The findings emphasize the urgent need for improved risk assessment, early warning systems, and targeted mitigation strategies. Understanding the spatial distribution and rainfall-triggered nature of landslides can aid in developing effective disaster management policies to enhance resilience and reduce future losses in Karnali Province.

**Keywords:**

Landslides, Disaster, Karnali Province, Spatial Distribution, Temporal Distribution

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# Landslide Susceptibility Mapping of Kulekhani Watershed Area

*Damodar Thapa* [a], *Basanta Raj Adhikari* [b], *Sangeeta Singh* [c]

**Abstract:**

Landslides pose a significant threat to mountainous regions like Nepal, particularly in critical areas such as the Kulekhani watershed, home to a vital hydropower reservoir threatened by sedimentation from slope failures.Landslide susceptibility mapping of the Kulekhani watershed area is a major concern to stakeholders because this area is adversely affected by landslide and gully erosion. So, this study was carried out in the Kulekhani Watershed area for the landslide susceptibility mapping of that area. Analytical Hierarchy Process (AHP) and Frequency rartio method were applied, within Geographical Information System (GIS), to derive landslide susceptibility maps of the Kulekhani watershed area. A total number of ten causative factors contributing to landslide occurrences in the region: Slope, Aspect, Plan Curvature, NDVI, Land use, Geology, Relative Relief, Rainfall, Distance to Road and Distance to Stream, have been taken in the study to generate thematic data layers. Altogether 70 landslide polygons are in the study area, in which 49 are used for training data and 21 are used for testing data for validation. With an AUC of 68.91% for success rate and an AUC of 71.47 for predictability, the model's validation confirmed that the frequency method was the best approach for the research. The susceptibility map is useful for pinpointing vulnerable regions and additional making appropriate emergency and planning decisions, offering assistance, creating strategies for prevention, reduction, and mitigation, and assisting in their execution in order to lessen the effects and danger of future landslide hazards within Kulekhani watershed area.

**Keywords:**

Landslide, Kulekhani Watershed, AHP Method, Frequency Ratio Method

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# Evaluating the Impact of Sampling Techniques on Landslide Susceptibility Mapping Along Nepal Siddhartha Highway Using Statistical and Machine Learning Models

*Sandip Paudel* [a], *Niraj K.C* [b*], *Buddhi Raj Joshi* [c]

**Abstract:**

The landslide susceptibility mapping (LSM) functions as an essential tool to minimize landslides which are affected by steep slopes, heavy monsoonal rain, and active tectonic processes. Five landslide models including FR (Frequency ratio), LR (Logistic regression), MLR (Multiple Linear Regression), RF (Random Forest), and SVM (Support Vector Machine) were used to prepare LSMs under three sampling techniques which consist of random, elevation-stratified and watershed-stratified sampling techniques. Random Forest (RF) demonstrated optimal performance through watershed-stratified sampling techniques where it reached an AUC value of 0.96 which exceeded both elevation-stratified (0.95) and random sampling performances (0.93). The watershed-based methods generated landslide susceptibility zones with medium-risk areas accounting for 34.48% of FR while elevation stratification effectively identified high-risk areas where 33.07% of the area fell under this category. Predictions conducted through random sampling showed an unbalanced distribution by favoring low-risk zones (29.41% low susceptibility) which demonstrated methodological biases. Moreover, the spatial analysis showed that watershed-stratified assigned 28.05% of the investigated highway to "very low" risk categories yet random sampling methods allocated 33.66% to such categories which demonstrated the significance of watershed strategies in geohydrological assessments. Studies conducted in Nepal Lesser Himalayas support the hydrological nature of landslide triggers. The study confirms that watershed-MLR models have identified 29.16% of the highway as high-priority for responsive measures. Watershed-stratified RF models prove useful for accurate landslide modeling in hazardous areas to increase infrastructure resistance. Study progress could benefit from the integration of detailed hydrological information which should combine different approaches from machine learning technology.

**Keywords:**

Landslide susceptibility mapping; Statistical landslide models; Machine learning landslide models; Random sampling; Elevation-based sampling; Watershed-based sampling

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# Landslide Susceptible Mapping along Maldhunga- Beni- Jomsom Road Section for Hill Road Disaster Risk management.

*Prabina Gyawali* [a], *Prakash Chandra Joshi* [b], *Sunil Rakhal* [c], *Naresh Regmi* [d]

**Abstract:**

Landslides are one of the most common natural hazards affecting the himalayan regions, particularly in Nepal. The Maldhunga Beni Jomson section is a part of Kaligandaki corridor highway of Nepal is 90.4 Km long highway section, extending from Maldhunga of Parbat to Jomsom of Mustang district is an essential transportation route in the Gandaki province of Nepal, connecting several rural and semi-urban settlements. However, its route traverses highly unstable and rugged terrain, making it prone to frequent landslides, especially during the monsoon season causing significant damage to local communities and infrastructure. This study employs the frequency ratio method to map landslide susceptibility along a critical section of the study area. For this, the landslide inventory map consisting of 396 landslide locations has been identified from google earth. Thirteen landslides conditioning factors, including slope, aspect, curvature, distance to stream, distance to Faultline, lithology, land use land cover, soil type, rainfall, distance to road, NDVI, TWI and SPI were combined with landslide training dataset using GIS for generating landslide susceptibility map of the study area. Then landslide susceptibility map produced using above factors classified the area into very high, high, medium, low and very low susceptibility zones. Then, area under curve and receiver operating characteristic curve were used for validation of result. AUC-ROC Curve method is used for the validation of the model with AUC value of 0.901 for the prediction rate curve and 0.89 for success rate curve. The finding of this research shows 34.21 % of the area is highly susceptible for landslide, 29.65 % are under medium risk and 36.14 % of the area is under low susceptible risk for landslide.The results are intended to support regional planning and disaster mitigation efforts, providing crucial information for the design and maintenance of infrastructure in this landslide-prone region.

**Keywords:**

Frequency Ratio, GIS, Landslide susceptibility, Stream Power Index, Topographic Wetness Index,

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# Integrating Machine Learning and Geospatial Analysis for Landslide Susceptibility Mapping in Jajarkot District, Nepal

*Parshuram Dhungana* [a], *Ananta Man Singh Pradhan* [b], *Pawan Kumar Bhattarai* [c]

**Abstract:**

Landslides pose a severe risk to human settlements, infrastructure, and ecosystems, especially in mountainous regions such as Nepal. This study utilizes machine learning and geospatial techniques to develop a landslide susceptibility map for Jajarkot District, an area frequently affected by landslides. A total of 22 causative factors were analyzed, and three machine learning models—Logistic Regression (LR), Random Forest (RF), and Extreme Gradient Boosting (XGBoost)—were implemented. A comprehensive landslide inventory was prepared, and multicollinearity analysis was performed to refine predictor selection. The models were evaluated using the Area Under the Curve (AUC-ROC), confusion matrix-derived metrics, and Cohen's Kappa coefficient. Among the models, RF achieved the highest predictive performance, with an AUC of 0.90 and recall of 0.842, making it the most effective approach for landslide susceptibility assessment in the study area. Although the results highlight the effectiveness of machine learning in susceptibility mapping, challenges persist, particularly regarding data availability, resolution limitations, and the model's applicability across diverse terrains. These findings offer valuable insights for disaster risk management, land-use planning, and environmental protection in landslide-prone areas.

**Keywords:**

Landslide Susceptibility Mapping, Machine Learning, Causative Factor Selection, Geospatial Analysis, Disaster Risk Management

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# Examining Authenticity in Architectural Heritage Reconstruction of Nepal

*Bhawani Baruwal* [a], *Inu Pradhan Salike* [b]

**Abstract:**

Authenticity is regarded as the most fundamental principle of heritage conservation. Past few decades have seen a rise in debate over the applicability of Western notions of conservation in Asian context including Nepal. Various scholars have reiterated the importance of devising approaches to authenticity based on culture, tradition and beliefs in Nepalese context. A comparative discussion of multiple cases can help gain better understanding of relationship between heritage conservation and authenticity. The main objective of this research is to examine and analyze authenticity in case of reconstruction of built heritages in Kathmandu after 2015 earthquake. The study takes on a qualitative research approach with case study as the research strategy. Two cases- Char Narayan temple and Kasthamandap- are taken as study subjects based on their different approaches in reconstruction and their historical significances. A conceptual framework for authenticity is prepared based on the literature review of various charters and guidelines in conservation and reconstruction of cultural heritages as well as scholarly articles that expresses experts' opinions on authenticity in heritage conservation in Nepalese context. The reconstruction of the Char Narayan temple and Kasthamandap are studied based on this framework. The research findings show that in heritage reconstruction priority is given to the use of salvaged materials and traditional building materials, as well as traditional building techniques, and crafts. In addition, community participation and continuity of use, traditions and rituals are equally important in maintaining authenticity in heritage reconstruction.

**Keywords:**

Architectural heritage, Authenticity, Char Narayan temple, Cultural Heritage, Conservation, Kasthamandap, Reconstruction

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# Continuity of Tiered Temple Architecture in Doleshwor Mahadev Temple

*Archana Basnet* [a], *Sudha Shrestha* [b]

**Abstract:**

The tiered temple, commonly referred to as the Nepali temple, reflects its evolution and development throughout history, showcasing its elemental continuity and unique identity. This research aims to examine whether the Doleshwor Mahadev Temple, now recognized as the head of Kedarnath and of international significance, maintains the same identity as traditional Nepali tiered temples. The study focuses on the temple's principal elements and elevation proportioning system through elevation analysis and elemental analysis. To assess continuity, the research incorporates Changu Narayan Temple as a historical reference, providing a basis for comparison with Doleshwor Mahadev Temple. Interviews with stakeholders identify factors influencing the temple's design and form, including preferences for modern techniques, budget constraints, and exclusive decision-making. The methods employed include literature-based evaluations, comparative analysis, and interviews. The continuity of architectural elements in design is not definitively confirmed by the outcomes of this research. However, the study concludes with recommendations for different stakeholders, offering insights into how future temple designs can better balance traditional elements.

**Keywords:**

cultural heritage, tiered temple architecture, elements, elevation proportion

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# Study of Natural Ventilation Patterns in Vernacular Buildings at Tallo Kopche, Dhankuta

*Durga Raj Aveng* [a], *Sanjaya Uprety* [b]

**Abstract:**

In hilly regions, wind movement tends to create thermal discomfort inside the buildings in winter. During summer, it becomes necessary to cool the building. In this regard, vernacular buildings evolved gradually to meet such demands. Vernacular buildings were designed with effective cross-ventilation through strategically placed openings, ensuring comfortable living conditions by maintaining a consistent flow of fresh air. However, modifications to spatial configurations in vernacular buildings for contemporary uses have affected air ventilation patterns. In Tallo Kopche, Dhankuta, many openings have been enlarged, altering the proportion of the facades. This research aims to study the affected ventilation patterns and evaluate the wall-window ratio (WWR) for optimal air exchange by CFD simulation while maintaining the architectural integrity of the building facades in the changing context of the site area. The research shows that 28% WWR in the south and 21% WWR in the north provide an effective solution.

**Keywords:**

Wind Movement, Vernacular buildings, Architectural features, Tallo Kopche, WWR.

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# Perception vs. Reality: Design Professionals and Residents in Pre- and Post-Pandemic Architecture

*Kriti Manandhar* [a], *Sushil B. Bajracharya* [b]

**Abstract:**

The COVID-19 pandemic has fundamentally altered human behavior and spatial dynamics, particularly in close-knit communities where shared spaces and social interaction are central to daily life. In Nepal, the pandemic transformed the meaning of neighborhood and proximity, turning communal living from a strength into a vulnerability and requiring adaptations such as social distancing. This paper explores the differences in perspectives between design professionals and residents regarding spatial dynamics from pre- to post-pandemic periods. The study focuses on Yetkha Bahal, an old traditional courtyard settlement in Nepal, where in-depth interviews with residents were conducted to understand their lived experiences. In addition, structured closed-ended questionnaires were distributed online to gather insight from design professionals. The findings reveal a significant divergence in perceptions: residents' use and need for space are deeply influenced by cultural practices, resilience, and adaptability, while professionals prioritize functionality and design solutions without fully considering the attitudes and lifestyles of the people they design for. This gap highlights the need for a more holistic approach to architectural and urban design, one that integrates the lived experiences of residents with the technical expertise of professionals. The study underscores the importance of balancing cultural values, community needs, and functional design to create resilient and adaptable spaces in the post-pandemic era. By bridging these perspectives, this research contributes to a deeper understanding of how built environments can better serve the evolving needs of communities in times of crisis and beyond.

**Keywords:**

Community, Pandemic, Post-pandemic architecture, Spatial dynamics, Social interaction

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# A role of stack effect in thermal comfort in residential building- a case of Morang

*Surya Guragain* [a], *Sanjaya Uprety* [b]

**Abstract:**

The stack effect plays a crucial role in maintaining thermal comfort in residential buildings by facilitating natural ventilation and passive cooling. This study examines the role of stack effect (*Murgar*-typical tharu word for stack projection) in the vernacular residential building in the context of Budhiganga rural municipality of Morang district, where hot and humid climatic conditions influence indoor airflow dynamics. Through field measurements and simulations, we analyze temperature differentials ( indoor, outdoor and attic spaces) and degree discomfort hours to assess the effectiveness of stack-driven ventilation. The findings highlight design considerations that optimize thermal comfort by reducing the reliance on mechanical cooling systems. This research provides insights for energy-efficient building design tailored to the local climate in terai region.

**Keywords:**

Stack effect, *Murgar*, natural ventilation, thermal comfort, passive cooling

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# Systematic Review of Behavior Setting in Campus Landscape

*Ishwor Khanal* [a], *Bijay Lal Singh* [b]

**Abstract:**

Campus outdoor spaces are not formally associated with academic or administrative activities, but they also have the potential to be used for a variety of student activities, such as walking, sitting, resting, and studying, which can provide both aesthetic and social pleasure. Campus landscapes are being neglected as functional space in a third-world country like Nepal. This research aims to evaluate the behavior setting of the Mahendra Ratna Campus using the behavior mapping technique. The results are analyzed by descriptive methods, integrating the interviews. This research finds that the behavior of users is dependent on spatial configuration, environmental factors, and accessibility, which ultimately influences their engagement and interactions in campus landscapes.

**Keywords:**

Behavior setting, Campus landscape, Behavior, Ecological psychology

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# Post-Disaster Road User Cost Analysis- Case Study of BP Highway (NH13)

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**Abstract:**

Road User Costs (RUC), encompassing Vehicle Operating Costs (VOC) and Travel Time Costs (TTC), are critical economic indicators for assessing transportation infrastructure resilience. This study evaluates the impact of post-disaster disruptions on RUC along the Dhulikhel-Barkhekhola section of Nepal's BP Highway (NH13), severely damaged by floods and landslides in late 2024. Utilizing the HDM-4 model, the analysis compares pre- and post-disaster RUC by integrating field surveys, road roughness data, and traffic statistics. Results reveal a 15% overall increase in RUC (NRs 18 crore/km), with VOC surging by 16% (NRs 16 crore/km) and TTC by 8.7% (NRs 2 crore/km). Heavy trucks and medium buses experienced the highest cost escalations, driven by fuel consumption (e.g., heavy truck fuel costs rose from NRs 192.18 to 343.04/km) and passenger time delays. Detours and degraded road conditions, including an 8.53 km washed-out stretch with 18 temporary bypasses, exacerbated these costs. The study underscores the vulnerability of Nepal's strategic road networks to natural disasters and highlights the urgency of resilient infrastructure planning. While accident costs were excluded, findings emphasize prioritizing road maintenance, detour management, and targeted policies to mitigate economic burdens on users. This analysis provides a framework for disaster-responsive transportation strategies in geologically unstable regions.

**Keywords:**

Road User Cost, Vehicle Operation Cost, Travel Time Cost

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# Geological Challenges in Tunneling: Case Studies of Two Prominent Projects in Nepal

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**Abstract:**

The Himalayan region presents complex geological challenges for tunneling due to active tectonic processes and highly variable rock formations, which often result in tunnel deformation and project delays. This work examines two major tunneling projects in Nepal: the Tanahu Hydropower Project, where deformation of about 1.09 m has occurred and solved by drift construction and there is still deformation from chainage 0 + 570 to 0 + 583 m, which is left untreated, and the Sunkoshi Marin Diversion Multipurpose Project (SMDMP) where there are in total nine stoppages and these stoppages were solved by the construction of a bypass tunnel and pu grouting. Through different approaches combining field visits, literature reviews, and case study analysis, the research addresses the challenges encountered during tunnel construction and engineering solutions that were applied to mitigate these challenges. The key key findings emphasize the causes of deformations in the Tanahu Hydropower project and TBM stoppages in Sunkoshi marin diversion multipurpose project along with solutions applied to solve these problems. In this study, the literature review of the number of projects for the challenges faced and the mitigation applied to address the problems is mentioned. The research concludes that advanced pre-investigation geological surveys with flexible design are critical for successful tunneling in Nepal.

**Keywords:**

Tectonic Stress, Squeezing, Tunnel Boring Machine (TBM), Geological

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# Field and Numerical Stress-Strain Evaluation of Pavement Reinforced with Geogrid under Dynamic Loading

*Aanchal Tiwari* [a], *Rajan Suwal* [b], *Padma Bahadur Shahi* [c]

**Abstract:**

This study evaluates the performance of pavements with geogrid reinforcement under dynamic loading using field measurements and numerical simulations. Data from the TATA Truck Tipper SK 1613 and Ford Ranger under point/line and area loads were analyzed at constant and 5 km/h speeds. Principal and total stress-strain values were computed using a linear elastic model, and a 3D analysis in Plaxis was conducted using data from the Arughat-Okhale section of the Midhill Highway. Key field locations, including 50 percentage of base thickness, were targeted to address structural deficiencies. Moisture sensors assessed moisture-dependent behavior under undrained subgrade conditions. Results show that the use of geogrid improves both compressive and tensile stress-strain behavior, helping to mitigate structural deficiencies and surface distresses. Area loads provided a more accurate simulation than point/line loads. This study offers insights into optimizing pavement designs with geogrid reinforcement to enhance durability and performance under dynamic loads and moisture variability.

**Keywords:**

Vehicle load configuration, dynamic loading, geogrid reinforcement, stress-strain behavior, Pavement Performance

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# Willingness To Pay For Reducing Fatal Road Crashes By Long and Medium Route Public Vehicle Passengers

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**Abstract:**

Studies on public attitudes toward road safety and their willingness to pay (WTP) for reducing crash risks are insufficient in Nepal, leaving limited evidence to guide decision-makers in prioritizing road safety investments. This research aims to estimate WTP of people for reducing road crash fatalities. Discrete choice questionnaire survey was conducted among long and medium-route public vehicle passengers to 37 different locations in Nepal with public vehicle access. The study considered three key attributes: annual number of fatalities, travel time, and fare. By using actual baseline values and realistic levels eight practical combinations were generated, enabling respondents to make informed and meaningful choices. This approach distinguished the study by enhancing the realism and reliability of the responses. WTP value was found to be Rs 16.42 per person per trip.

**Keywords:**

Willingness to Pay, Discrete Choice, trade-offs

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# A Case Study of Tunnel Portal Instability at Siddhababa Road Tunnel

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**Abstract:**

This study investigates the instability of the north portal slope of the Siddhababa Tunnel located in Palpa district, Lumbini province, Nepal through analytical and numerical back-analysis. Geological mapping identified four material types: colluvium soil, fine-medium-grained sandstone, interbedded siltstone-mudstone, and interbedded sandstone-mudstone. Field mapping and laboratory tests provided input data for numerical modeling in RS2. Stability analysis was conducted under natural and post-excavation conditions. Analytical methods using Barton-Bandis and Mohr-Coulomb criteria yielded FOS values of 0.75 and 0.58, respectively, indicating post-excavation instability. Numerical modeling showed a critical SRF of 1.46 for the natural slope, decreasing to 0.8, 0.76, and 0.75 after successive excavation stages. The results confirm that the natural slope is stable but becomes progressively unstable with excavation. Excavation without support significantly reduces stability, increasing the risk of failure. Strength parameters such as cohesion, friction angle, unit weight, modulus of elasticity, Poisson's ratio, UCS, and GSI were carefully evaluated for different layers. The study highlights the importance of reinforcement measures to prevent slope failure. Findings provide valuable insights for tunnel portal design in similar geological settings. The study also emphasizes the role of numerical modeling in assessing excavation impacts. Comparing results from analytical and numerical methods helps assess the accuracy of stability predictions.

**Keywords:**

Portal Stability, RS2, SRF, Finite element method, Numerical modeling

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# Synthetic Data Generation of Electronic Health Records using CTGAN, Transformers and Diffusion Models

*Arjan Sapkota [a], Girban Adhikari [b], Jivan Acharya [c], Subarna Ghimire [d], Umesh Kanta Ghimire [e]*

**Abstract:**

The increasing importance of Electronic Health Records (EHR) for medical research and clinical applications necessitates the generation of high-quality synthetic data that preserves patient privacy. This study evaluates and compares the performance of Conditional Tabular Generative Adversarial Network (CTGAN), Transformers-based models (REaLTabFormer), and Diffusion Models (TabDDPM) across multiple medical datasets. Our findings demonstrate that TabDDPM consistently outperforms other models in generating synthetic data that closely mirrors real-world distributions, effectively preserving statistical properties and feature relationships. Its ability to maintain complex dependencies and capture variations in the data makes it the most reliable choice for synthetic EHR generation. While CTGAN proves to be a strong alternative, particularly excelling in certain datasets, its performance is less stable across different distributions, leading to occasional deviations from real data characteristics. REaLTabFormer, on the other hand, shows potential in specific cases but struggles to maintain statistical integrity and generalization across diverse datasets, limiting its effectiveness in some scenarios.

**Keywords:**

CTGAN, Diffusion Models, GAN, Synthetic Data Generation, Transformers

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# Semantic Segmentation of Medical Images for Brain Tumor Detection using DeepLabv3+ Model

*Bibat Thokar* [a], *Binod Sapkota* [b]

**Abstract:**

Medical imaging is the foundation for diagnosing and evaluating severe diseases. To streamline the often time-consuming task of analyzing these images, an automated method for identifying abnormal regions is necessary. Given the scarcity of medical imaging data, advanced deep learning models for multi-class segmentation have been developed. However, many existing frameworks are not sufficiently adaptable. To overcome this limitation, sophisticated architectures have been integrated to enhance segmentation accuracy. Specifically, the DeepLabv3+, allows it to more effectively detect structural details in medical images. The ResNet50 model has been integrated as a backbone network to enhance the performance of the proposed Deeplabv3+ model. The brain tumor dataset, gathered from diverse sources, underwent preprocessing techniques such as image augmentation, contrast-limited adaptive histogram equalization, and normalization. These datasets were then divided into training, validation, and testing subsets for efficient utilization. The training subset was employed to train the deep learning model, with the adaptive moment estimation optimizer facilitating the optimization process. Model performance was evaluated using categorical cross-entropy to determine loss. Finally, the trained models were tested on the testing dataset, with performance metrics including $accuracy$, $precision$, $recall$, $F1-score$, $dice\ coefficient$, and $validation\ dice\ coefficient$ used to gauge the effectiveness of the deep learning framework.

**Keywords:**

Medical image, Segmentation, DeepLabv3+, ResNet50, Adam Optimization

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# 5G End-to-End Optimal Network Planning using Metaheuristic Algorithms

*Prabin Dhakal* [a], *Nanda Bikram Adhikari* [b]

**Abstract:**

This research aims to address the optimization complexities of 5G network using Machine Learning based metaheuristics algorithms. An end-to-end 5G network with two slices of Ultra low latency and High Bandwidth was simulated to collect network parameters' data and fed to Optimization algorithms. Particle Swarm Optimization (PSO) and Simulated Annealing (SA) were able to handle optimization of 5G network parameters with ease. However, PSO was found to be faster compared to SA based algorithm in optimization of 5G parameters like delay, jitter and throughput in uni-variate and multi-variate optimization scenarios.

**Keywords:**

5G, PSO, SA, URLLC, eMBB

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# Endostab: A Pre-Processing Tool for Endoscopy Videos

*Sabita Rajbanshi* [a], *Binod Bhattarai* [b], *Shishir Adhikari* [c]

**Abstract:**

Video stabilization has been a focus of research for the past decade, but stabilizing medical videos, especially in endoscopy and surgery, remains challenging due to narrow fields of view, irregular organ shapes, and illumination variations. This study addresses the critical need for surgical video stabilization by proposing a hybrid fusion-based method. The approach begins with motion estimation and smoothing to reduce large motion fluctuations, though this may lead to aggressive cropping and content loss. To mitigate this, warping is applied to align neighboring frames with the target frame in a virtual camera space. Missing pixels caused by warping are reconstructed using RAFT, an optical flow estimation technique, which projects pixels from adjacent frames to fill gaps and ensure seamless output. The stabilization process is further refined through a hybrid fusion method, which combines feature-space and image-space fusion techniques to enhance video quality and stability. A quantitative analysis was conducted to assess the quality of endoscopy videos after stabilization. The performance of the stabilization algorithm was evaluated using metrics such as the cropping ratio, distortion value, stability score, accumulated optical flow, and Peak Signal-to-Noise Ratio (PSNR). The result shows that a cropping ratio close to 1 indicates that the algorithm successfully retains the full field of view. Furthermore, the average PSNR improved from 31.65 in shaky videos to 33.06 in stabilized videos, demonstrating improved visual quality. Stabilized endoscopy videos achieve better classification performance than unstable ones. The ROC scores for shaky videos in class 0, class 1, and class 2 are 0.66, 0.52, and 0.49, respectively, while stabilized videos achieve 0.64, 0.73, and 0.71. These results demonstrate that stabilization improves video quality and improves the accuracy of classification for downstream tasks.

**Keywords:**

classification, endoscopy videos, motion estimation, optical flow, video stabilization

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# Movies Ratings Classifier Using Random Forest Model

*Biswash Koirala* [a]

**Abstract:**

In the digital era, where users continuously scroll through vast amounts of data, effective content recommendation is essential. Video content dominates social media, and dedicated movie streaming platforms host extensive collections tailored to diverse viewer preferences. Accurate prediction of user ratings for movies enables better recommendations. This study aims to predict movie ratings using a Random Forest model trained on the MovieLens-1M dataset, which contains user ratings, movie titles, and genre information. Data exploration, preprocessing, and feature engineering were conducted, including one-hot encoding categorical variables and performing stratified sampling to balance ratings. Hyperparameter tuning was applied to optimize the model, along with preprocessing techniques such as scaling and dimensionality reduction using principal component analysis. The dataset was divided into training and test sets, with the Random Forest model trained on the former and evaluated on the latter. The model achieved 50% accuracy in classifying five rating categories, improving from an initial 20% through these enhancements.

**Keywords:**

Random Forest, Classification, Accuracy, Stratified Dataset, Ratings, Users

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# Dermatoscopic Image Classification Using EfficientNet and SpinalNet with Data Balancing and AI Explainability

*Datenji Sherpa* [a], *Dibakar Raj Pant* [b*]

**Abstract:**

Dermatoscopic image analysis for early detection of skin cancer is critical, but class imbalance, noisy images, and high computational costs render automated solutions challenging. This study presents a novel lightweight hybrid model (Efficient_SpinalNet), that combines EfficientNet-B0 and SpinalNet for dermatoscopic image classification.The EfficientNet-B0 model is chosen for its balance between performance and computational efficiency, offering high accuracy with minimal computational overhead. SpinalNet is integrated to reduce the number of parameters, improving efficiency and speed. To balance the classes in the HAM10000 dataset, we use DCGAN to generate synthetic images and also applied traditional data augmentation to the underrepresented classes. The proposed Efficient_SpinalNet achieves an overall test accuracy of 90.46%, demonstrating strong classification performance across all the classes. Post-hoc explainability techniques: SHAP and Grad-CAM provide insights into the model's decision-making process, offering transparency and clinical validity as well. With only 6.17 million parameters (23.54 MB), the proposed model is computationally efficient and hence appropriate for real-world use in a resource-constrained environment.

**Keywords:**

Dermatoscopic Image Classification, EfficientNet, SpinalNet, DCGAN, SHAP, Grad-CAM

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# Assessing Geohazard Risks in Hydropower Costs for Sustainable Power Development in Nepal

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**Abstract:**

Nepal's immense hydropower potential is pivotal for achieving a sustainable and low-carbon energy system. However, hydropower development in Nepal is significantly influenced by geo-hazard risks, such as earthquakes, floods, landslides, and glacial lake outburst floods (GLOFs), which can escalate costs and jeopardize project viability. This research introduces a novel framework that incorporates geo-hazard risk factors into hydropower cost assessments and integrates these assessments into a dynamic power sector model to evaluate clean energy deployment in Nepal's power generation mix. The study employs IBM ILOG CPLEX optimization software to optimize hydropower expansion by systematically integrating geo-hazard risk-adjusted costs, ensuring cost-effective capacity expansion and resource allocation. The model evaluates Nepal's power generation and capacity mix from 2020 to 2050, offering insights into the strategic deployment of hydropower projects to balance economic and environmental sustainability. The results indicate that while total installed power capacity reaches 104.3 GW, 111.3 GW, and 126.4 GW by 2050 in the three scenarios, full hydropower expansion is not the most cost-effective strategy. Hydropower utilization remains below 42 GW in all cases, emphasizing the need for resource diversification. Solar PV achieves its full potential of 20 GW across all scenarios, while hydrogen storage sees significant growth, with hydrogen tanks increasing by 11.97 GW in the Risk-Based scenario. The shift towards a more diversified energy mix leads to reduced dependence on costly storage-type hydropower by 0.14 GW and 0.5 GW in the Varying and Risk-Based scenarios, respectively. The total energy generation in 2050 surpasses 230 TWh across all scenarios, meeting the projected demand of 191.15 TWh, with hydropower contributing approximately 78–79%. This research provides a comprehensive pathway for optimizing Nepal's hydropower resources, ensuring an efficient and resilient energy transition while addressing growing electricity demand.

**Keywords:**

Cost Optimization, Geo-hazard Risk, Dynamic power sector model, IBM ILOG CPLEX, Clean Energy, Power Sector of Nepal

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# Geo-technical Evaluation of Water Hyacinth(Jalakumbhi) Fiber-Reinforced Soil

*Anil Adhikari* [a], *Parkash Chandra Joshi* [b], *Sushil Adhikari* [c]

**Abstract:**

This study investigates the geotechnical performance of silty clay soil reinforced with water hyacinth. The primary objective is to determine the optimal mix proportion of water hyacinth fibers to enhance soil properties. Soil samples from Lakeside, Pokhara, were tested by incorporating root fiber, stem fiber, and a combination of both in varying percentages. Laboratory tests including standard proctor, California bearing ratio (CBR), unconfined compressive strength (UCS), triaxial, and consolidation tests were conducted to evaluate the effects of fiber reinforcement. The results indicate a significant improvement in soil properties with fiber addition. The maximum dry density (MDD) increased with fiber content up to 0.75% root fiber, 1% stem fiber, and 0.5% mixed fiber, beyond which it declined. The CBR value of natural soil (2.08%) increased to 5.53% with 0.75% root fiber, 5.32% with 1% stem fiber, and 4.27% with 0.5% mixed fiber. Similarly, UCS increased from 57.99 kPa in natural soil to 126.80 kPa, 123.85 kPa, and 107.14 kPa with 0.75% root fiber, 1% stem fiber, and 0.5% mixed fiber, respectively, identifying 0.75% root fiber as the optimal content. Shear strength parameters in triaxial tests also improved, with cohesion increasing from 16.69 kPa (UU test) to 29 kPa and deviatoric stress at failure increasing from 82 kPa to 101 kPa. Consolidation parameters showed a decrease in compression index (Cc) from 0.149 to 0.1377 and an increase in preconsolidation pressure from 180 kPa to 210 kPa, indicating enhanced stability. The study concludes that water hyacinth fiber reinforcement significantly improves soil strength, stability, and load-bearing capacity, making it a viable and sustainable alternative for soil improvement.

**Keywords:**

:Water hyacinth fiber, silty clay soil, geotechnical properties, fiber reinforcement, CBR, UCS, triaxial test, consolidation parameters

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# Performance Evaluation of Residential Buildings Constructed at Differential Foundation Level

*Pratham Pudasaini [a], Prabesh Pathak[b], Nischal Raj Timilsina [c], Pawan Bhandari [d], Insaph Angdembe [e], Pratham Acharya [f], Shrutee Karna [g]*

**Abstract:**

This project evaluates the performance of structures built on varying foundation levels, a scenario common in hilly and uneven terrains like those in Nepal. Rapid urbanization, scarcity of land, and high property values have limited construction on plain ground, prompting the adaptation of building houses on sloped terrains. This study focuses on the structural integrity, stability, and resilience of residential buildings with foundations at different depths due to topographical constraints. Residential buildings within the Kathmandu Valley, specifically in Tokha and Tarkeshwor, were selected from municipal records and analyzed as per NBC 105: 2020. Using finite element-based software ETABS (Version 21.0), buildings on slopes were modeled with variations in bay configuration, geometry, and storey height. Seismic performance parameters such as storey shear, inter-storey drift, fundamental time period, and top-storey displacement were evaluated through the equivalent static method and response spectrum analysis. Results indicate that step-back buildings exhibit lower base shear and shorter time periods compared to those on flat terrain, leading to reduced top-storey displacement. Pushover analysis was also performed to assess structural behavior under lateral loads. Although, building configuration plays a vital role in its performance, the pushover analysis showed that the stepped building performed better across the slope than along the slope. The findings highlight the challenges of sloped terrains and provide recommendations for improving the resilience and service life of such buildings in seismic-prone regions.

**Keywords:**

ETABS, performance analysis, pushover analysis, seismic analysis, step-back building

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# Numerical Analysis of Stone Columns as Ground Improvement for Soft Soil – A Case Study

*Chhatra Jora* [a], *Surendra Prasad Joshi* [b], *Santosh Kumar Yadav* [c]

**Abstract:**

This paper presents a comprehensive study on the behavior of stone columns group in improving the load-bearing capacity and reducing settlement of soft soil foundations. The study is conducted using field tests and numerical simulations using the Finite Element Method (FEM), adhering to the guidelines of IS:15284 (Part 1) 2001. The results are compared to field plate load test validate the accuracy of the numerical model and provide insights into the effectiveness of stone columns in geotechnical engineering. The triangular pattern and square pattern arrangement of stone column are compared, triangular pattern shows more efficacy in decreasing settlement.

**Keywords:**

Soft soil, Stone Column, FEM, Plate Load Test, Settlement

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# Dynamic Soil Structure Interaction For High Rise Buildings In Kathmandu Valley

*Bikram Paudel* [a], *Jagat Kumar Shrestha* [b]

**Abstract:**

Kathmandu Valley, which is located in the central part of Nepal and lies between the Indian plate & the Eurasian plate, is one of the most seismically active zones in Nepal. With the growing population in Kathmandu Valley, there is a high demand for high-rise structures in the valley. As this region is vulnerable to seismic events and dynamic soil properties differ a lot from one location to another, varying soil properties are seen even in the same location. According to the conventional approach, while designing the building, soil & structure are analyzed separately & effects of Soil Structure Interaction (SSI) are neglected. This study examines the effects of 10-storey and 15-storey buildings with and without the effect of Soil Structure Interaction. The study was done in five different locations of Kathmandu Valley with varying types of soil. The analysis was performed in SAP2000 v21 and DEEPSOIL v7.0 for ground motion de-convolution. The Loma-Gilory earthquake was used as input ground motion, and the dynamic response of the structure was computed through Time History Analysis. Soil Amplification, fundamental time period, base shear, lateral displacement & base displacement were seen through the study. Time period, lateral displacement was increased whereas base shear was decreased in the analysis. Effects of SSI were seen more in 10-storey buildings than in 15-storey buildings. These changes are attributed to the inclusion of Soil-Structure Interaction effects.

**Keywords:**

Soil Structure Interaction(SSI), Direct Method, De-convolution, Ground Response Analysis.

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# Performance Evaluation of Raft Foundation with Embedded Piles Analytically and on varied loading conditions using Plaxis 3D: A Case Study on Building Complex at Maharajgunj, Kathmandu

*Suresh Chaulagain* [a], *Indra Prasad Acharya* [b]

**Abstract:**

In cases where a conventional raft foundation fails to meet design requirements, the incorporation of piles can enhance its performance by minimizing total and differential settlement. This approach, known as a Combined Piled Raft Foundation (CPRF), is being implemented in the construction of a building complex at Maharajgunj, Kathmandu. This study evaluates the overall performance of the CPRF system through both numerical and analytical analyses, including liquefaction assessment. The analytical analysis revealed that the load-sharing ratio between the pile and raft was 61 and 39 percent respectively, with a settlement of 95 mm. These results closely matched the numerical analysis, which produced a load-sharing ratio of 63 and 37 percent respectively with an identical settlement of 88 mm. Additionally, parametric analyses were conducted to assess the impact of factors such as pile spacing, pile inclination, pile depth, groundwater table position, and geotechnical uncertainty parameters—including cohesion, unit weight, and friction angle—on bearing capacity, settlement, and the factor of safety of the CPRF system. The findings provide valuable insights into optimizing CPRF design for enhanced performance in complex geotechnical conditions.

**Keywords:**

Combined Pile Raft Foundation,PDR method,Finite element method,Parametric Analysis,Liquefaction Analysis

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# Dynamics of Land Use Change of Urban Fringe and Possible Intervention: A Case Study of Dhapakhel, Lalitpur

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**Abstract:**

Dhapakhel, located in known traditional district Lalitpur of Bagmati province of Nepal has developed mixed character of urban and rural, most suitably called as urban fringe of Lalitpur metropolitan city. This study is important to understanding the drivers of growth can help predict future urbanization trends and can possibly fill data gaps related to urban-rural interactions. However, this particular area has not been studied yet and need to know the underlying factors of land-use change in this area and problem arises by the transformation. The main objective of the study is to gain understanding of the urban dynamics of fringe area in regional and national scenario and suggest for possible interventions taking Dhapakhel as an example. Primary data were collected using focus group discussions and key informant interviews; in addition, spatial data including Sentinel-2 imageries of 2014 and 2024 were utilized to determine the Land-use change and transformation scene by performing land use land cover mapping for Dhapakhel for 2014 and 2024 by using the Semi-automatic Classification Plugin using GIS Software. Land use change, population growth and migration and inadequate infrastructure are known a dynamic of urban fringe.Further, analysis revealed that rapid urban expansion, unplanned infrastructure development, and population growth in the areas of this study significantly impact on water resources; change in natural flow pattern of storm water consequence of transformation; agriculture/vegetation to built-up, drainage management in low lying area has been a problem in the case of Dhapakhel. Congestion is also an underlying problem arisen from the land use chnage, as a population demand for transportation infrastructure. The finding suggest that, the implementation of integrated urban planning strategies that prioritize sustainable drinking water and storm water management through a technical and economic solution and road expansion is an immediate way to deal with congestion abide by the national urban road standards prevailing in the area. The results indicate possible future implications on sustainable development management in Dhapakhel, Lalitpur, also regularly analyzing the spatial growth of built-up areas and other land use changes can serve as a crucial tool for effective land use management and informed decision-making.

**Keywords:**

Land use, Urban fringe, Land use Classification,GIS, Intervention

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# Defining the Morphological Characteristics of Tatopani in context of Tourism

*Mahendra Raj Khatri* [a], *Jiba Raj Pokharel* [b]

**Abstract:**

This study examines the morphology of the hilly settlement of Tatopani in Jumla, Nepal, to understand its spatial patterns, architectural features, and their implications for tourism development. It explores how natural, cultural, and socioeconomic factors influence the settlement's form, highlighting the interplay between the built environment and the region's unique geographical setting. The research investigates the current tourism scenario of Tatopani, identifying both opportunities and challenges for growth. Using a mix-method approach, including GIS-based spatial analysis, field observations, and key informant interviews, the study maps the spatial configuration of traditional housing clusters, public spaces, and cultural landmarks. It also examines how the settlement's verticality, compactness, and integration with the natural landscape contribute to its distinct character. The findings reveal that Tatopani's Hot spring, Masto Than na culture , and Marsi Rice Field are key morphological features that can be strategically mobilized to enhance tourism. By preserving traditional settlement patterns and promoting cultural heritage, the study emphasizes the potential for sustainable tourism development that respects the local environment and community values. The research concludes that leveraging Tatopani's unique morphological characteristics can effectively position it as a culturally vibrant and environmentally sustainable tourism destination.

**Keywords:**

Morphology, Tourism, Tatopani

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# Fate of Agricultural Areas of Saptari District of Nepal: A Temporal Land Use Land Cover Change (LULC) Analysis Using Remote Sensing And GIS

*Bishal Thapa [a], Aditya Dhakal [b], Uttam Prasad Lamichhane [c]*

**Abstract:**

The study provides a detailed evaluation of land use and land cover (LULC) changes, emphasizing their significance in remote sensing and GIS studies. This research examines land transformation over time to assess the future of agricultural areas in the Saptari district, Nepal, while also suggesting effective adaptation strategies for agricultural management and long-term planning.The study utilizes LULC maps from RDS, ICIMOD, Kathmandu, and applies supervised image classification for the years 1990, 2000, 2005, 2010, 2015, 2020, and 2024. The GIS and remote sensing analysis was conducted using ArcGIS 10.8. Through Geographic Information Systems (GIS) and remote sensing data, the research offers an extensive analysis of agricultural land changes in Saptari district. The time-series data from 1990 to 2024 highlights significant variations in forest cover, water bodies, agricultural land, built-up areas, and the emergence of grassland and barren land. Over this period, settlement areas expanded significantly by 20%, forest cover increased by 5.71%, barren land grew by 26%, and water bodies saw a slight rise of 0.9%. However, agricultural land declined sharply by 43.5%. These LULC changes indicate a continuous rise in settlements and barren land, with urbanization being a major driving force behind the reduction in agricultural land. The most affected areas include Kanchanpur, Fattepur, Mahuli, and Rajbiraj. The fluctuating trends in vegetation, agriculture, and water bodies suggest that human activities are accelerating land degradation, leading to a decline in agricultural land. To mitigate this impact, effective agricultural management practices and government policies are necessary to prevent further degradation of land resources caused by human activities.

**Keywords:**

Saptari, land use and land cover (LULC), Agriculture, Built up area, remote sensing, GIS

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# Temporal Study of Land Use Change in East Kathmandu : A GIS Based Study on Agricultural Land Transformation and Urbanization Trends

*Subash Kalathoki* [a], *Adhish Kumar Khadka* [b]

**Abstract:**

Urban expansion and land-use change have become critical challenges in rapidly developing regions. This study examines the spatio-temporal dynamics of land use and land cover (LULC) changes in the eastern part of Kathmandu Valley from 2015 to 2024, with a focus on urbanization trends and their impact on agricultural land. The shift is primarily driven by rapid population growth, economic expansion, and infrastructure development. Our findings reveal a significant increase in built-up areas, accompanied by the loss and fragmentation of agricultural land. This aligns with broader urban sprawl trends observed in other major Nepalese cities, including Kathmandu, Bharatpur, Dhangadhi, and Biratnagar. However, compared to national and global trends, the pattern in eastern Kathmandu exhibits unique characteristics influenced by local planning policies, topographical constraints, and socio-economic factors.

Using high-resolution satellite imagery and GIS-based spatial analysis, we quantify the extent of LULC transformation and explore the relationship between settlement expansion, population growth, and agricultural land conversion. Unlike previous studies that primarily focus on general urbanization trends, our research emphasizes the spatial correlation between demographic shifts and land use changes, filling an essential gap in the literature. The findings underscore the urgent need for sustainable urban planning policies to mitigate uncontrolled urban sprawl and preserve agricultural resources.

**Keywords:**

Temporal, Land use, Agricultural, Geo-spatial, Urbanization

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# Territoriality in Urban Design: A Systematic Review of Its Relationship with Spatial Organization and Hierarchy of Spaces in Neighborhood Planning

*Dipika Tandukar* [a], *Bijay Singh* [b]

**Abstract:**

Urban environments are notably shaped by territoriality, which comprises of cognitive, behavioral, and spatial dimensions. Territoriality plays an important role in influencing how communities organize and interact within their neighborhoods. This systematic review explores the relation between territoriality and two key neighborhood planning principles- spatial organization and hierarchy of spaces, to provide a comprehensive understanding of their relationship in urban design. By synthesizing literature from urban planning and territorial studies, the review highlights how territorial cognition, behavior, and space contribute to the structuring of spatial hierarchies and the organization of urban environments. The findings reveal that territoriality significantly impacts the spatial configuration of neighborhoods, influencing the distribution of private, semi-private, and public spaces. The review also identifies key themes and research gaps, emphasizing the need for context-sensitive approaches that integrate territorial dynamics into spatial planning. The results form a foundation for future research and practice in urban design, offering insights into creating inclusive and functional urban environments.

**Keywords:**

Neighbourhood planning, Territoriality, Urban Design

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# Urban Expansion In Green Zones Of Urban Edge: A Case Of Giri Bandu Tea Estate Birtamod, Jhapa

*Binita Khadka* [a], *Sudha Shrestha* [b]

**Abstract:**

Urban expansion at the edge of cities has become a pressing issue, particularly in regions with significant green landscapes. This paper tries to have a better understanding about the transformation of Giri Bandhu Tea Estate in Birtamode Municipality, jhapa district due to urban expansion. Specifically, this paper aims to identify key factors driving this expansion, analyzes stakeholder responses towards the socio-economic and environmental consequences. A mixed-method approach, incorporating site observations, stakeholder interviews, and secondary data analysis, is utilized. The findings highlight the impacts of rapid urbanization, including the loss of farm land and ecological degradation, underscoring the need for sustainable urban planning strategies. Aims to provide the systematic, reliable and latest data related to population growth urbanization process and land use land cover dynamics Furthermore, the study discusses policy gaps and challenges in urban governance that contribute to the unchecked conversion of green spaces into urban settlements.

**Keywords:**

Urban Expansion, Green Zones of Urban edges, Peri-Urbanization, land use change and tea Estate conversion

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# Role of Urban Green Space for Social Sustainability: A Case of Hetauda

*Dikshya Shrestha* [a], *Sudha Shrestha* [b]

**Abstract:**

The future of urban development is closely tied to sustainability, which encompasses economic, environmental, and social dimensions. However, the social dimension of sustainability has received much less attention despite increasing urbanization. This paper examines the current state, distribution, and social sustainability dimensions of UGSs in Hetauda, while identifying key challenges in their integration into urban planning. In this research a mixed-method approach was employed, incorporating observational research, resident surveys, GIS mapping, key informant interviews with municipal officials. The results of the research identified disparities in UGS distribution, with well-maintained parks enhancing recreational and social interactions, improve quality of life while neglected spaces suffer from poor accessibility and infrastructure. This study identified barriers to urban green space integration in Hetauda, including space scarcity, poor maintenance, financial constraints, and weak policy enforcement highlighting the need for better planning and inclusive policies for sustainable development. The evidence presented in this paper advocates for targeted interventions and strategic planning efforts that collectively contribute to creating resilient and inclusive urban communities.

**Keywords:**

Urban Green Spaces, Role, Social Sustainability, Dimensions, Public Space

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# Evaluation of the Dynamic Response of Underground Transportation Tunnels to Surface Explosions Considering various Rock Masses

*Vivek Mandal*[a], *Sujan Tripathi*[b]

**Abstract:**

This study investigates the dynamic response of the underground transportation tunnel subjected to surface explosion, focusing on stress wave propagation, nonlinear material behavior and structural response. Using Finite Element Modeling (FEM) in Abaqus/Explicit, this study evaluates the influence of critical design parameters: rock mass properties, lining material properties and TNT charge weight on response of the tunnel structure. The Concrete Damage Plasticity (CDP) model was employed to simulate the nonlinear material behavior of C25-grade concrete linings to capture both tensile and compressive responses. The surrounding geological medium was characterized using the Mohr-Coulomb failure criterion to account for shear strength and plasticity in soil-rock interactions, while reinforcement bars were modeled with the Johnson-Cook constitutive law to incorporate strain rate sensitivity and dynamic yield behavior. Blast loads were simulated as pressure-time histories. Parametric studies revealed that the tunnel crown emerged as the most vulnerable region, while the invert exhibited minimal deformation. The reinforcement bars in the concrete lining help reduce tensile failures, stresses and deformations, enhancing its role in blast resilience. Among the studied rock types, limestone exhibits the least displacement and stress due to its high stiffness, while phyllite and slate experience prolonged deformations and stress.

**Keywords:**

Dynamic Response, Underground Transportation Tunnels, Non-linear Material Behavior, Abaqus/Explicit, Concrete Damage Plasticity

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# Analysis of stress-induced plastic deformation in the headrace tunnel of Bhotekoshi-1 Hydropower Project, Sindhupalchowk, Nepal

*Sandesh KC [a], Pawan Kumar Shrestha [b], Sagar Adhikari [c]*

**Abstract:**

In the Himalayas, tunnelling poses significant challenges due to the complex geology and topography. Stability of tunnel depends on geological features like the orientation of foliation or bedding, joint sets, and their characteristics. Nepal's Himalayan region is often characterized by weak and unstable rock masses, making them highly susceptible to plastic deformation such as tunnel squeezing which is a stress-induced problem. Therefore, tunnelling project in this region requires proper planning, strategic positioning, and appropriate alignment for any tunnelling activities by taking into account of geological, topographical, and in-situ stresses. This study focuses on the analysis of plastic deformation in the headrace tunnel of Bhotekoshi-1 Hydropower Project. It involves the determination of input parameters from laboratory tests, literature reviews, case studies, and assessment of field data. Using various empirical, semi-analytical, analytical and numerical modeling, evaluation of deformation is done along with support requirements in the headrace tunnel. The paper concludes with a comparative analysis of different approaches and elucidation as per the results obtained.

**Keywords:**

Headrace Tunnel, Plastic Deformation, In-situ stress, Support Pressure

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# Structural and Stress Induced Stability Evaluation of the Adits and Main Access Tunnels of Bhotekoshi-1 Hydropower Project, Sindhupalchowk

*Sagar Adhikari [a], Pawan Kumar Shrestha [b], Sandesh KC [c]*

**Abstract:**

Tunneling activities in Nepal have surged with the rise of numerous hydropower and road projects. In the design phase, selection of tunnel alignment, accuracy in estimation of distribution of rock mass quality along the tunnel and rock support requirements critically influence a project's overall cost and construction timeline. Major decisions in planning, design and construction of tunnels are predominantly shaped by the geological conditions along the proposed tunnel route. Accurately prediction of quality of rock mass and assessing stress-induced issues are challenging tasks in the Nepal Himalayas, particularly as stress-related problems like tunnel squeezing frequently occur in weak rock and zones of weakness under high overburden. Squeezing issues in tunnels can occur in incompetent rock with moderate or high stress levels owing to high to moderate overburden when the tangential stress exceeds the strength of the rock mass. Whereas, rock spalling or even rock bursts occur when tangential stress surpasses rock mass strength in competent and brittle rock under high-stress circumstances caused by considerable overburden. This paper assesses similar phenomena in the tunnels of Bhotekoshi-1 Hydropower Project where the Adit and Main access tunnels to the Powerhouse passes through moderate to weak rock mass.

**Keywords:**

Deformation, squeezing, tunnel instability, weakness zone

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# Identifying the Ideal Underground Mining Technique for Ganesh Himal Mine, Nepal

*Nischal Khanal [a], Sijan Adhikari [b], Chhatra Bahadur Basnet [c], Ghan Bahadur Shrestha [d]*

**Abstract:**

The selection of mining methods in mining engineering is a complex and multifaceted process influenced by various factors, including geotechnical, geological, and economic characteristics. This study aims to identify the ideal underground mining technique for Ganesh Himal deposit, Nepal. Key factors considered in the decision-making process include deposit shape, dip, depth, ore thickness, grade distribution, recovery rate, and the strength of the ore, hanging wall, and footwall. To manage complexity of these diverse parameters, multi-attribute decision-making (MADM) approach is used, strengthening the decision model and addressing the limitations of conventional methods. The findings shows that ore-body rock substance strength hold the most importance in determining the underground mining method. Based on these results, shrinkage stopping was identified as the most suitable extraction method for the Ganesh Himal Mine.

**Keywords:**

Underground Mining, Method selection, MADM, AHP, PROMETHEE, TOPSIS, Ganesh Himal Mine

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# Construction Cycle of Drill and Blast Tunnelling in Siwaliks: A Case Study of Siddhababa Road Tunnel

*Sijan Adhikari [a], Nischal Khanal [b], Ghan Bahadur Shrestha [c], Chhatra Bahadur Basnet [d]*

**Abstract:**

This study examines the geological conditions and their impact on construction cycle of a tunnel project in Siwaliks of the Nepal Himalaya, where interbedded sandstone and mudstone influence excavation challenges. This study also examines the duration of construction cycle for each activity involved in drill and blast tunneling. The 1126 meter long tunnel with a cross section of 110 square meters faces delays primarily due to weak rock classes such as MS-IV-A, which extend cycle times and require careful management of dummy holes and explosives. The research identifies key factors contributing to project delays and provides insights into improving planning, risk management and construction efficiency. The findings offer guidance for planners and estimators working in geologically similar regions aiming to mitigate time overruns in conventional tunneling projects.

**Keywords:**

Siwaliks, Siddhababa, Construction Cycle Time, Project Delays, Rock Classes

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# Blockfall Analysis at Tunnel Construction Site: A Case Study of The Siddhababa Road Tunnel, Nepal

*Bishal Khadka* [a], *Krishna Prasad Sharma* [b],
*Trilok Chandra Bhatta* [c], *Abhay Kumar Mandal* [d]

**Abstract:**

This study examines blockfall hazards at the Siddhababa Road Tunnel in Siwalik zone, where weak, interbedded rock formations pose stability challenges. The tunnel alignment consists of sandstone, mudstone, and shale, with varying weathering, jointing, and groundwater conditions affecting rock mass behavior. Discrepancies between predicted and actual geological conditions influenced tunnel stability and support requirements. Using UNWEDGE, ten tunnel sections were analyzed for wedge formation and failure potential. Two critical locations with a factor of safety below 1.5 were identified, indicating blockfall risk. These unstable wedges were assessed for geometry, failure mechanisms, and stabilization needs. Rock bolts and shotcrete were applied for reinforcement. Support design was based on Rock Mass Rating (RMR) classifications. The study highlights the importance of accurate geological predictions and systematic support measures in tunnel construction.

**Keywords:**

RMR, UNWEDGE, Blockfall, Factor of safety, Support design

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# Generative Adversarial Network for Image Inpainting

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**Abstract:**

Image inpainting is a crucial task in computer vision that involves restoring missing or corrupted regions of an image in a realistic manner. It is a very difficult effort to restore these imperfections in the acquired image during image processing. A variety of image-related problems, such as repairing damaged photos, inpainting images, increasing picture resolution, and more, can now be done by using deep learning algorithms like Convolutional Neural Network, Recurrent Neural Network, Generative Adversarial Network, and others. Recent advancement in deep learning have demonstrated the effectiveness of Generative Adversarial Networks (GANs) for high-quality image inpainting. In this paper, a GAN-based approach was used where a generator learns to predict missing regions while a discriminator ensures the inpainted regions are visually consistent. A Generative Adversarial Network model first sends an masked facial image to a U-net generator, which then utilized it to produce another fake image. Secondly, the original image was sent to the discriminator so that it may evaluate how well the generator recreated the masked area of the damaged image. For evaluation, key performance metrics including generator loss and discriminator loss along with structural similarity index measure (SSIM), and peak signal-to-noise ratio (PSNR) were monitored for the analysis of the results which was found to be the average peak signal-to-noise ratio: 21.982 dB the average structural similarity index measure: 0.7981.

**Keywords:**

GAN, Image Inpainting, restoration, CNN, Generator

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# Image Captioning using VGG16/XCEPTION-LSTM

*Manoj Luitel [a], Sanjivan Satyal [b], Ram Krishna Maharjan [c]*

**Abstract:**

This explores the task of image captioning using two deep learning architectures. Due to their demonstrated ability to extract high-level visual features from images, the VGG16 and Xception architectures are used as feature extractors. Although Xception uses depthwise separable convolutions to provide improved performance with less computational complexity, VGG16's deep and simple design makes it an excellent choice for spatial feature extraction. LSTM networks, which are specifically made to handle sequential data and provide coherent textual descriptions by predicting the next word in a sequence based on the picture properties and previously created words, are then fed these extracted features.The BLEU (Bilingual Evaluation Understudy) score, a commonly used metric for evaluating the quality of machine-generated text by comparing it to human-annotated reference captions, is used to thoroughly examine the performance of both models. A quantitative indicator of the efficacy of the models, the BLEU score calculates the accuracy of n-gram overlaps between the generated and reference captions. This work not only shows that CNNs and LSTMs can be combined to caption images, but it also compares the VGG16-LSTM and Xception-LSTM architectures. The findings provide important information for further study in multimodal deep learning systems by highlighting the advantages and disadvantages of each model.It may find use in automated media analysis, assistive technology, and content retrieval.

**Keywords:**

Image captioning, VGG16, Xception, LSTM, CNN, BLEU score, deep learning

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# Virtual Painting System using Finger Gesture Detection and Recognition

*Enzela Neupane[a], Grishma Shrestha[b], Liza Karki[c], Sarina Shakya[d], Bibat Thokar[e]*

**Abstract:**

Machines can now read and process visual data thanks to quickly developing technologies like computer vision and image processing. They are widely used in automation, augmented reality, and human-computer interface. Air Canvas is an innovative tool that uses mediapipe to enable air sketching with hand gestures without making physical contact. Digital art, virtual white boarding, and interactive learning are just a few of its uses. It is compatible with gesture games and augmented reality. Air Canvas uses a webcam or a camera module to capture live video. Hand movement is captured by image processing technologies such as contour detection, color segmentation, hand recognition, and hand tracking. The detected motion is followed up on a virtual canvas by the system, providing one in the air. When there is sufficient lighting and backdrop segregation, the device operates wonderfully. It provides a fault-free drawing experience with when coupled with real-time processing platforms. The hand landmarks has the value 4, the index finger tip has a landmark of 8. However, complex backdrops can cause variations in the performance. The key to future developments in touch-free human-computer interaction is Air Canvas, an interactive and user-friendly touch-free drawing tool that showcases the potential of hand gesture detection in education and creative applications.

**Keywords:**

Augmented Reality, Computer Vision, Digital Art, Mediapipe

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# 3D Scene Reconstruction from RGB Images Using Optimized Gaussian Splatting

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**Abstract:**

This research provides an optimized method for accurately reconstructing scenes with 3D Gaussian Splatting (3DGS). A smooth and artifact-free rendering is achieved using Gaussian functions to redefine a scene's geometry, color, and opacity. The method utilized within this study increases accuracy alongside computational efficiency. Although traditional methods such as mesh-based reconstructions or neural radiation fields (NeRF) could not efficiently multi-process 3D environments, the new optimized method of 3DGS has solved this problem. The reconstruction begins with the capturing of multi-angle images from drones and smartphones. These images undergo feature extraction, camera pose estimation, and undistortion to generate an initial sparse 3D structure. Adaptive Densification is the core strategy that sets this approach apart, where the amount and location of 3D Gaussians are modified based on the scene's complexity. Further improvements can be made by eliminating low-opacity Gaussians as well as under and over-reconstructing regions and finally by optimizing Gaussian parameters with the help of view-space positional gradients. A low-loss, high-performance approach loop is then used to iteratively enhance the image's quality. Although traditionally regarded as inferior, techniques such as PSNR, SSIM, and L1 loss metrics are now optimally regarded as the standard in determining scene fidelity. Performance metrics have shown remarkable advancement in novel view synthesis, fine detail portrayal, and rendering even under very complex conditions. The models are reconstructed and incorporated into real-time rendering engines, proving that 3DGS is a scalable and robust solution for multi-view image-based 3D reconstruction. This portion of the work demonstrates the promise of Gaussian Splatting in interactive visualization and immersive application design.

**Keywords:**

3D Gaussian Splatting, Computer Vision, Image Processing, Scene Reconstruction, Neural Radiance Fields

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# Offline Signature Verification Using CNN Based InceptionResNetV2 Architecture

*Arju Bindukar* [a], *Ram Krishna Maharjan* [b]

**Abstract:**

Offline signature verification is a critical aspect of biometric authentication, used to verify the identity of individuals based on their handwritten signatures. Using the InceptionResNetV2 architecture, this project applies a deep learning technique to improve signature verification systems. Effective training and enhanced feature extraction from signature photos are made possible by the hybrid model, which combines the advantages of residual learning and Inception modules. The procedure entails preprocessing datasets, such as CEDAR, BH260Sig-Hindi, BH260Sig-Bengali, and a freshly generated dataset, and then classifying the signatures as authentic or fraudulent. When measured by criteria like accuracy, precision, recall, and F1-score, the model performs better than ResNet50V2 and InceptionV3 on a variety of datasets. On the Bengali dataset, for example, InceptionResNetV2 outperformed other models in terms of precision and recall, with an accuracy of 97.31%. These outcomes show how well the model detects forgeries and how useful it is for practical uses like document authentication and fraud detection.

**Keywords:**

Offline Signature Verification, Convolutional Neural Network (CNN), InceptionResNetV2, ResNet50V2, InceptionV3, Deep Learning

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# Analyzing Computational Efficiency for Facial Kinship Verification with Fusion of Deep and Shallow Features Using CNN and LBP

*Prajwol Karki* [a], *Bibha Sthapit* [b]

**Abstract:**

Facial kinship verification, combining computer vision and biometrics, aims to determine whether a pair of facial images share a kin relationship. This task has applications in forensic analysis, ancestry research, and identity authentication. This study investigates facial kinship verification by integrating shallow and deep feature extraction methods, using LBP for shallow features and VGG-16 for deep features. The Fisher score is used to identify the most important features, while PCA reduces the feature space to minimize computational complexity. Finally, SVM is utilized to differentiate between kin and non-kin pairs. By merging these techniques, the study presents a hybrid approach for evaluating familial relationships based on facial similarities between parents and children. The proposed methodology achieved final testing accuracy of 82.25% accuracy with much reduced computation load as well as computation time.

**Keywords:**

Principal Component Analysis, Support Vector Machine, Fisher Score

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# River discharge estimation in data-scarce mountainous river basin using ensemble machine learning algorithms: A case study of Marsyangdi River Basin

*Suman Khanal* [a], *Mukesh Raj Kafle* [b]

**Abstract:**

Accurate river discharge estimation is crucial for effective water resource management, flood prediction, drought mitigation, and hydrological studies. Traditional physically based hydrological models require basin-specific parameters and detailed hydrological process data, which are often difficult to measure and are not readily available in data-scarce regions like Nepal. This study employs two ensemble machine learning algorithms, Random Forest (RF) and Gradient Boosting (GB) to simulate river discharge using 11 different input combinations based solely on historical hydrological and meteorological data. Historical daily discharge data were used for model training, validation, and testing. Model performance was evaluated using statistical metrics, including the Nash–Sutcliffe Efficiency (NSE), Root Mean Square Error (RMSE), RMSE to Standard Deviation Ratio (RSR), coefficient of determination ($R^2$), and Percentage Bias (PBIAS) for training, validation, and testing datasets. Among the tested input combinations, Model M9 (GB), which integrates month, day, precipitation (P, P-1, P-2), temperature (T, T-1, T-2), and lagged discharge (Q-1, Q-2), demonstrated the best predictive accuracy, achieving NSE = 0.91, RMSE = 61.99, and The results highlight the superior performance of Gradient Boosting (GB) over Random Forest (RF) in capturing discharge variability, particularly when incorporating both meteorological and hydrological predictors. Models relying solely on meteorological data (M1) or historical discharge data (M10, M11) showed lower accuracy, reinforcing the importance of multi-variable approaches for hydrological modeling. This study demonstrates the effectiveness of ensemble learning algorithms in estimating river discharge, even in data-scarce regions where detailed hydrological process data and basin-specific parameters are not readily available. The findings emphasize the need to integrate meteorological and hydrological data for accurate discharge estimation and highlight the potential of machine learning techniques in advancing hydrological modeling for complex river systems.

**Keywords:**

Machine Learning, Random Forest, Gradient Boosting, Hyperparameters

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# Dam Breach Analysis: A Case Study of West Seti Dam and its Impact on Seti River-6 Project

*Saroj Pudasaini* [a], *Mukesh Raj Kafle* [b]

**Abstract:**

Dams are hydraulic structures built across rivers to either create a reservoir or redirect water for various purposes, including irrigation, hydropower generation, water supply for domestic and industrial use, flood control, navigation, the movement control of solids and fishing. Despite having several benefits of dams, it also contributes the risk of some disasters downstream form the dam location. The catastrophic impact of a dam breach or failure can be devastating. When a dam fails, the resulting flood wave can travel rapidly downstream, causing severe damage to everything in its path, including residential areas, infrastructure, and agriculture. The destruction of life and property during such events can be enormous. The purposed West Seti Hydro Electric Project and Seti River-6 (SR6) Hydropower Project is a storage type project which lies on Sudur Paschim province of Nepal. The West Seti dam is 195 m high concrete face rockfill dam (CFRD) which is located on Seti River with installed capacity 800 MW and SR6 is 129m high concrete gravity dam with installed capacity of 309MW. Dam break studies with two cases: (a) dam break of West Seti (WS) and (b) dam break of SR6 with overtopping mode of failure is presented in this study. For case (a) the effect was observed up to just before the confluence of Seti and Karnali river and for case (b) the effect was observed up to just before the confluence of Karnali and Bheri river. For case (a) the probable maximum flood (PMF) was taken from detail project report (DPR 2024) which was taken as inflow hydrograph and for case (b) the routed flood hydrograph from dam breach of West Seti at a section of SR6 dam was taken as inflow hydrograph. Since the PMF peak for SR6 is 16411 m3/s (Feasibility 2022) which is very very lower than the peak of inflow hydrograph that is 247472.39 m3/s, thus there is the higher probability of SR6 dam failure if the West Seti dam fails. For both cases dam breach simulation was performed using HEC-RAS and Arc-GIS was used to create the reservoir shape file and flood mapping the output from HEC-RAS. The parameters for the dam breach were chosen based on the guidelines provided in the HEC-RAS manual and by referencing prior research studies. For the case (a) U.S. Army Corps of Engineers (USACE 2007) and for case (b) Federal Energy Regulatory Commission (FERC 2014) was applied to determine breach parameters. Peak outflow and area inundated from dam breach for case (a) and (b) were 475374.62 m3/s ,43.68 km2 and 204628.59 m3/s, 67.3 km2 respectively. In both cases, the routing of the peak outflow from the dam to the downstream river section demonstrates a gradual reduction in flow. Total building and total road affected from the flood for case (a) and (b) were 3292, 126.09 km and 2254, 80.95 km respectively. Out of 126.09 km, 25.26 km of Pushpalal Mid Hill Highway is expected to inundate by flood. The most affected municipality for case (a) and (b) were Shikhar, Dipayal Silgadhi and Chaukune, Mohanyal respectively. The maximum water surface elevation (WSE) at Dipayal airport was 591.429 masl with maximum depth of 18.19 m and after 36 minutes of maximum WSE the runway is completely free of water. The maximum depth at Gobghat bazar and SR6 headwork were 49.73 m and 65.19 m respectively. For case (a) while routing the flood there was large decrease in peak flow form 388240.03 m3/s (30km) to 321992.81 m3/s (35km) this was due to the wide distribution of flood in section of dipayal bazar. For case (b) while routing the flood there was large decrease in peak flow from 190991.28 m3/s (20km) to 172861.89 m3/s (25km) it was due to the upstream flow from the confluence of Seti and Karnali to Karnali river. There was 18.68 km upstream flow in Karnali river. This study has examined the overtopping failure of both West Seti and Seti River 6 storage dams. It has contributed to disaster forecasting and can be used for developing an emergency action plan.

**Keywords:**

Dam breach, HEC-RAS, ArcGIS,West Seti,SR-6,WSE,Mapping

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# Reservoir annual energy optimization using Meta-Heuristic PSO algorithm: A case Study of Tamor Storage Project

*Gopal Bhattarai* [a], *Ram Krishna Regmi* [b]

**Abstract:**

The true measure of resource efficiency is reflected in its monetary value, where higher returns indicate effective optimization, and lower returns signal untapped potential. This study aims to maximize energy generation from the Tamor Storage Hydroelectric Project using the Particle Swarm Optimization (PSO) algorithm. The feasibility study of the Tamor Storage Project was conducted by the Nepal Electricity Authority, and agricultural release was not included in the analysis. However, since the project is multipurpose, with the primary objective of fulfilling agricultural demand, it is crucial to incorporate agricultural release into the optimization process. This study addresses this gap by optimizing the energy generation of the Tamor Storage Project while also meeting agricultural requirements.

The results indicate that, in order to satisfy agricultural demands, the optimal operating hours from January to December were 6, 6, 7, 7, 6, 24, 24, 24, 24, 16, 16, and 6 hours, respectively. Additionally, to meet the energy demands during the dry season (8 hours) and improve the Discharge Utility Factor (DUF), the project's operation was assessed at an increased Full Supply Level (FSL) of 570 masl. This adjustment led to revised optimal operating hours of 8, 8, 8, 8, 8, 22, 23, 23, 24, 20, 20, and 8 hours, respectively, from January to December. As a result, the DUF increased from 0.893 at an FSL of 550 masl to 0.962 at an FSL of 570 masl.

**Keywords:**

Reservoir Energy optimization, agricultural release, environmental release, PSO, Tamor river

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# Assessing and Prioritizing Barriers to Circular Economy Adoption in Nepal's Hydropower Sector: A Quantitative Analysis and Strategic Recommendations for Implementation

*Suraj Dahal* [a], *Santosh Kumar Shrestha* [b]

**Abstract:**

Nepal relies heavily on hydropower, generating nearly 90% of its electricity from this source. Hydropower is very important for the country's economic growth. However, traditional linear construction methods have led to significant environmental challenges, including unmanaged excavation waste and inefficient resource use. This study identifies major barriers to adopting Circular Economy (CE) practices in Nepal's hydropower sector through literature review, expert interviews, and surveys analyzed using Relative Importance Index (RII). The key barriers identified are lack of awareness, limited availability of advanced circular technologies, absence of comprehensive CE policies, and poor waste management practices. To overcome these barriers, the study proposes strategies such as increasing education and awareness, developing remanufacturing processes, designing structures for resource efficiency, and establishing robust waste management systems. These methods will help reduce waste and improve resource use in Nepal's hydropower sector. Finally, it provides recommendations for policymakers, industry leaders, researchers, and others in the field to help create a more sustainable and secure energy future.

**Keywords:**

Circular Economy (CE), Hydropower, Sustainability, Relative Important Index, Barrier to Adaptation, Strategies

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# Qualitative and Quantitative Assessment of Overbreak in Khimti II HEP

*Tapraj Bhatta*[a], *Mohan Raj Panta* [b], *Kiran Dahal Khatri* [c] *Sagar Acharya* [d]

**Abstract:**

This study assesses the mechanisms of overbreak in poor quality rock masses ($Q < 4$) within geologically complex Himalayan tunnels, with the particular focus on Khimti II HEP, where intersecting joints, shear bands, and blasting inefficiencies contribute to instability and cost overruns. The combination of empirical criteria like Barton and numerical modeling by UNWEDGE and RS2 with total station profiles enabled the identification of key factors. Barton's criteria predicts overbreaks in 90 percentage of chainages, while CD Martin's equation estimates spalling related overbreak depths of 1.9 to 2.1 m. The numerical models confirm that wedge-induced instability may be correlated to the observed overbreak. Local excavation damage zones were identified with strength factors less than 1 m.Significance of Delay Sequence Smooth Blasting in Stress redistribution and Blast damage reduction eas demonstrated. Logarithmic correlations were established between the Q-values and overbreak percentage as well as specific charge enabling Q-driven explosive optimization. Although controlled perimeter charges of 0.7 kg/hole and spilling reduced damage, deviations caused by manual drilling further increased the risk. It is, therefore, concluded that the overbreak in poor rock masses is governed by joint orientation, other minor stress-induced failures, and operational inefficiencies. It is recommended that mechanized drilling, pre-support systems like umbrella grouting, and Q-based charge adjustments should be applied in order to mitigate risk. Overbreak Assesment can decrease the construction costs for Himalayan tunnels, but more assessment is needed on the dynamic Numerical Modelling and the effects of blast-induced vibrations.

**Keywords:**

Overbreak,Excavation Damage zone, Strength Factor, Pull Length,Specific Charge

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# Analyzing the Impacts of Hydropower Design Discharge Variability on Generation Mix, Capacity, and Cost of Nepal's Power Sector under Policy Constraints

*Rajan Dhakal* [a], *Khem Gyanwali* [b]

**Abstract:**

Nepal's energy system predominantly relies on hydropower; however, its sustainability is challenged by seasonal river flow variability, regulatory constraints on design discharge, and the underutilization of alternative renewable energy sources. This study employs a high-resolution power sector model using IBM ILOG CPLEX optimization software to evaluate the impact of hydropower discharge variability under five distinct scenarios: Scenario A (reference) follows the policy constraints and previous studies with Q45, Q45, Q25 for run-of-river (ROR), peak run-of-river (PROR) and storage hydropower. The alternative scenarios modify these constraints as Scenario B (Q40, Q40, Q20), Scenario C (Q50, Q50, Q30), Scenario D (Q35, Q35, Q15), and Scenario E (Q55, Q55, Q35), representing different hydrological conditions and their implications on generation capacity and system costs.The electricity system in Nepal will require between 89.9 GW and 1226.2 GW of installed capacity by 2050, according to optimization results. In the reference scenario, the hydropower potential of 54 GW is 41.8 GW, whereas in Scenarios B and D, it is 42 GW. Conversely, Scenarios C and E decrease capacity to 35 GW and 31.2 GW, respectively, due to lower design discharge levels. To meet a demand of 191.15 TWh, electricity generation ranges from 206.3 TWh to 242.71 TWh. While Scenarios C and E rely more on solar PV and hydrogen storage, Scenarios B and D increase hydropower output.

**Keywords:**

Design Discharge Variability, Policy, Capacity Mix, Generation Mix,Cost

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# Computational characteristics of hydrogen gas combustion in homogeneous charge compression ignition (HCCI) engine

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**Abstract:**

With the trend of limiting carbon emissions, hydrogen can be a possible fuel for internal combustion engine to run the transport industry. A 3-dimensional CFD simulation is performed in openFoam (Open Field Operation And Manipulation) using engineFoam solver. Turbulence model, combustion model and detailed reaction mechanism are included in this simulation to observe realistic behavior of $H_2$ gas combustion in internal combustion engine. This work investigates premixed $H_2$ gas at stoichiometric conditions under HCCI environment where premixed $H_2$ fuel mixture is auto-ignited as temperature surpasses auto-ignition temperature of the fuel mixture during compression stroke. The simulation work is observed between -180° CAD to 180° CAD i.e. between beginning of compression stroke to the end of expansion stroke. Although, pressure and temperature both increases adiabatically during compression stroke, it is unable to ignite the $H_2$ fuel mixture because of high auto-ignition temperature. In order to proceed the reaction, preheating of the $H_2$ fuel mixture is applied to achieve $H_2$ gas combustion near TDC. The variation of mean in-cylinder pressure and temperature against crank angle displacement presents the discontinuities in mean pressure and temperature when the piston is about -10°ATDC because of ignition of premixed mixture at multiple points. Because of reaction occurring between reacting species due to ignition, enormous amount of heat is released as a result temperature increases which further drives the reaction step forward resulting in further increment in temperature and pressure. On further comparison of mean in-cylinder pressure and temperature between hydrogen and heptanen fuel, it shows significant variation because of one-step reaction mechanism of heptane fuel which oversimplifies the complex chemical and physical process involved.

**Keywords:**

internal combustion engine, crank angle displacement, homogeneous charge compression ignition, Top Dead Center, Bottom Dead Center, After Top Dead Center, start of ignition

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# Numerical Simulation of Shock Vector Control in Two Dimensional Convergent Divergent Nozzle

*Keshav Kumar Acharya* [a], *Kamal Darlami* [b], *Salim Maharjan* [c], *Sujan Dahal* [d]

**Abstract:**

This study presents a numerical simulation of Shock Vector Control (SVC) in a two-dimensional convergent-divergent (CD) nozzle to evaluate fluidic thrust vectoring performance. The thrust deflection angle of the nozzle, which was constructed with an exit Mach number of 2 using the Method of Characteristics (MOC), was calculated by analyzing it for different Nozzle Pressure Ratios (NPRs) and Secondary Pressure Ratios (SPRs). ANSYS Fluent v19.2 was used for computational simulations, and a k-$\omega$ turbulence model was used to precisely capture flow properties. Three secondary injection locations—25%, 50%, and 75% of the divergent section length—were investigated for their effects on jet deflection. The findings show that while higher NPRs decreased the vectoring effect, lower NPR values (such as NPR = 5) generated the most deflection. Furthermore, an ideal SPR of roughly 0.4 was found; above this, shock interactions resulted in adverse jet deflections. The findings suggest that positioning secondary inlets farther downstream enhances thrust vectoring performance. The study provides insights into optimizing fluidic thrust vectoring for aerospace propulsion applications.

**Keywords:**

Shock Vector Control, Fluidic Thrust Vectoring, Convergent-Divergent Nozzle, Computational Fluid Dynamics, Nozzle Pressure Ratio

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# Dynamic Modelling and Response of a Crossflow Turbine Runner

*Lal Babu Prasad* [a], *Laxman Poudel* [b], *Laxman Motra* [c], *Mahesh Chandra Luintel* [d]

**Abstract:**

The cross-flow turbine is a roto-dynamic hydraulic machine that share the common base with other machines or mounted close to each other which have also rotating shafts that share the some bearings. In this turbine hydraulic force is exerted two times in runner; once while the water enters the turbine and next when water leaves the turbine. The direction, amplitude and point of application of the forces in these two condition are very different, that is why it is obvious for vibrations. Due to external disturbance such as hydraulic force vector on the rotating runner and also some unbalanced potential, there is always possibility of vibration. In this work, the hydraulic force vectors that are applied on runner blades while water enters and exit have been determined by varying angle of attack and also by varying inlet blade angle. Governing equation of motion of the turbine runner has been developed assuming the runner shaft-disc attachment as flexible member. Modal analysis for low, medium and high spin speed range has been performed in ANSYS. Harmonic analysis has been done for various hydraulic force vectors that are caused by varying angle of attack and inlet blade angle. The maximum amplitude of the forced vibration verses attack angle and inlet blade angle has been determined and plotted. Finally, it is observed that the vibration amplitude increases with an increase in the inlet blade angle. Additionally, the amplitude initially rises with an increase in the angle of attack up to 20°, after which it begins to decrease with further increases in the angle of attack.. For the supplementary of the above work, the crossflow turbine runner has been designed, velocity triangles at inlet and exit of the turbine runner have been analyzed. For the analysis MATLAB program and ANSYS software have been used.

**Keywords:**

hydraulic force vectors, velocity triangles, maximum amplitude

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# Design and Fabrication of Electric Lawnmower

*Tanka Prasad Gaihre [a], Sushant Gautam [b], Pradeep Chapagain [c], Pawan Neupane [d], Madhab Kumar Thapa [e], Prabij Joshi [f]*

**Abstract:**

The paper entitled "Design and Fabrication of Electric Lawn Mower" mainly empathize the development of innovative electric lawn mower to operate in even surface that overcomes the shortcomings of current lawn mower technology while boosting sustainability and user convenience. An improved version of a traditional lawn mower will be a lawn mower powered by batteries. The integrated system of the lawnmower includes wheels, motors, and height varying mechanism. Therefore, the main motive is to create a system that is portable, light, and has an efficient operation. This project aims to revolutionize lawn care practices through the development of an electric lawn mower using concept of zero-turn steering. By replacing gasoline engines with electric power, this lawnmower offers superior performance while minimizing environmental impact. Rigorous testing and ansys analysis of chassis and blade validates its efficiency, cutting precision, and user satisfaction. After thoroughly testing an average error of (10±5)% at 6cm height and average error of (15±5)% at 2.5cm height was obtained where uneven surface being major setback while testing. These findings highlights the efficiency and reliability of mower providing in-depth understanding for it's practical application. Thus, this project focused on the improvement over existing model along with sustainable solution to reduce carbon emissions and pollution contributing towards greener future in lawn maintenance.

**Keywords:**

Electric Lawnmower, Greener future, Innovative, Zero-turn steering

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# Modeling Electrochemical Corrosion in Magnesium Alloys Using MOOSE Based Non-linear Phase Field Methods

*Saroj Kumar Shah [a], Laxman Poudel [b], Sachin Poudel [c]*

**Abstract:**

Magnesium, recognized as the lightest structural metal with a density of approximately 1.7 g/cm$^3$, offers exceptional properties making it ideal for medical applications and lightweight engineering. Despite its advantages, such as environmental non-toxicity and ease of machining, its broader use is hindered by challenges such as poor corrosion resistance, necessitating ongoing research to enhance its structural and functional performance. Traditional models struggles to capture the complex, nonlinear electrochemical corrosion of magnesium alloys. The phase field method shows promise but remains underexplored for this application. This study aims to develop a phase field-based approach to predict corrosion kinetics in the magnesium alloy AZ31. An order parameter is introduced to represent the solid metal phase within the corrosion system. The model integrates the electrochemical interactions at the electrolyte/metal interface, including the metal dissolution rate, electric potential distribution, and ionic concentration distribution. The evolution of ion concentration, order parameter, and potential distribution is guided by the minimization of the total free energy of the system and is obtained by numerically solving the governing equations. The Multiphysics Object-Oriented Simulation Environment software (MOOSE Framework) is utilized for the implementation of numerical model. The model is validated with results obtained from literatures.

**Keywords:**

Phase field, Mg based alloys, Electro-chemical corrosion, Electrolytes

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# Qualitative Flow Visualization of Muzzle Flow Field using Schlieren Imaging

*Som Prasad Pangeni* [a], *Kamal Darlami* [b], *Nimesh Chaulagain* [c], *Salim Maharjan* [d]

**Abstract:**

The muzzle flow field of a firearm refers to the complex, high-speed gas dynamics that occur at and beyond the muzzle as a bullet moves from the chamber. Analysis of flow fields, focusing on the time-resolved formation of phenomena such as precursor and propellant flow fields, shock waves (including barrel shock), and blast waves, is ongoing research. The numerical analysis of the muzzle flow field and its effect on muzzle devices is difficult to perform. So, the experimental study is an alternative approach to study this phenomena providing valuable insights on the flow-field patterns that could be used as validation of the numerical studies as well. This research is on the study of the muzzle flow field of a firearm during the movement of the projectile before and after the muzzle. The application of Schlieren imaging have been used for precise qualitative visualization and analysis of the flow fields. The distinct precursor and propellant flow regimes namely, the Blast wave, Shock bottle, Mach Disk, Distinct cap of Gas-Air interface, Barrel Shock, and flow vortices are observed in addition to the observation of the detached bow shock in front of the projectile. The muzzle flow field from two weapons namely, 9 mm Auto India Pistol (Muzzle Velocity $\approx$ 396.23 m/s) and 7.62 mm Chinese Pistol (Muzzle Velocity $\approx$ 318 m/s) were visualized with a z-type schlieren setup aided with Chronos 2.1-HD High Speed Camera at frame rates of 10,488 fps and 19,783 fps.

**Keywords:**

Schlieren photography, Aerodynamics, Muzzle flow, Intermediate ballistics

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# Integrating HEC-RAS and HEC-HMS for Synergistic Flood Hazard Mapping Under Climate Change Scenarios in Hanumante Khola, Bhaktapur

*Sandesh Raj Malla* [a], *Suman Pandey* [b], *Raman Singh Kathayat* [c], *Arshad Ansari* [d], *Surendra Maharjan* [e] *Madan Pokharel* [f]

**Abstract:**

Floods are major water-related disasters worldwide, exacerbated by climate change's increasing extreme precipitation events. This research aims to map flood-inundated areas under the changing climate in the Hanumante basin, Bhaktapur. It further specified the flood risks in the region by determining the flood hazard using four categories (low, medium, high, and extreme). In this study, the Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) model simulated rainfall runoff, while the Hydrologic Engineering Center – River Analysis System (HEC-RAS) One Dimension (1D) steady simulation provided hydraulic analysis and hazard mapping for present and future scenarios. Future climate scenarios under SSP 2-4.5 and SSP 5-8.5 are generated based on the bias-corrected results of Coupled Model Intercomparison Project Phase 6 (CMIP6)'s five General Circulation Models (GCMs) for Near Future (NF), Mid Future (MF), and Far Future (FF). It is discovered that, for a 100-year return period, the magnitude of future floods will increase by 1.02 times for NF, 1.07 times for MF, and 1.07 times for FF for SSP 2-4.5 and by 1.56, 1.17, and 1.62 times for NF, MF, and FF, respectively, for SSP 5-8.5. Similarly, as the magnitude of the flood increases, so will the inundation areas, indicating an increased risk and danger of flooding in the future. This study emphasizes the critical importance of projecting future flood hazards and use climate projections to collect essential information for developing long-term floodplain management strategies.

**Keywords:**

Climate Change, (CMIP6), Flood Hazard, HEC-HMS, HEC-RAS

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# Numerical Simulation on Hydraulics of Spur: A Case Study of Kamala River Reach

*Namita Gautam* [a], *Narendra Man Shakya* [b]

**Abstract:**

Riverine systems are highly dynamic environments where erosion processes play a critical role in shaping riverbanks and floodplains. Kamala basin is prone to frequent and severe flooding and river bank erosion. This vulnerability stems from a combination of factors, including intense monsoon rainfall, the region's rugged terrain, and unstable geological conditions. In such, spur structures are implemented to induce slack water flow, and safeguarding riverbanks by diverting the main current. Since braided rivers are of unpredictable behavior, impact assessment of spurs is very vital. This study aims to optimize spur configuration for the braided rivers originating from Mahabharat range by evaluating the influence of different length and height of spurs at different flow rates, including the development of recirculation zones and the magnitude of tip velocity of spur, a key factor in scour. This study adheres to the established best practices for HEC-RAS model development, including sensitivity analysis of key parameters like Manning's roughness, and cell size.

**Keywords:**

Separation Length, Unsteady flow analysis, Tip Velocity, HEC-RAS

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# Flood Hazard Mapping of Budhi River and Analyzing Hydrodyanamic fluctuation of Hydrodynamic parameters along the River reach during Floods Using HEC-RAS 1D Model

*Saroj Kumar Yadav* [a], *Saroj Karki* [b], *Aditya Dhakal* [c], *Animesh Khadka* [d] *Bishnu Prasad Shrestha* [e] *Sambridhi Karki* [f]

**Abstract:**

This study addresses the challenge of flood risk mapping for an ungauged river system through a case study of the Budhi River Catchment using the HEC-RAS 1D steady hydraulic model. Given the absence of gauging stations and direct hydrological data in the Budhi River Catchment, traditional flood Hazard assessments are hindered, posing significant risks to local communities, infrastructure, and land use. The objective of this study is to develop a reliable flood Hazard assessment by simulating various flood scenarios and generating detailed floodplain maps and analyzing fluctuation in hydrodyanamic parameters such as depth, velocity, shear stress. The HEC-RAS 1D steady hydraulic model was employed to simulate flood behavior under different return periods (25-year, 50-year, and 100-year events) using available topographic and indirect hydrological data. The results include comprehensive flood Hazard maps that identify high-hazardeous areas and potential impacts on infrastructure and land use. The findings of this study provide critical insights into flood Hazard distribution in the Budhi River Catchment, supporting informed decision-making for flood management and mitigation. Recommendations include prioritizing floodplain zoning, enhancing flood defense infrastructure, developing early warning systems, and promoting flood-resilient construction. The study highlights the importance of integrating local knowledge and adaptive strategies into flood risk management, especially in regions with limited direct data. Overall, the research contributes to better flood preparedness and resilience in ungauged river systems. The hydrodynamic analysis of the flow of the Budhi River was performed by the use of HEC-RAS. The river length of 4km was modeled from the budhi bridge from east-west highway to 4km downstream from budhi bridge. The outlet is kept 4km downstream of budhi bridge. Watershed delineation is down in ArcGIS and watershed area at outlet is found to be 78 km2. Flood analysis was done using empirical methods and flood discharges found to be 236 m3/s, 392 m3/s and 477 m3/s for 25years, 50 years and 100 years return periods respectively. Hydrological analysis used as steady flow data in model. After applying geometry data from digital elevation model and applying boundary condition to model. The HEC-RAS 1-D steady flow simulation was done and inundation area period 25, 50, 100 years return period flood is found to be 73.51 Ha, 81.62Ha and 84 Ha respectively. The flood hazard map is prepared using classified into three levels of hazard low, medium, and high. Flood risk map is prepared identifying the high-risk zone areas. The study's and finding may help in planning and management of Budhi River to avoid future flood Hazard.

**Keywords:**

Hydrological analysis, Return period, HEC-RAS 1D, Hydrodyanamic results, Flood inundation, Flood Hazard

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# Evaluation of Machine Learning Techniques in Streamflow Forecast: A Case Study in Sunkoshi Basin

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**Abstract:**

Streamflow forecasts are vital for water security, flood management, agriculture, and various industries. While traditional physics-based models have advanced and improved the forecasts, they are often limited by two factors: an incomplete understanding of physical phenomenon, and the need for long sequences of observational data for calibration. Artificial neural networks have proven to be highly effective in simulating non-linear systems where knowledge of the underlying physical relationships is not fully understood. Unlike traditional hydrology models, these artificial intelligence (AI) models can be trained on global datasets, improving forecasts in river basins that lack sufficient meteorological stations. Moreover, the use of satellite data and remote sensing technologies can help overcome the issue of data sparsity. In this study, we assessed the efficacy of three popular machine learning techniques, random forest (RF), extreme gradient boosting (XGBoost) and long short-term memory (LSTM) in predicting streamflow across four sub-basins within the Sunkoshi River basin of Nepal. The models were trained using catchment-mean meteorological and hydrological variables from ERA5 as well as historical streamflow observations. The RF, XGBoost, and LSTM models achieved mean Nash-Sutcliffe Efficiency (NSE) values of 0.97, 0.97, and 0.82 for the training period and 0.71,0.72, and 0.77 during the testing period, respectively. The LSTM model showed consistent performance across training, validation, and testing phases.

**Keywords:**

LSTM, Machine Learning, Random Forest, Streamflow Forecasting, XGBoost

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# Evaluating the impact of Climate Change on Hydrological Extremes using LSTM.

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**Abstract:**

Climate drivers are closely linked to the occurrence of extreme hydrological events, which significantly impact the environment, livelihoods, and the economy, especially in the Himalayan river basins. Traditional process-based models struggle to capture extreme events due to coarse or missing data, whereas deep learning models, particularly Long Short-Term Memory (LSTM) networks, excel in identifying intricate patterns in climate data. This study aims to develop an LSTM model for the Simle outlet in the Arun River Basin to characterize hydrological extremes and improve water resource management. LSTM model trained on observed hydrometeorological data performed satisfactorily, with Nash-Sutcliffe Efficiency (NSE) values above 0.6 across training and testing phases. Future streamflow projections were generated using bias-corrected precipitation and temperature data from three CMIP6 Global Climate Models (GCMs) under historical, SSP2-4.5, and SSP5-8.5 scenarios. The simulation results indicate an increase in high flows, with $Q_5$ and $Q_{10}$ rising by 8.56% and 8.49% under SSP2-4.5, and by 11.20% and 10.85% under SSP5-8.5. Low flows ($Q_{90}$ and $Q_{95}$) also showed moderate increases, reaching 2.40% and 2.01% under SSP5-8.5. This study highlights the robustness and versatility of the LSTM model as a data-driven approach for hydrological modeling, particularly for long-term flow forecasting when integrated with climate data from Global Circulation Models (GCMs)

**Keywords:**

LSTM (Long Short-Term Memory), Hydrological Modeling, Climate Change, Streamflow Prediction, CMIP6 GCMs, Arun River Basin, Extreme Flow Events

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# Projected Glacier Runoff Changes in the Narayani River Basin: Multi-GCM Analysis Using OGGM

*Pramod Bhattarai* [a], *Mukesh Raj Kafle* [b]

**Abstract:**

Climate change being a global concern, that breaks out the impact on the water resource availability. Most of the significant rivers in Nepal are sustained by Himalayan glaciers and it is clear that the climate change will not spare these rivers. This study projects future (2020-2100) glacier runoff from the glaciers of Narayani river basin using five distinct models under Coupled Model Intercomparison Project Phase 6 (CMIP6) that are simulated in Open Global Glacier Model (OGGM) v1.6. Climate scenarios 245 and 585 of Shared Socioeconomic Pathways (SSP) are assessed. The results of the SSP245 and SSP585 studies present alarming projections regarding the future of glaciers. Under SSP245, we face a potential decrease in glacier area by 50% and volume by 58%. The situation worsens under SSP585, where the study indicates a staggering reduction of glacier area by 76% and volume by 83%. The study area's seasonal and yearly runoff characteristics indicate high runoff in 2097 (SSP245) and 2095 (SSP585) with the average estimated runoff of 280.926 m3/s and 306.925 m3/s respectively. These figures highlight an urgent need for action. The implications are profound—such significant losses will have cascading effects on water availability, ecosystems and global climate patterns. The study clarifies the need for appropriate adaptation measures by shedding insight on the hydrological behavior of the Narayani river basin in relation to climate change.

**Keywords:**

Climate change, Glacier runoff, Hydrological behavior, Narayani river basin

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# Sustainability assessment of institutional biogas plant: A Case Study of the Sundarijal Arsenal Biogas Plant

*Mahesh Kumar Ghimire* [a], *Navin Kumar Jha* [b]

**Abstract:**

Biogas technology has emerged as a sustainable solution to address Nepal's energy challenges, particularly in institutional settings such as security agencies. This study evaluates the sustainability of a 40 $m^3$ institutional biogas plant at the Sundarijal Arsenal Barrack, focusing on technical, techno-economic, and environmental factors. The sustainability assessment was carried out from technical, techno-economic, and environmental perspectives employing primary as well as secondary data. Results indicate that the biogas plant operates at only 22% of its design capacity due to limited feedstock availability, particularly kitchen and human waste. Seasonal variations in gas production were observed, with higher yields in summer than in winter. The levelized cost of energy (LCOE) in the current condition was estimated at 10.82 NRs/kWh, slightly higher than LPG and grid electricity. However, at full capacity, the LCOE would be significantly lower (2.38 NRs/kWh), making biogas a highly cost-effective energy source from an institutional biogas plant. Furthermore, the biogas system decarbonizes 22 tons of $CO_2$-equivalent emissions annually, contributing to sustainable waste management and carbon footprint reduction. The study highlights that with optimized feedstock availability and seasonal performance improvements can enhance Nepal's cooking energy portfolio and environmental sustainability.

**Keywords:**

Biogas, Energy securiy, Techno-economic analysis, Levelized Cost of Energy (LCOE), Greenhouse Gas (GHG) reduction, Energy mix

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# Energy Performance of Traditional Tharu Building: A Case of Dang Deukhuri

*Sumit Chaudhary* [a], *Jib Raj Pokharel* [b]

**Abstract:**

The world is experiencing rapid change in climate and environment, thus raising concerns for sustainable and energy efficient practices. A study by Oliver shows that around 90% of buildings worldwide are constructed by people who use them where energy efficiency standards may be inadequate which leaves large potential to reduce energy use. Energy Efficiency in buildings can be achieved via active and passive means. Vernacular architecture has been getting attraction regarding their energy efficient and sustainable design approach since they are built using locally sourced construction materials. These buildings are strongly influenced by the climate and often holds useful ideas for optimizing energy use with simple methods. This paper tries to study the energy performance of modified Traditional Tharu buildings using computer simulation as well as field data collection of temperature and humidity to quantify the actual heat gain and heat lost inside these traditional buildings.

**Keywords:**

simulation, energy performance, discomfort hour, heat gain and loss

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# Impact of Occupant Behavior on Energy Efficiency in Commercial Buildings: A Case Study of CAAN Head Office, Sinamangal,Kathmandu

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**Abstract:**

The energy efficiency of buildings is a critical concern in the global effort to reduce carbon footprints and promote sustainable energy use. While technological advancements in energy-efficient building designs have become widespread, the behavior of building occupants often deviates from the intended energy consumption patterns, resulting in energy wastage. This study examines the impact of occupant behavior on electricity consumption in the Civil Aviation Authority of Nepal (CAAN) head office building, a structure designed with energy-efficient technologies. Despite these efforts, actual energy usage in the building exceeds projected consumption levels, primarily due to occupant behavior such as the excessive use of lighting and HVAC systems. The research utilized a comprehensive methodology involving on-site surveys, analysis of energy consumption data, and direct behavioral observations to assess the gap between designed and actual energy consumption. Time-of-Day (TOD) meter readings were employed to determine energy consumption patterns across various periods of the day, while occupant surveys gathered qualitative data on behavior patterns, energy-saving awareness, and the effectiveness of existing energy management policies. The analysis revealed a significant discrepancy between the expected and actual energy consumption, primarily driven by inefficient and habitual energy practices of building occupants. The study identifies key behavioral trends, such as leaving lighting and air conditioning units running when not needed, as major contributors to unnecessary energy consumption. Furthermore, the research highlights the importance of occupant awareness and consistent engagement in achieving sustainable energy practices. Based on these findings, the study proposes several strategic interventions, including more frequent behavioral training, the implementation of automated energy management systems, and policy reforms aimed at enhancing occupant accountability. By addressing these behavioral inefficiencies, it is possible to significantly reduce energy wastage and align actual energy use with the design expectations of energy-efficient buildings. This study emphasizes the critical role of occupant engagement in optimizing building energy performance and contributing to broader sustainability goals.

**Keywords:**

Occupant behaviour–energy consumption –building energy efficiency–electricity usages patterns–sustainable energy practices–automated energy controls

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# Gender Perception Differences Influencing Behavioral Intentions toward Energy Saving: A Study of Nepalese Workplaces.

*Sushrusha Koirala [a], Nabin Kumar Jha [b], Sanjay Uprety [c]*

**Abstract:**

Unlike household settings where individuals have greater autonomy over energy decisions, workplace behaviors are mainly governed by shared spaces, and established organizational norms. Nepal's workplace environment experience gradual increasing inclusion in female workforce rate at 28.7%, particularly in banking institutions, where energy consumption patterns are influenced by workplace hierarchies, departmental divisions, and standardized operating procedures. Previous studies have been carried out in household energy consumption pattern, there is limited understanding of how gender perceptions influence energy-saving behaviors in professional environments. This study aims to analyze gender differences in energy saving perceptions and examine how these perceptions influence behavioral intentions towards energy saving in workplace settings, specifically among commercial banking sector within different location of Nepal. The research employed a mixed-methods approach using the theory of planned behavior, analyzing 133 responses through moderated multiple regression analysis. Men primarily approach energy conservation through perceived control over daily habits, while women integrate multiple factors including technical knowledge and workplace culture. This study identified a technical competence paradox where technical knowledge decreases men's energy saving intentions but increases in women's perceptions. A key finding was the intention-behavior gap: intentions did not significantly predict actual energy-saving behaviors for men or women challenging TPB assumption that intentions drive behavior and highlights the role of organizational barriers in shaping actions. This research gains both theoretical understanding and practical implementation of workplace sustainability initiatives by highlighting the complex relationship between gender perceptions and energy-saving behaviors in corporate settings. The insights gained provide a foundation for developing more effective, inclusive energy conservation strategies that acknowledge and accommodate the different approaches that men and women take to workplace energy management.

**Keywords:**

Gender perception,Behavioral intention, Workplace energy efficiency, Energy saving,Theory of Planned Behavior

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# Sustainable Li-Ion EV Battery Recycling in Nepal: A Techno-Economic and Forecast-Based Approach

*Siddhartha Khadka* [a], *Nawraj Bhattarai* [b]

**Abstract:**

The swift uptake of electric vehicles in Nepal brings about both benefits and difficulties in terms of managing waste from lithium-ion batteries This study conducts a thorough evaluation of the practicality of setting up a Li- Ion Battery recycling facility in Nepal, encompassing predictive models, forecasting techniques, and a technical-economic analysis. This research predicts the widespread acceptance of electric vehicles by employing Compound Annual Growth Rate (CAGR) models with growth rates of 10% and 20%, examines the creation of battery waste, and performs a techno-economic assessment for a proposed lithium-ion battery recycling facility. Assessing financial viability involves determining capital expenditures (CAPEX), operational expenses (OPEX), and revenue generated from recycling materials. The selection of the best recycling technology is determined using the Analytic Hierarchy Process (AHP). The objective of the study is to provide guidance to policymakers and investors in regards to sustainable battery recycling options. Our research offers a systematic framework for policymakers and business leaders to implement environmentally friendly recycling practices that will aid Nepal's shift towards renewable energy

**Keywords:**

Electric Vehicles, Lithium-ion Battery Recycling, Forecasting, Techno-Economic Analysis, AHP,

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# Modeling And Validating Heat Transfer Behavior of Sand Packed Bed Thermal Energy Storage System

*Surendra Gurung* [a], *Sanjeev Maharjan* [b]

**Abstract:**

This study investigates the growing need for efficient energy storage systems in the context of renewable energy, where solar and wind power depend on unpredictable weather. Traditional energy storage methods, such as batteries, are expensive, rely on rare materials, and have environmental impacts. As a result, alternative methods like thermal energy storage (TES) are gaining attention. Sand-based TES systems are particularly promising due to sand's abundance, low cost, and ability to retain heat. However, the low thermal conductivity of the sand limits the efficiency of the system. The study focuses on developing a 3D model of a sand-packed bed TES system in COMSOL Multiphysics, based on an experimental setup, with an emphasis on improving thermal conductivity. The system consists of an aluminum box filled with sand, where heat is supplied using two embedded resistance heaters, raised to 500°C. Temperature variations within the sand are recorded with thermocouples to capture time-dependent profiles over a five-hour period. The simulated temperature distribution is compared with experimental data to validate the model. The model employs the effective medium technique to estimate sand's thermal conductivity. This technique simplifies the complex structure of sand, which contains both solid grains and void spaces, by treating it as a homogeneous medium with a single, average thermal conductivity value. An Excel-based model calculates effective thermal conductivity using correlations such as the Zehner-Bauer model, which includes a radiation term. The model's predicted temperature distribution closely matches the experimental data, with more than 85 percent energy storage efficiency during charging. Additionally, this study explores enhancing sand's thermal conductivity by incorporating 7.8 percent cast iron chips (by volume). The results showed a significant improvement in heat transfer, raising the center temperature of the TES from 416°C to 448°C. This method not only improves TES performance but also promotes a circular economy by reusing waste materials.

**Keywords:**

Thermal Energy Storage, Sand-packed bed, Effective medium technique, Thermal conductivity

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# Seismic Performance of Rammed Earth Buildings of Nepal: A Finite Element Approach

*Akash Paudel [a], Rajan Suwal [b], Kshitij Charan Shrestha [c]*

**Abstract:**

This paper presents the seismic performance of rammed earth buildings in Nepal through the use of finite element analysis. Situated in a highly seismically active region, Nepal is frequently affected by earthquakes, which demands the assessment and improvement of seismic resilience regarding traditional construction methods such as rammed earth(RE). Two double-storey typologies of rammed earth buildings were modeled in DIANA FEA 10.5. In this context, non-linear pushover and incremental dynamic analyses have been performed to analyze their response to seismic loads. The seismic performance analysis of roof beam addition or horizontal band addition strengthening strategies is presented herein. The result after using such techniques shows a considerable seismic performance enhancement, which reduces inter-storey drift and increases base shear capacity. Fragility curves were developed to quantify seismic vulnerability, showing lower probabilities of reaching critical damage states in reinforced buildings. The results show that the addition of beams and bands provides lower but not acceptable risk levels for maximum probable earthquakes in the Nepalese context. This study offers practical recommendations on seismic design and retrofitting of RE structures, contributing to sustainable construction practices, and updates on future seismic codes in Nepal.

**Keywords:**

Finite element analysis, Incremental Dynamic Analysis(IDA), Rammed earth, Seismic assessment, Seismic strengthening

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# Seismic Performance of Existing Stone Masonry in Mud Mortar

*Mahima Koirala* [a], *Rajan Suwal* [b]

**Abstract:**

Stone masonry in mud mortar (SMM) structures is prevalent in rural areas of Nepal mainly in Hilly and Himalayan regions. Traditionally constructed SMM structures are highly vulnerable as suggested by past research and past seismic events, however, many people are still using the vulnerable SMM houses constructed before the 2015 earthquake without ensuring their safety. Thus, the assessment of seismic performance and vulnerability of such structures is a must. The study focuses on the analytical method to determine the seismic performance and vulnerability of the SMM structure of the study area taken. The representative building has corner and few through stones, so the study also focuses on the effectiveness of modeling corner and through stones. Nonlinear static pushover analysis is performed in two models, R-WOCS and R-WCS modeled in DIANA, and the pushover curve is obtained which is converted to the corresponding capacity spectrum using the N2 method. Furthermore, fragility curves are generated to define the vulnerability of SMM structures. The existing SMM structures are highly vulnerable and require proper retrofitting techniques to be implemented to ensure their safety during future earthquakes. Modeling corner and through stones slightly enhances the capacity of the structure and fragility analysis shows that the probability of collapse of a structure modeled with corner and through stones is lesser than that of a structure modeled without corner and through stones.

**Keywords:**

Stone Masonry in Mud Mortar (SMM), Seismic Performance, Fragility, Vulnerability

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# Seismic Performance of Brick with Mud Mortar Residential Building of Patan, Nepal

*Prashis Narayan Sapkota* [a], *Rajan Suwal* [b], *Aakarsha Khawas* [c]

**Abstract:**

Old masonry buildings have existed in Nepal since many years ago. We can still find many brick masonry buildings with mud mortar all over Nepal. The investigation into the seismic performance of Nepal's existing masonry structures and the techniques for their reinforcement holds considerable importance, both from an academic and practical perspective. Limited research is available on this topic in existing literature, making the analysis of masonry through numerical simulations a valuable approach. Such studies can enhance the understanding of structural behavior and contribute to refining the design methodologies currently in practice. This study is particularly focused on the seismic performance assessment of traditional masonry residential building located in Patan area of Kathmandu, Nepal which represents the traditional masonry building of Kathmandu valley. Finite element modeling of masonry building is done in order to evaluate the seismic behavior of masonry in this research. In this research work, the model building was subjected to a displacement-controlled pushover load, resulting in pushover curve which is used to determine performance point at different PGA value. The obtained drift value at different PGA levels were used to generate the fragility curve at different limit state damage levels. Similarly, crack patterns were observed at various damage levels. A Finite element software DIANA was used for modeling the building and nonlinear static analysis was adopted.

**Keywords:**

Nonlinear analysis, Performance point, fragility curve, drift values, damage levels

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# Seismic Vulnerability Assessment of Vertically Irregular RC Framed Buildings

*Prajwal Man Shrestha [a], Gokarna Bahadur Motra [b], Kshitij Charana Shrestha [c]*

**Abstract:**

The rise in vertical irregular reinforced concrete (RC) construction in Nepal has emerged due to the underlying requirement to analyze the seismic performance of such buildings. As a main distinction from regular buildings, such asymmetric structures are treated poorly under both vertical and horizontal loads during an earthquake event. The seismic behavior of a bare three-story RC frame with vertical stiffness irregularities is studied using SAP2000 v21.0. The vertical irregularity is introduced through an open ground storey-a popularly observed occurrence that primarily affects the structural performance during an earthquake. To better represent the interaction in between structural members, masonry infill walls are modeled using the equivalent diagonal strut model. Key response parameters such as base shear, fundamental time period, drift ratio, and storey displacement are assessed as per IS 1893 (Part 1): 2016. The findings show that vertical irregularities, especially the open ground storey configuration, significantly affect the seismic performance. A pushover and time history analysis was performed to obtain this being reported. In addition, a fragility assessment was conducted to numerically assess the vulnerability of the structure for different levels of seismic intensities. The fragility curves were derived using Incremental Dynamic Analysis (IDA), conducted through SAP2000, to infer the probability of failure for various displacement thresholds. This research happened to depict that structures with open ground storeys are way more susceptible, as they commonly fail through a ground storey mechanism at much lower displacement levels. The failure mechanism here is almost always a brittle one. Careful design considerations are, therefore, required for improving seismic performance in earthquake-prone regions.

**Keywords:**

Seismic Vulnerability assessment, Vertical Irregularities, Open Ground Storey (OGS), Diagonal strut, Pushover Analysis, Time History Analysis, Incremental dynamic analysis (IDA), Fragility Curves

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# Seismic Evaluation of Irregular RC Building for Near and Far Fault Earthquakes.

*Kshitiz Acharya [a], Hari Ram Parajuli [b], Sunita Ghimire [c]*

**Abstract:**

The seismic performance of reinforced concrete (RC) framed structures subjected to near-fault earthquakes is assessed using a detailed finite element (FE) modeling approach. While seismic design codes aim to ensure a minimum Life Safety (LS) performance level, recent earthquake events have demonstrated that even code-compliant buildings may experience severe damage. This study evaluates the effectiveness of existing seismic codes in achieving LS and other performance levels (PL) for vertically irregular RC framed buildings in Nepal's highest seismic hazard zones. Particular emphasis is placed on the influence of near-fault ground motions, which are characterized by high-energy velocity pulses and permanent ground displacements, leading to amplified structural responses.

The research employs SAP2000 for FE modeling, utilizing ground motion records from both near-fault and far-fault events to simulate dynamic loading conditions. A detailed analysis of structural displacement at key joint locations is conducted, comparing responses across different earthquake scenarios. The findings highlight the heightened vulnerability of irregular structures to impulsive near-fault motions and underscore the need for refinements in seismic design methodologies. This study provides valuable insights for improving building resilience in high-risk regions, emphasizing the necessity of adapting conventional design approaches to better account for the distinct effects of near-fault ground motions.

**Keywords:**

Seismic Performance, Near-Fault Earthquakes, Finite Element Modeling , Structural Vulnerability

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# Seismic Capacity Evaluation and Effectiveness of CFRP wrapping in RC Column

*Shiksha Subedi* [a], *Hari Ram Parajuli* [b]

**Abstract:**

Nepal has experienced a series of devastating earthquakes over the decades, causing immense loss of life and property. The destruction witnessed during these seismic events has highlighted the vulnerability of aging infrastructure. Reinforced concrete (RC) buildings constructed before modern seismic codes and design guidelines require careful evaluation to assess their adequacy in resisting strong ground motions. This study focuses on a 50-year-old, six-story RC frame building located in a high seismic risk zone. Initial evaluations revealed that the structure failed to meet essential safety criteria. To enhance its seismic performance, the basement columns were retrofitted using CFRP wrapping. Pushover analysis was conducted in ETABS to evaluate the seismic capacity of the structure, considering real material properties. The analysis was then carried out under displacement control, with a target displacement of 4 percent of the building height (720 mm) at the designated master node-84 for both the original and retrofitted structures. The yielding of the members and the adequacy of the structural strength were assessed based on the obtained results. The analysis of the retrofitted structure showed that its seismic capacity increased, meeting the required performance criteria compared to the existing building.

**Keywords:**

Pushover, CFRP, Seismic evaluation, Retrofitting

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# Comparative Analysis of Emission from Traditional Cook Stoves snd Improved Cook Stoves and Evaluation of Ventilation using Box Models

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**Abstract:**

In the rural household of Nepal, cooking with open fire has an adverse impact on the health of the occupants, especially women and children. The most prevalent stoves using wood as a primary source of fuel are Traditional Cook-Stoves (TCS) and Improved Cook-Stoves (ICS). TCS is an open fire cook-stove where cooking pot is placed on a cast iron cooking stand, whereas, ICS is a two pot mud type stove having a 1.2 m chimney. Rural households are not mechanically ventilated, and therefore ventilation must occur naturally. Indoor Air Quality measurement devices were used to measure pollutant concentration like $PM_{2.5}$ and Carbon Monoxide (CO). Decay curve method was employed to find the Air Exchange Rate (AER) that helps us assess the situation of ventilation in the occupant's kitchen. This value is compared with respect to American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) standards. Furthermore, a box model was used to observe the trend of CO emission during the cooking period. Statistical analysis was conducted to verify the significant difference of pollutant emission from the two stoves. The study was carried out at Salambu, Kavre: a remote location in the hilly region of Nepal.

The real time indoor mean concentration and standard deviation of $PM_{2.5}$ during cooking period was 109.7 µg/m$^3$ ($\sigma$ =29.3 µg/m$^3$) for ICS and 314.5 µg/m$^3$ ($\sigma$=120.4 µg/m$^3$) for TCS. Similarly the mean and standard deviation for personal measurement condition was 109.3 µg/m$^3$ ($\sigma$=26.0 µg/m$^3$) for ICS and 248.9 µg/m$^3$ ($\sigma$=121.1 µg/m$^3$) for TCS. The result showed a 65% (p¡0.0001) and 56.1% (p¡0.001) reduction in $PM_{2.5}$ for indoor and personal conditions while comparing ICS over TCS. The AER for the sampled households were observed to be in the range of 0.2 ACH to 11.6 ACH where less than 50% of the households meet the standard of 5 ACH set by ASHRAE and the relationship between AER and CO decay time was seen to be linear with $R^2$=0.21. Although ICS emissions were observed to be less than TCS, both did not meet the WHO standard permissible value for safe health. Furthermore, the backflow of pollutants in the kitchen was not accounted for the model generation although it had a significant impact on the pollutant concentration.

**Keywords:**

ICS, TCS, AER, Ventilation, $PM_{2.5}$, CO

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# Technical Assessment and Energy Saving Opportunities in Biomass-based Industrial Boilers of Nepal with the use of VFD and oxygen trim sensor

*Nirmal KC* [a], *Hari Bahadur Darlami* [b]

**Abstract:**

Industrial boilers are critical for Nepal's industrial sector, with most relying on biomass as the primary fuel source for heat generation. Although biomass is locally available, its combustion often results in inefficiencies and higher emissions. The current state of industrial boilers in Nepal is characterized by outdated designs, a lack of regular maintenance, and inefficient operations, leading to excessive energy consumption and environmental concerns. This study evaluates energy-saving opportunities in industrial boilers in six different Nepalese industries. The boiler's efficiency was assessed using direct and indirect methods, with efficiency values ranging from 26% to 70%. The main sources of energy loss were identified, including flue gas losses (23% - 60% ),loss due to hydrogen in the fuel (2% - 3% ) incomplete combustion losses (0. 31%) and radiation and convection losses (3%). Heat loss due to flue gas comprises of 80% of the total losses in the studied boilers, higher level of oxygen (17% to 20.1%) in the flue gas being the main reason. Installation of variable frequency drive (VFD) and oxygen trim sensor, is analyzed to determine their energy-saving potential. The study also evaluates the payback periods for these interventions, demonstrating their economic feasibility. The implementation of VFD and oxygen trim sensor resulted in energy savings ranging from 1.05 GJ to 2.90 GJ annually, with payback periods between 0.57 and 1.58 years. The findings indicate significant potential for improvements in energy efficiency, reduction in fuel consumption, and operational costs.

**Keywords:**

Biomass, Boiler, Flue gases, Variable Frequency Drive, Oxygen Trim Sensor, Operational Cost, Payback Period

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# Reducing Energy Consumption and GHG Emissions in the Dairy Industry: A Study in Kathmandu and Lalitpur

*Rashmi Dhungana* [a], *Jeevan Khatry* [b]

**Abstract:**

The dairy industry is a significant contributor to energy consumption and greenhouse gas emissions in Nepal. This study aimed to identify energy savings opportunities in the dairy industry and assess the potential impact of technology intervention on energy consumption and greenhouse gas emissions. The study was carried out in two dairy industries in Kathmandu and Lalitpur. Energy audits were conducted and energy savings measures were implemented, including improving the power factor, improving the combustion engine and insulation. The projections of the LEAP model show that technological intervention can significantly reduce greenhouse gas emissions in the dairy industry. Assuming technology intervention, the share of fuel would be 14.6 TJ of diesel, 8.1 TJ of firewood at the beginning of 2020, while at the end of year 2050, the share would be 25.4 TJ diesel, 26.2TJ Electricity, 0TJ of firewood, and 22.1 TJ of solar power. If technology intervention will not take place, it increases from 3059.6 MT in the base year and reaches 4248.1 MT at the end of 2050. Under normal conditions, the demand for fuel share would be 41.6 TJ of diesel and 8.1 TJ firewood based, while at the end of year 2050, the share would be 57.7 TJ diesel and 11.2 TJ firewood. Under technology intervention, the share would be 25.4 TJ diesel, 26.2TJ Electricity, 0TJ firewood, and 22.1 TJ solar powered. The demand for fluid milk would increase from 54.35 million liters in the base year 2020 to 165.68 million liters in business-as-usual scenario to 199.3 million liters in the technology intervention scenario. In addition, by adopting technology intervention, Nepal can earn $7762.5 at the end of 2050. The findings highlight the importance of adopting energy efficient technologies in the dairy industry to mitigate the impact of climate change.

**Keywords:**

Analysis, Efficiency, Energy Consumption, LEAP, GHG emissions

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# Techno-Economic And Environmental Analysis of Dairy Industry" A case study of Kathmandu Milk Supply Schemes "

*Anita Rijal* [a], *Shree Raj Shakya* [b]

**Abstract:**

The dairy industry is one of the most energy-intensive sectors, relying heavily on electricity for milk processing, refrigeration, and other essential operations. The growth and Efficiency of the dairy sector in Nepal face several challenges due to a lack of energy management. The consumption of energy and GHG emissions related to dairy processing increases day by day. This paper explores the energy-saving opportunities along with introducing different technological interventions in Kathmandu Milk Supply Schemes, DDC under different energy-efficient scenarios. The research aims to evaluate energy consumption patterns, efficiency improvement opportunities, and the potential for a transition of thermal energy fuel to enhance sustainability. The study assesses the total electricity consumption and thermal energy consumption in the dairy sector and explores strategies such as replacing inefficient motors transitioning from diesel-fired boilers to electric alternatives, and implementing waste heat recovery systems. An energy audit is conducted to quantify energy savings and carbon emission reductions. Additionally, a cost-benefit analysis is performed to determine the payback period for proposed efficiency measures. Energy consumption was found to be 4526 MWh with emissions of 721 tons of CO2 per kWh and 821 tons of CO2 per liter from thermal energy. Findings indicate that electrification and efficiency improvements can significantly reduce consumption costs and environmental impact. The study concludes that adopting energy-efficient technologies in the dairy industry can play a crucial role in achieving sustainability and reducing reliance on fossil fuels.

**Keywords:**

Energy Audit, Energy Efficiency, Scenario Analysis

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# Assessment of Residential Energy Consumption and opportunity of energy transition for security forces barracks -A case study of Hilly regions of Nepal

*Mrigendra Pradhan* [a], *Debendra Bahadur Raut* [b]

**Abstract:**

The study examines residential energy use in security force barracks in Nepal's hilly regions, focusing on the shift from LPG to electric induction cooking and solar PV integration. Findings show LPG remains dominant at over 40% of consumption, contradicting government policies. Per capita energy use of 560 kWh underscores the need for electrification. A techno-economic study on replacing LPG with 10-20 kW induction cooktops confirms their viability, highlighting reduced long-term costs despite higher initial investment.

Furthermore, solar PV system design was of specific capacity to each barracks were evaluated to enhance energy sustainability in barracks, considering load demand, system sizing, and financial feasibility. The Levelized Cost of Energy (LCOE) of around Rs 8/kWh without use of battery confirms that solar PV integration can be a cost-effective solution, with LCOE values lower than the national electricity tariff of Rs 11/kWh.

This research provides key insights for policymakers, emphasizing the need for infrastructure development, awareness programs, and strategic investments in electrification and renewable energy solutions. Transitioning security force units to electric cooking and solar energy will not only reduce reliance on fossil fuels but also align with Nepal's long-term energy sustainability goals.

**Keywords:**

Residential energy consumption, LPG-to-electric transition, solar PV integration, energy policy, financial feasibility, security force barracks

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# Fueling the Shift: A Quantitative Assessment of Energy Stacking and Transition Index in Urban, Semi-Urban, and Rural Nepal

*Kritik Niraula [a], Anita Prajapati [b], Shree Raj Shakya [c]*

**Abstract:**

This study examines energy consumption patterns of 586 households, across three distinct regions: Kathmandu (urban), Chitwan (semi-urban), and Ramechhap (rural), to analyze the limitations of the traditional energy ladder model and the growing relevance of the energy stacking model in the context of Nepal, further exploring on factors driving clean energy transition process. The paper also formulates a Household Energy Transition Index (HETI) specific to Nepal to quantify the energy transition progress. Findings reveal that while urban households primarily rely on LPG and electricity, rural areas remain heavily dependent on firewood due to economic constraints, lack of infrastructure, and cultural preferences. Semi-urban regions exhibit a mix of traditional and modern energy sources, illustrating a slow but ongoing transition. The research highlights the significance of education, income, and occupational patterns in shaping energy choices, with higher education and income levels strongly correlating with the adoption of cleaner fuels. Despite Nepal's efforts to expand electrification, the transition to modern energy sources is hindered by affordability concerns, supply chain inconsistencies, and deeply ingrained traditional cooking habits. Policy interventions must prioritize location specific tailored strategies, such as financial incentives for clean energy, enhanced rural electrification, and awareness programs, to accelerate Nepal's clean energy transition. A shift towards electric cooking, improved cookstove designs, and renewable energy integration can enhance energy security, environmental degradation, and promote socio-economic development.

**Keywords:**

energy transition, energy stacking, household energy consumption, clean cooking, rural-urban energy divide

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# Groundwater Potential Zoning of Dhanusha District, Nepal Using GIS and Its Variation Due to Temperature

*Aashish Kumar Jha* [a], *Aditya Dhakal* [b], *Uttam Prasad Lamichhane* [c], *Pritika Jha* [d]

**Abstract:**

Groundwater is the most precious thing including in socio-economic development. Groundwater plays a crucial role in the Dhanusha district of Nepal, supporting agriculture, domestic use, and industries. This study aims to delineate Groundwater Potential Zones (GWPZ's) using Geographic Information System (GIS) and incorporating multiple hydro-geological and environmental factors such as rainfall (17.2 – 20.17 mm), land use, soil type, slope, drainage density, and groundwater depth. Rainfall and Infiltration calculations were performed in GIS to generate a groundwater potential map, categorizing the area into very high, high, moderate, low, and very low potential zones.

Furthermore, the study evaluates groundwater availability variations due to temperature fluctuations (annual range: 26.8 – 30.2°C), in annual average and post monsoon time affecting recharge and extraction rates. Rising temperatures increase evapotranspiration, potentially reducing groundwater recharge and availability. During the time interval (2005 AD – 2013 AD), the maximum avg temperature decreased from previous years, resulting in an increase in the groundwater level of the Dhanusha district from (5.5 to 3.2 m) from the surface. The findings provide valuable insights for sustainable groundwater management, irrigation planning, and climate adaptation in the region. This research serves as a critical tool for policymakers in ensuring efficient water resource utilization.

**Keywords:**

Groundwater Potential, GIS, Temperature Variation, Dhanusha District, Nepal

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# Performance Assessment of SCADA Integrated Irrigation Project: A Case Study from Nepal

*Sudip Shrestha* [a], *Maheswor Shrestha* [b]

**Abstract:**

The integration of Supervisory Control and Data Acquisition (SCADA) system in irrigation infrastructure offers a promising solution for efficient water management. This study assesses the Gomati Bahuntar Smart Irrigation project located at Benighat Rorang Municipality-5, Dhading, Nepal's first SCADA integrated irrigation project using the method of field observation, questionnaire survey, in-depth interviews and focus group discussion. Quantitative method was used to conduct the performance assessment, whereas qualitative method was used to identify challenges and solutions across different phases of the project. The quantitative analysis reveals that the project has significantly reduced the water loss as indicated by the composite score of 0.88. Similarly, the overall water use is also improved after the project, as shown by the composite score of 0.81. Another significant improvement is seen in conflict reduction over water as the scores improved from -0.86 before the project to 1.31 after the project. Furthermore, the implementation of SCADA has also played a part in agricultural productivity as reflected by the composite score of 0.95 for crop yield. However, issues such as SCADA equipment vandalism, network instability and limited technical expertise were encountered. These problems were addressed through community engagement, technical fixes and expert consultation, respectively. This study highlights the potential of the SCADA system to enhance the irrigation system and also underscores the need for capacity building in this sector to ensure long-term sustainability.

**Keywords:**

Supervisory Control and Data Acquisition (SCADA),Smart Irrigation, Water Management Efficiency,Capacity Building, Sustainability

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# Spatiotemporal Dynamics of Precipitation in Gandaki Province between 1990 and 2023

*Bishnu Prasad Shrestha [a], Aditya Dhakal [b], Sambridhi Karki [c], Saroj Kumar Yadav [d]*

**Abstract:**

Analysis of spatial and temporal variability of precipitation is crucial for understanding the intensity of rainfall over different time periods and geographical locations within a specific area. Since agricultural crop growth heavily depends on seasonal rainfall, examining rainfall patterns directly influences productivity and, in turn, the socio-economic development of a nation. Thus, understanding the variation of rainfall across various regions is important for disaster preparedness, decision-making, and climate change analysis, benefiting professionals such as hydrologists, meteorologists, agriculturalists, and industrialists. This paper explores the spatial and temporal variability of precipitation in Gandaki Province, Nepal, based on daily and monthly data from 1990 to 2023, sourced from the Department of Hydrology and Meteorology (DHM). The analysis of 34 years of data reveals that 79.07% of the annual precipitation occurs during the monsoon season (June-September), with the remainder spread across the other seasons. The data shows that, among the districts of Gandaki Province, Kaski experiences the highest and Mustang the lowest annual precipitation. July is identified as the wettest month, with an average rainfall of 16.885 mm/day, peaking at 27.11 mm/day in Kaski and dipping to 3.34 mm/day in Mustang. Conversely, November is the driest month, with an average rainfall of just 0.2846 mm/day, ranging from a maximum of 0.444 mm/day in Kaski to a minimum of 0.1623 mm/day in Mustang. Four districts—Myagdi, Gorkha, Tanahu, and Syangja—show an upward slope trend, while the others exhibit a downward slope in trend analysis studies. Myagdi has the steepest slope at +11.759, while Mustang shows the greatest negative slope at -14.496. The study of Consecutive Wet Days (CWD) and Consecutive Dry Days (CDD) indicates that the number of CDDs exceeds CWDs at the Lumle station (814) in Kaski, where the average CDD is 195 and the average CWD is 170. The frequency of extreme precipitation events, R10mm (rainfall between 10 mm and 25mm) and R25mm (rainfall of 25 mm or more) are also calculated. R25 occurred on average 70 times, R10 41 times, and the remaining 254 events had precipitation less than 10mm or no precipitation at all in Lumle (station 814).

**Keywords:**

IDF & DAD, Climate indices, Trend Analysis and Rainfall Erosivity

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# Generation of IDF curve for the data-scarce area by using satellite data through correction factor formulation

*Ashok shrestha* [a], *Mukesh Raj kafle* [b]

**Abstract:**

This paper studies developing a bias-correction method for satellite data for data scarce regions to generate IDF curves, addressing the lack of a generalizable data correction method. Data produced from more than 55 stations selected all over Nepal was plotted and the best line of fit was deemed to be an exponential equation then followed by a polynomial and linear equation.The exponential equation was found to be $C.F.(x,y) = 3.923 \times e^{(-0.00039 \times E(x,y))}$ and linear equation was $C.F.(x,y) = -0.000697 \times E(x,y) + 3.3896$ as per curve fitting. The linear equation outperformed for lower levels while the exponential outperformed others for higher elevation as shown by the statistical factors such as RMS, NSE, and P-Bias. The curve generated by the corrected satellite data was closer to the observed data than the curve generated from the satellite data. As per the research, it is possible to generate a feasible IDF curve from the corrected satellite data for data-scarce regions.

**Keywords:**

IDF, Correction factor, Bias-correction, Precipitation, Least square method, Elevation, Curve fitting, GEV Distribution

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# Water-Energy-Food-Environment Nexus for Tomato Production in NARC Tarahara, Sunsari, Nepal

*Sameer Shakya [a], Jawed Alam [b], Aditya Dhakal [c], Tirtha Raj Karki [d]*

**Abstract:**

The complexity of the relationship between water, energy and food resources in the context of the tomato cultivation in NARC, Sunsari, Nepal is the subject of this study. This project aims to provide an in-depth analysis of the dynamics of the WEF Nexus in the context of Tomato Cultivation in NARC, Sunsari. In the context of the growing global concern about agricultural sustainability and the management of resources, the WEF Nexus framework has become increasingly important as a comprehensive approach to understanding and responding to the challenges that agricultural systems face. This project combines theoretical analysis with empirical data collection and case study methodology to gain a better understanding of the intricacies of the relationship between the water availability, energy input and food production processes related to tomato cultivation. The investigation covers a wide range of topics, including the historical context of tomato cultivation in NARC, the importance of the WEF Nexus framework in agricultural sustainability, the study's specific objectives, and the limitations of the research methodology. Methodologically, the study employs a multifaceted approach that includes use of Cropwat Model and WEFE Nexus tool for the study. Overall, this study helps to advance scholarly knowledge in the field of agricultural sustainability while also providing practical guidance for policymakers, agricultural practitioners, and other stakeholders involved in the management of water, energy, and food resources in agricultural contexts. The project comprehensive analysis and actionable recommendations aim to encourage informed decision-making and promote sustainable agricultural practices in the study area and beyond.

**Keywords:**

Water-Energy-Food (WEF) Nexus, Water, Energy, Food, Tomato production, CROPWAT

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# Free Sedimentation Simulation of a Cubical Shaped Particle in OpenFOAM based CFD-DEM Solver

*Sanjeev Bashyal* [a], *Pawan Kumar Bhattarai* [b]

**Abstract:**

Sediment transport is vital for understanding Earth's landscapes and engineering systems, yet modeling it accurately is challenging due to complex fluid-particle interactions, particularly with non-spherical particles. This study develops a Computational Fluid Dynamics-Discrete Element Method (CFD-DEM) framework within OpenFOAM to simulate the free sedimentation of cubical particles in a water column. The methodology introduces a body-fitted immersed boundary approach, embedding precise cubical geometries into a background fluid mesh. Fluid dynamics are modeled using the PIMPLE solver to solve incompressible Navier-Stokes equations, while particle motion is tracked via Lagrangian mechanics, driven by gravity and fluid forces (pressure and drag) in a one-way coupling scheme, where the fluid affects particles without reciprocal influence. Simulations of cubical particles (1.5 mm, 2 mm, and 2.5 mm) settling in a water column reveal rapid initial acceleration, peaking at approximately 100 m/s within 50 milliseconds, followed by consistent settling velocities. Localized pressure increases below and decreases above the particles highlight the solver's ability to capture fluid-particle interactions. Compared to experimental data for well-rounded particles, simulated settling velocities show close agreement, with minor deviations likely due to shape differences or the one-way coupling limitation. This framework advances particle transport modeling by accurately representing non-spherical particles, laying a foundation for future enhancements like two-way coupling and multi-particle simulations to address more complex scenarios within the OpenFOAM environment.

**Keywords:**

OpenFOAM, CFD-DEM, Immersed Boundary, Mesh, Body-Fitted Meshing

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# Transforming Homes into Hospitality: Effects on Architectural Integrity in Patan's Heritage Zones

*Bijeet Shakya* [a], *Sanjaya Uprety* [b]

**Abstract:**

The transformation of traditional homes into hospitality establishments in Patan's heritage zones is reshaping the city's historic landscape. With the rise of cultural tourism, many heritage buildings are being repurposed into boutique hotels and guesthouses, offering unique experiences while generating economic benefits. However, this shift also raises concerns about preserving architectural authenticity and maintaining the social fabric of the community. This study explores the effects of these changes, analyzing structural modifications, regulatory challenges, and community perceptions. Through qualitative research, including field observations, stakeholder interviews, and policy analysis, the findings highlight the delicate balance between modernization and heritage conservation. While adaptive reuse provides financial sustainability for heritage properties, unchecked modifications often compromise their historic integrity. Additionally, as more residential spaces transition to commercial use, local communities face displacement pressures, changing neighborhood dynamics, and rising property values. To ensure sustainable development, stricter heritage conservation policies, community involvement, and responsible tourism strategies are necessary. Encouraging adaptive reuse that respects traditional architectural elements while accommodating modern needs can help Patan retain its cultural identity without sacrificing economic opportunities. By integrating heritage preservation with thoughtful urban planning, the city can foster a future where cultural tourism supports, rather than diminishes, its rich history.

**Keywords:**

Heritage conservation, adaptive reuse, cultural tourism, architectural integrity, regulatory frameworks.

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# Cradle-to-gate life cycle assessment of *Dachi Appa*: A traditional Nepali veneer brick

*Diraj Thapa* [a], *Sanjaya Uprety* [b]

**Abstract:**

This study performs a cradle-to-gate Life Cycle Assessment (LCA) of dachi appa, a traditional Nepali veneer brick renowned for its cultural and architectural significance. Field research at Dakshin Barahi Brick Factory in Bhaktapur, combined with literature reviews and interviews, evaluates energy consumption and carbon emissions during production.

Results indicate the total carbon emission during production of each brick accounts to 0.53 KgCO2-eq with the brick-burning stage, reliant on coal, as the most carbon-intensive stage, accounting for 93.8% of total emissions. Other stages, including raw brick-making, transportation, and material extraction, contribute minimal emissions. Coal is the dominant energy source, responsible for 91.2% of total emissions.

The study emphasizes the need for efficient burning techniques like replacing coal with renewable alternatives such as wood pellets. Government and associated authorities should impose stricter energy regulations to improve the sustainability of Dachi Appa, preserving its cultural heritage while reducing environmental impact.

**Keywords:**

Lifecycle assesment, dachi appa, environmental impact, carbon emission sustainability

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# Assessing the reconstruction of monumental heritage in Kathmandu: Junga Hiranya Hem Narayan Temple

*Salisna Bajracharya* [a], *Sudha Shrestha* [b]

**Abstract:**

The reconstruction of monumental heritage had become a key focus in Nepal's post-earthquake recovery efforts after the 2015 Gorkha Earthquake. Under the Department of Archaeology, most of these monuments had been reconstructed back to its setting. While doing so, many questions regarding the risk of exhibiting historical inaccuracies in implementation of authenticity of these monuments have been raised. Junga Hiranya Hem Narayan temple, built in 1874, is a monumental heritage in Kalmochan ghat complex which by completely demolished by the 2015 earthquake. Later, the reconstruction work was initiated in 2016, with completion in 2019. This paper assesses the reconstruction process of Junga Hiranya through exploring the issues and challenges in reconstruction leading to the key changes observed in the reconstructed temple in terms of retaining its authenticity. In this research, methods used to collect data are literature reviews, fieldwork and in-depth observations, historical document analysis and interview. The study research shows that the changes after reconstruction is majorly due lack of documentation and research, inappropriate policies and guidelines: mode of contract, lack of skilled manpower and lack of community participation. This study, in end highlights the importance of a systematic and proper research framework and process (aligning to the guidelines) to carry out a true and authentic reconstruction of monumental heritage.

**Keywords:**

Reconstruction, Monument, Authenticity, Configuration, Material, Craftsmanship

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# The Vernacular Architecture and its role in Rular Tourism: A Case of Bhada Village, Kailali, Nepal

*Prerana Chaudhary* [a], *Sanjay Uprety* [b]

**Abstract:**

The rapid transformation of vernacular architecture in rural Nepal, driven by cultural globalization, poverty, and the availability of foreign materials, has led to the loss of architectural character and integrity. This study examines the primary factors influencing these changes in Bhada village due to tourism, employing an interpretative qualitative approach through field studies, surveys, and interviews with local residents. Findings reveal that tourism-driven modernization, economic incentives, and infrastructure improvements contribute to architectural shifts, posing challenges to traditional skills and values. While tourism enhances income and development, preserving cultural identity remains a challenge. The study underscores the need for sustainable and culturally sensitive tourism practices to conserve Nepal's vernacular heritage.

**Keywords:**

Vernacular Architecture, Traditional Tharu culture ,Tourism Development, Modernization, Economic generation

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# Architectural Layout Typology Optimization of Healthcare Facility for General Hospital

*Jagdish Chandra Joshi* [a], *Ashim Ratna Bajracharya* [b]

**Abstract:**

Architectural design in healthcare facilities is crucial for optimizing patient care and operational efficiency. This paper focuses on design providing optimized floor plans with key departments such as emergency, diagnostic, outpatient, inpatient and therapeutic. Each department presents unique challenges that require tailored design solutions to support patient needs, staff efficiency and smooth facility operations. This papers highlight the urgency of handy preparation layout typology for informed decision making for planning purpose of the healthcare facility using intelligent computational system. The design norms and standard of healthcare facility translation into mathematical modeling to extract block layout plan. This papers delves with key indicator such as adjacency between department, frequency of end-users' movement, interdepartmental distance and average service delivery length to key optimized concept design of general hospital. The obtained block plan is turned into architectural floor plans by designers. This paper contributes to take quick and informed decision making for healthcare facility design with easing the process.

**Keywords:**

Healthcare Facility, Circulation Area, Typology Optimization,

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# Understanding the Social Dynamic between Street vendors and Pedestrian Integrating through Computing Analysis

*Minu Lama Bal* [a]

**Abstract:**

This research explores the social dynamics between street vendors and pedestrian movement in Lagankhel, a bustling urban marketplace, through site observations and computational analyses. It employs pedestrian flow and isovist analyses to evaluate movement efficiency and visual accessibility. The findings indicate that vendor clustering at high-traffic locations leads to congestion, limiting pedestrian circulation and visibility. Key congestion points caused by excessive vendor presence disrupt movement patterns, while reduced visibility in dense vendor zones hampers wayfinding. The results emphasize the importance of balanced spatial planning and social dynamic that support both economic activity and pedestrian mobility. By combining computational tools with on-site observations, the research offers a inclusive and vibrant for optimizing vendor placement and improving urban market conditions.

**Keywords:**

Street vendor, Pedestrian, Social Dynamic

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# Study of Deformation of Hyperbolic Paraboloid Shell Under Varying Rise to Span Ratio

*Piter Bhatta* [a], *Hikmat Raj Joshi* [b]

**Abstract:**

This study examines how varying rise-to-span ratios (RSR) affect the displacement of hyperbolic paraboloid (HP) shell roofs of inverted umbrella configuration. Using finite element analysis (FEA), the model was created in Rhinoceros 8 with Grasshopper, and analyzed in ABAQUS 2024. The shell's rise-to-span ratio was varied from 0.05 to 0.25, with results showing that lower RSRs lead to higher deflections, particularly at the shell's free edge and tip. In contrast, higher Rise/Span (steeper shells) reduce displacement by up to 70%, highlighting the crucial role of curvature in enhancing stiffness. Shallow shells (Rise/Span$\leq$ 0.10) are more prone to large deflections, while steeper shells (Rise/Span$\geq$ 0.15) are more efficient due to membrane action. This research emphasizes the importance of rise-to-span ratio in optimizing the structural performance of thin-shell roofs.

**Keywords:**

Hyperbolic Paraboloid Shell, Hypar, HP, Inverted Umbrella HP Shell, Rise/Span

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# Study on Deformation Development Using Numerical Modeling for Varying Pillar Width of Proposed Twin Tunnel: A Case Study of Siddhababa Road Tunnel

*Harish Chandra Badu* [a], *Krishna Kanta Panthi* [b], *Sailesh Adhikari* [c]

**Abstract:**

Road tunnels are essential for improving transportation infrastructure in a mountainous country like Nepal. This study investigates the geotechnical challenges and deformation development trend of Siddababa road tunnel associated with the construction of a tube tunnel adjacent to the one. Being a critical transit corridor that connects city Butwal at the low land with hilly districts in the north and city Pokhara, the existing road at Siddababa area faces geological challenges associated block falls, leading to the construction of a single-tube tunnel. However, with increase traffic volume in the future and improved safety requirement has prompted discussions regarding the construction of twin tunnels. Through numerical modeling, the manuscript analyzes the interaction between the two tunnels and the surrounding rock mass. It further presents analyzed deformation results for varying pillar width between the tubes and recommends optimum pillar width needed to improve stability and reduce adverse stress effects.

**Keywords:**

Siddhababa, RS2, Overburden, Deformation, Pillar Width

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# Effect on Lateral Displacement and Stiffness of RC-Shear Wall with Eccentric Opening

*Sovit Gautam* [a], *Bharat Mandal* [b]

**Abstract:**

Shelter and building infrastructure are essential needs, no matter how advanced human civilization becomes. Due to the scarcity and high land cost, the Dual system: Reinforced Concrete Moment Resisting Frame (RC-MRF) - shear wall is widely adopted for its cost-effectiveness, ease of construction, and ability to withstand horizontal and gravity loads. However, openings in shear walls are also crucial for design criteria, functionalities, and architectural needs, providing natural light, visual comfort, and energy savings, so the effect of eccentric openings on the performance of the structural wall remains to be explored. This study investigates the influence of various opening sizes and eccentricity on the displacement and stiffness of RC- Shear walls. This study compares the Hsiao analytical method to validate the result of ETABS for structural walls with centrally placed and eccentric openings, showing minimal deviations ($R^2$ = 0.9557, 0.8683). Vertical eccentricity has a very minimal effect on the wall stiffness for a greater wall aspect ratio. However, increasing horizontal eccentricity reduces lateral stiffness by introducing torsion, causing wall twisting and greater displacements. Such eccentric openings create uneven stiffness, leading to stress concentrations and reduced lateral resistance. Finally, the graph was plotted to predict the increase in the deflection ratio of the shear wall with comparison to the shear wall without opening for various opening sizes (0-1.5m) and horizontal eccentricity (0-1.5m) for different wall aspect ratios.

**Keywords:**

RC-Shear walls, Eccentric opening, Hsiao analytical method, ETABS, Displacement, Stiffness

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# Application of Artificial Neural Network for Early Cost Estimation of RCC T-Beam Bridge Projects in Nepal

*Ankit Khanal* [a], *Sujan Tripathi*[b]

**Abstract:**

Accurate early cost estimation is pivotal for the successful execution of bridge construction projects within budget, particularly in developing countries like Nepal, where infrastructure development is crucial for economic growth. This study focuses on enhancing the accuracy of early stage cost estimation for Reinforced Cement Concrete (RCC) T-Beam bridge projects using Artificial Neural Networks (ANNs). The research addresses the challenges faced in estimating costs during the initial stages of projects due to incomplete information and the lack of standardized cost estimation techniques. By leveraging ANNs, this study aims to develop a robust and user-friendly model that provides reliable early-stage cost predictions. The model was trained and tested using data from 71 RCC T-Beam bridge projects in Nepal, employing the backpropagation to optimize neural network architecture using Bayesian Optimization technique and a ReLU activation function, implemented in Python using TensorFlow and Keras on Google Colab. The result demonstrated the effectiveness of the ANN model, achieving Mean Absolute percentage Error(MAPE) values of 21.47% and 27.44%, $R^2$ values of 0.812 and 0.722 for the training and testing sets respectively. This MAPE indicates that the model fairly predicts cost of RCC T-Beam Bridge on unseen set of data and $R^2$ value showcasing the model's effectiveness to capture the relationships between input variables and final cost. The findings contribute to the existing body of knowledge by offering a practical solution for stakeholders and policymakers to improve early-stage cost estimation of Bridges in Nepal.

**Keywords:**

Cost Estimation,Artificial Neural Network,Bridge Construction Projects,Prediction Model,Machine Learning

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# Size Optimization of Planar Truss Structures under Various Constraints Implementing Modified PSO based on FEM and Surrogate Model

*Bijay Karki* [a], *Sujan Tripathi* [b]

**Abstract:**

This paper proposes a hybrid optimization method for optimizing planar truss structures under multiple constraints against stability, stress, displacement, buckling, and natural frequency. The modified PSO algorithm was used with a surrogate model to reduce computational costs without compromising the solution's accuracy. However, conventional FEM-based optimization is computationally expensive due to the need for multiple analyses for multiple iterations. This paper utilizes a CatBoost-driven surrogate model to improve the computational efficiency of truss structure optimization, delivering high predictive accuracy while substantially cutting down processing time compared to conventional finite element methods. The framework is validated on a 6-noded, 10-bar truss and an 8-noded, 15-bar truss, demonstrating its effectiveness in achieving optimal designs showing results close to previously known best solutions. The surrogate model demonstrated high precision for regression and classification tests, indicating strong predictive performance across all evaluated metrics. The obtained findings indicated a nearly 50% reduction in computational time compared to the traditional FEM-based approach without losing any accuracy in the design solution.

**Keywords:**

Planar Truss Structures, Size Optimization, Modified Particle Swarm Optimization, Surrogate Model, Finite Element Method, Latin Hypercube Sampling

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# Development of robust machine learning model to predict the major structural response of Brick Masonry Buildings

*Suyogya Dahal* [a], *Sujan Tripathi* [b]

**Abstract:**

Advanced techniques like data-driven approaches and machine learning are crucial for understanding and designing resilient masonry buildings to withstand seismic and other hazards. This study highlights the potential of machine learning for low-cost, fast structural assessments of buildings, significantly improving existing vulnerability assessment procedures and increasing the reliability of results with lower investments. By utilizing machine-learning models to estimate a building's structural response, this research aids in the vulnerability characterization of the building. The focus is on predicting the maximum compressive, tensile, and shear stress induced in the building using standard building features collected in post-disaster surveys. The study further analyzes the importance of building features, such as different geometric configurations and material properties, in determining a building's maximum tensile, compressive, and shear stress. Different machine-learning regression models were trained and evaluated for prediction of accuracy using metrics such as MAE, MSE, RMSE, and $R^2$. Among these models, the CatBoost algorithm, which demonstrated the best $R^2$ value, was identified as the best-performing ML model with the highest precision.

**Keywords:**

Brick masonry, Tensile stress, Compressive stress, Shear stress, PyCaret, Machine learning, CatBoost, Prediction model

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# Bicyclist's Perception based Level of Service in Heterogeneous Traffic Condition: A Case Study of Bharatpur, Nepal

*Rabin Dhital* [a], *Anil Marsani* [b]

**Abstract:**

In Bharatpur bicyclists are compelled to share road space with various types of motorized vehicles, exposing them to heightened safety risks. To address this issue, it is crucial to assess the quality of bicycle travel from the perspective of users and implement suitable mitigation measures. This study aimed to develop a tool for evaluating the quality of bicycling on roadway segments by considering multiple roadway-related physical and functional characteristics. User perceptions of bicycle suitability were collected using a Five-point Likert scale across homogeneous roadway segments in Bharatpur, a mid-sized city of Nepal. Using this data, bicyclist-perceived Level of Service (LOS) criteria were established through Ordered-Probit (OP) model, which are well-suited for analysing the ordered nature of the dependent variable (Bicyclist perceived LOS). The study revealed that among the continuous independent variables, the Average Traffic Speed, Average Traffic Volume, On-street parking Proportion (ONP) had the most significant impact on perceived LOS, followed by Shoulder width . In case of categorical independent variables Pavement type,settlement type and continuous variable Heavy Vehicle Percentage are non-significant to bicyclist-perceived LOS. This OP model can predict correctly LOSB and LOSC are 60.71% and 75% respecively.These LOS criteria were then used to assess the suitability of various roadway segments for bicycling in Bharatpur . This study found that most (10 out of 12) of roadway section offered LOS C(moderately good) implies need of bicycle infrastructure.

**Keywords:**

Bicycle; Roadway Section; Perceived Level of service (PLOS); Ordered-probit (OP) model

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# Influence of Building Massing on Perceived Walkability; A Case of Swayambhu Marg

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**Abstract:**

Walkability is a sustainable and healthy mode of transport. However, the decision to walk is influenced by built environment attributes. The term walkability is used to describe the extent to which the urban environment is pedestrian friendly usually by quantifying multiple building massing attributes at neighborhood scale. Perceived walkability, i.e., how walk-friendly people experience certain area, however has only been explored by limited number of studies. The research analyzes how respondents perceived and evaluated existing building massing attributes of urban environment. The study is conducted in meso scale i.e. building massing with attributes Building Height (Containment), Building Plane (Complexity), Street Focal Point (Coherence) and Ground Floor Window Presence (Transparency/ Visibility). This research has integrated spatial analysis and surveys which has accessed how variation in building massing affects pedestrian experiences. It adopts an interdisciplinary approach, for objective study i.e. observation, long sight line measure is used and for subjective study survey was conducted along with cognitive testing. It concentrates on evaluating the influence of building massing on walkability of Swayambhu Marg, Kathmandu. Swayambhu's historical and cultural context draws foot traffic, the lack of design interventions addressing relationship between building massing and streetscape detracts from walkability. The findings indicate slight differences in observation and perception study. The findings indicate that well calibrated massing can enhance street level vibrancy by preserving human scale proportions that can contribute to feelings of safety and comfort. Conversely, overly imposing and poorly contextualized massing tends to detract from walkable quality of street. It offers insights for strategic adjustments in building massing as it can serve as critical tool for fostering pedestrian friendly cities.

**Keywords:**

Perceived Walkability, Building Massing, Sight Lines, Cognitive Testing

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# Understanding Mode Choice Behavior of School Job holders: The Influence of Accessibility, Connectivity, and User Perception

*Dinesh Bhattarai* [a], *Anil Marsani* [b]

**Abstract:**

This study examines the mode choice behavior of school job holders in Lalitpur Metropolitan City, Nepal, with a focus on accessibility, connectivity, and user perception. Data were collected from 316 school employees using structured surveys and analyzed through Structural Equation Modeling (SEM) and Confirmatory Factor Analysis (CFA). The CFA model demonstrated acceptable fit indices (CFI = 0.948, RMSEA = 0.046), validating the latent constructs. SEM results revealed that connectivity had a significant positive impact on mode choice ($\beta$=0.188,p¡0.001 $\beta$ =0.188,p¡0.001), while accessibility and user perception showed positive but statistically insignificant effects. Key determinants such as transfer ease, service frequency, waiting time, and perceived reliability were found to shape transport decisions. Quantitatively, reducing walking distance by 10% and waiting time by 15% could increase public transport usage by 20%, while improving route directness could shift 15% of users from private to public transport modes. The study recommends enhancing service frequency, improving connectivity through direct routes, and implementing incentive-based strategies to promote public transport use among school job holders. These findings provide actionable insights for policymakers to develop sustainable urban mobility solutions in Lalitpur Metropolitan City.

**Keywords:**

Accessibility, Connectivity, User Perception, Confirmatory Factor Analysis,Latent Variables, Structural Equation Model,

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# Evaluating Public Transport Accessibility for Work Trips: A Case Study of Kathmandu Valley

*Sajan Pandey* [a], *Rojee Pradhananga* [b], *Hemant Tiwari* [c]

**Abstract:**

Public transport accessibility plays a vital role in sustainable urban mobility, influencing employment opportunities and economic participation. In rapidly urbanizing regions like Kathmandu Valley, inadequate and unstructured public transport systems lead to congestion, increased dependence on private vehicles, and limited accessibility to workplaces. This study assesses public transport accessibility to workplaces in Kathmandu Valley by employing the travel time ranges as per Public Transport and Walk Accessibility Index (PTWAI). A travel time matrix was generated using PTV Visum, incorporating public transport networks, walkability factors, and operational headways. Accessibility scores were weighted using employment data to reflect work trip demand. Results indicate that 66 wards (10.37% of the population) exhibit low accessibility, while 112 wards (47.65%) have moderate accessibility, and 69 wards (41.99%) enjoy high accessibility. Municipality-wise analysis reveals that rural municipalities, particularly Konjyosom, Bagmati, and Mahakal, suffer from the lowest accessibility, whereas Kathmandu Metropolitan City demonstrates the highest accessibility.

**Keywords:**

public transport, accessibility, travel time

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# Bus Stop Consolidation in Lagankhel-Khokana Section

*Kshitiz Poudel* [a], *Rojee Pradhananga* [b], *Hemant Tiwari* [c]

**Abstract:**

Public transportation plays a major role for efficiently moving large number of passengers. Public Transport with high ridership acts as a benefactor towards reducing pollution and traffic congestion in urban areas. A balance between the accessibility and operational efficiency is required for the efficient public transportation system . This study deals with the reduction of redundant and unnecessary stop locations. Lagankhel-Khokana section was taken as study area consisting 5 routes to Bungmati, Khokana, Champi, Tikabhairab and Dukuchap from Lagankhel. For this study, boarding and alighting information for the routes were obtained from the ADB's Onboard Survey conducted in Kathmandu Valley in 2024.Routes were then analyzed individually for clustering of the stops around high demand stop; stops eliminated were then calculated and travel time savings for the route was determined. Possible demand loss after the elimination of stops for given threshold were calculated and clustering distance for individual route was calculated resulting in reduced travel time and possible low demand loss. The analysis shows a recommended spacing of 300 meter for the route consolidation. This as a result consolidates minimum of 3 stops in Lagankhel-Khokana section resulting in the travel time saving of 2.25 minutes per trip and maximum of 16 stops resulting in the travel time saving of 12 minutes per trip.

**Keywords:**

Bus Stop Consolidation, Travel Time Reduction, Public Transport Planning, Boarding and Alighting Points, Clustering, Elimination Of Stops, Demand Loss

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# Feasible Locations of the Charging Infrastructures for Public Transportation using GIS and AHP: A Case Study of Kathmandu Valley

*Purushartha Khatiwada* [a], *Rojee Pradhananga* [b], *Hemant Tiwari* [c]

**Abstract:**

The major transportation problems such as air pollution, fossil fuel depletion and low efficiency of conventional energy has encouraged development of electric vehicle technology. The public transportation play a vital role in transportation system as vast majority of traffic are generated through public transportation. The adoption of electric vehicle technology is challenging to the public transportation due to lack of charging infrstructures and their proper planning. This paper deals with the location of the feasible zones for the placement of the charging infrastrcture for the public transport vehicles. The K-means clustering is used to cluster the data of boarding alighting point such that their centroids can be used as initial feasible locations. Raster analysis is performed to check the suitability of the areas. The Analytical Hierarchy Process (AHP) assigns suitable weights to the rasters. After the analysis are carried out it is found that the majority of the locations are feasible as they fall in suitable to moderately suitable regions which is found by suitability mapping by merging the rasters. The major feasible locations are areas with commercial or public land use which are highly accessible by roads and urban facilities.

**Keywords:**

Multi-Criteria Decision Analysis, Analytical Hierarchy Process, Geographical Information System, Charging stations, K-means clustering, Raster analysis

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# Western-Central Corridor: Catalyst for Spatial and Economic Transformation in Regional Development

*Suraj Chapagain* [a], *Ajay Chandra Lal* [b], *Sudeep Sharma Poudyal* [c]

**Abstract:**

The Butwal-Pokhara Siddharth Highway, a critical transportation corridor in Nepal, has significantly influenced regional development by enhancing connectivity and economic growth. This study examines the impact of the highway on Waling focusing on patterns of economic links and challenges in equitable growth. Using a mixed-methods approach, the research integrates quantitative data from surveys and economic indicators with qualitative insights from interviews and focus groups. Findings reveal that the highway has spurred commercial and residential development, increased land values, and improved access to markets, particularly benefiting urban centers like Waling. However, disparities persist, with rural areas lagging due to inadequate infrastructure and limited investment. The study highlights the highway's role in fostering tourism, agriculture, and trade, while also identifying challenges such as out-migration, road safety concerns, and uneven development. Strategic interventions, including infrastructure upgrades, balanced urban-rural integration are proposed to address issues of regional growth. This research contributes to the academic discourse on transportation corridors and regional development, offering practical recommendations for policymakers to ensure equitable benefits from infrastructure investments.

**Keywords:**

Transportation corridor, regional development, urban-rural integration, infrastructure

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# The Role of Vehicle Interior Design in Promoting Gender-Inclusive Public Transportation in Kathmandu

*Prajina Shrestha* [a], *Ajay Chandra Lal* [b]

**Abstract:**

This paper examines gender-based safety issues in Kathmandu's public transportation system, focusing on how vehicle interior design affects women's commuting experiences. Using a mixed-methods approach that includes surveys with 190 users, key informant interviews, and field observations, the study identifies several key challenges. Findings reveal that overcrowding, high-floor designs, and inadequate seating arrangements contribute to discomfort and a heightened sense of insecurity among female passengers. Many women report harassment and difficulty in boarding, with insufficient enforcement of reserved seating policies further exacerbating these issues. While some services like Sajha Yatayat have introduced gender-friendly features such as low floors and separate entry and exit doors, most vehicles still fall short of meeting the necessary safety and accessibility standards. Based on these insights, the paper recommends adopting low-floor designs, optimizing seating configurations, enhancing safety features like CCTV and grab bars, and improving policy enforcement and public awareness. These measures are essential to create a more inclusive, safe, and comfortable public transportation system in Kathmandu.

**Keywords:**

Gender Inclusion, Public Transportation, Safety Perception of women, Vehicle Design and Infrastructure

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# Tactical Urbanism Unveiled: Navigating Complexities in Urban Transformation

*Sujata Yadav* [a], *Ajay Chandra Lal* [b]

**Abstract:**

Public spaces are vital centers of community life, and urban areas are constantly being shaped by expanding populations, shifting economic conditions, and environmental issues. The process of transforming these areas is difficult and calls for solutions that manage the fast pace of urbanization while attending to contemporary urban needs. Cities today face many challenges, including environmental sustainability, conflicting stakeholder interests, social change, and economic pressures. Creative approaches are required as cities deal with these problems in order to promote engagement and inclusivity. A strategy that uses short-term, inexpensive, and adaptable interventions, tactical urbanism has drawn interest as a means of addressing pressing urban problems and promoting long-term change. Before making long-term investments, tactical urbanism enables cities to test and improve urban changes, promoting experimentation and community involvement.

This research examines two case studies the New Road area and Hadigaun to explore how tactical urbanism can address urban transformation challenges in Nepal. These locations, each with distinct socioeconomic and cultural dynamics, provide contrasting perspectives on community engagement and urban change. The study uses a mixed-methods approach, such as surveys, interviews, direct observations, and municipal data to analyze the role of tactical urbanism in shaping public spaces. The findings highlight its impact on businesses, residents, and the overall urban experience. In New Road, aesthetic and functional improvements aimed to enhance the area's vibrancy, while Hadigaun's vehicle-free initiative exemplified a community-led intervention fostering social interaction and accessibility. Through these cases, the study reveals the complexities of tactical urbanism in creating more inclusive and adaptive urban environments. Hence, this research contributes to a deeper understanding of tactical urbanism's role in Nepal's urban transformation, demonstrating its potential as an effective strategy for sustainable and community-driven urban development.

**Keywords:**

Tactical Urbanism, Urban Transformation, Inclusive Planning, Community Engagement, Short-term Interventions

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# Spatial Transformation and its Impact on Social Vulnerabilities in Traditional City Core (A Case of Asan)

*Rodina Tuladhar* [a], *Inu Pradhan-Salike* [b]

**Abstract:**

Urban spaces evolve under socio-economic, cultural, and political influences. This research examines spatial transformations in Asan, Kathmandu, and their impact on social vulnerabilities. Rapid urbanization, modernization, and demographic shifts have altered physical aspects, threatening Asan's historical identity and social cohesion. As a key site on Kathmandu's Heritage Walk and a major festival route, Asan faces native displacement, loss of cultural identity, and disrupted social ties. Using surveys, interviews, and spatial analysis, the study reveals that traditional buildings are being replaced by concrete structures, and residential spaces converted into commercial storage, weakening the social fabric. The loss of open spaces, declining cultural activities, and weakening of Guthis have intensified social vulnerabilities and reduced community involvement. By assessing spatial and social dynamics, the study highlights the need for strategic interventions to balance modernization with heritage conservation. Policy recommendations aim to ensure Asan's resilience while preserving its historical significance.

**Keywords:**

Spatial Transformation, Social Vulnerability, Historic urban core, Urbanization, Asan

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# Towards Inclusive Urban Spaces: Public Toilet Accessibility for Women in Kathmandu and Lalitpur Metropolitan City

*Prajeeb Raj Kandel* [a], *Ajay Chandra Lal* [b]

**Abstract:**

Urban spaces are home to diverse populations, yet urban planning often prioritizes efficiency over inclusivity, resulting in environments that fail to accommodate women's needs. Public toilets, an essential aspect of urban infrastructure, are particularly neglected, disproportionately affecting women due to biological, social, and safety concerns. In Nepal, the inadequacy of public toilets marked by poor accessibility, affordability problems, and lack of inclusivity significantly limits women's mobility and participation in public life. This study examines the challenges women face in accessing public toilets in Kathmandu and Lalitpur. Through a mixed-method approach, combining quantitative surveys with 168 women and qualitative stakeholder interviews, the research explores issues related to accessibility and inclusivity. The study also investigates the gaps in existing policies that contribute to the inadequate provision of sanitation facilities for women. The findings reveal significant barriers that hinder equitable access to public toilets, reinforcing the need for policy reforms, inclusive design, and improved management. This research provides valuable insights for urban planners and policy makers to guide the development of gender-sensitive, accessible, and inclusive public toilets. Addressing these challenges is essential for promoting gender equality, public health, and sustainable urban development, as well as fostering inclusive urban spaces for all.

**Keywords:**

Accessibility, Public Toilets, Women

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# Urban Reuse of Brownfields: Assessing Redevelopment Model of Chobhar Dry Port

*Saroj Bohara[a], Suman Dhakal [b], Prabin Basnet[c], Chudamani Karki[d], Sudha Shrestha[e]*

**Abstract:**

A crucial component of urban transformation is the redevelopment of industrial brownfields, especially in areas where defunct industrial sites impede environmental sustainability and economic growth. This study examines the redevelopment of the Himal Cement Factory into the Chobhar Dry Port, a key logistics hub in Nepal. Grounded Theory Research, inductive coding, and Qualitative Thematic Analysis (QTT) in MAXQDA are used in this qualitative study to investigate themes pertaining to public-private partnerships (PPP), brownfield redevelopment, land acquisition difficulties, and citizen participation. Significant issues are revealed by the findings, such as land disputes, sociopolitical opposition, and logistical inefficiencies, all of which were resolved by government interventions and a PPP model. The study also analyzes the Inspection Request procedure and the Ladder of Citizen Participation to identify gaps in community engagement. In order to ensure the sustainable and equitable redevelopment of industrial brownfields in Nepal and comparable contexts, the research emphasizes the necessity of inclusive governance, structured policy frameworks, and stakeholder collaboration.

**Keywords:**

Brownfield, Redevelopment, MAXQDA

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# Development and Analysis of Vermicompost from Animal Waste and Plant Residue using Eisenia Foetida Earthworm

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**Abstract:**

Vermicompost is a nutrient-rich organic fertilizer produced through the biological decomposition of organic waste by earthworms, enhancing soil fertility, microbial diversity, and plant growth while reducing pollution. Although earthworms have been found to improve the chemical properties of the vermicompost, there has not received due attention of the investigators in Nepal. This study was conducted for 35 days with objectives, to develop the vermicompost by the use of animal waste and plant residue using Eisenia foetida earthworm; to determine the effects of variation of cow dung and plant residue ratios on nutrient value of vermicompost. Pre-decompose of animal waste and plant residue was done in three pits for about two weeks to reduce C/N ratio. Then the digestion of pre-decomposed matter was performed in three worm bins separately with each of 200-liter capacity. Each three bins were incubated with 6 kg of Eisenia foetida earthworms (which contain near about 2100 numbers of earthworms) and a total of 18 kg (near about 6300) worms. The bins were initially filled with 2 cm height of 12 mm stone chips, which was then covered with 2cm thick layer of 1-4 mm size gravel and 2cm soil layer above it for proper air and water circulation. The bins were kept under shade and maintained at moisture level of near about 70% for the optimum functioning of earthworms. The samples of vermicompost were taken in the interval of 7 days in 35 days and their nutrient values were determined. From the sample analysis, the value of **Nitrogen**, **Phosphorus**, and **Potassium** were obtained in the range of **(0.359-0.511)%**, **(0.175-0.227)%**, and **(0.014-0.044)%** respectively.

**Keywords:**

Eisenia foetida, plant residue, Vermicomposting, Worm Cast, Bio-solid, Cow Dung

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# Role of Agriculture Policies in Alleviating Rural Poverty in Nepal

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**Abstract:**

Nepal, a lower-middle-income country, is predominantly rural, with 79% of its population living in rural areas and 66% engaged in agriculture. Agriculture plays a critical role in the national economy, contributing one-third of GDP. However, productivity remains low due to factors such as land fragmentation, limited modern technology, and inadequate infrastructure. Most agricultural activities are subsistence-based, with farmers struggling to meet food needs and facing financial instability. This has led many rural residents to migrate to urban areas or seek foreign employment, exacerbating the shortages of manpower in the agricultural sector. Nepal's agricultural policies, such as the Nepal Agriculture Perspective Plan (APP) and the Agriculture Development Strategy (ADS), focus on commercialization, technological advancement, and infrastructure development. Despite these efforts, challenges such as land degradation, lack of irrigation, and poor access to the market persist. Remittances, which contribute significantly to the national GDP, have alleviated poverty, but also reduced the agricultural workforce. This paper explores the factors affecting agricultural productivity in Nepal, the impact of migration on the rural workforce, and the effectiveness of current agricultural policies. It emphasizes the need for targeted interventions that promote sustainable practices, modern technology, and improved infrastructure to promote agricultural growth and reduce poverty.

**Keywords:**

Agriculture, Nepal, Policies, Poverty, Remittances Rural

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# Assessing the Impact of Urbanization and Climate Change on Urban Flooding: A case of Dhobi khola

*Aashray Kapali* [a], *Ajay Chandra Lal* [b]

**Abstract:**

Flooding remains one of the most devastating and frequently recurring natural disasters, exacerbated by changing landscapes and climate dynamics. This study explores the dynamic relationship between morphological parameters such as fractal dimension, land cover, hydrological parameters such as discharge and inundation and climatic parameters such as rainfall. The role of land cover, from dense urbanization to natural vegetation, is critically assessed to understand its effect on flood behavior. Additionally, the interplay between rainfall patterns and river discharge is explored to examine their collective impact on flood risk. Through spatial and statistical techniques, the study defines how these variables correlate, shedding light on the complex feedback mechanisms that drive flood events. By exploring these dynamic interactions, the study offers critical insights into flood prediction and management strategies, providing a foundation for more resilient urban planning and disaster mitigation.

**Keywords:**

Morphological Dynamics, Fractal Dimemnsion, Hydrological Processes, Inundation Modeling

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# Impact of Climate Change on the ROR Hydropower: A Case Study of Upper Trishuli 3A Hydropower, Nepal

*Nabin Devkota* [a], *Mukesh Regmi* [b]

**Abstract:**

Electricity generated from hydropower is affected by the change in hydrological characteristics of river basin. Climate change, the burning issue of today's world, affects region's hydrological regime and ultimately the power generated from hydropower plant. Our study modelled the precipitation and temperature time series data to understand the effect of climate change on hydrological regime. The study is carried out using ensemble of 5 CMIP6 GCMs in a calibrated and validated SWAT (Soil and Water Assessment Model) from observed DHM data. Using future data of two scenario i.e., SSP245 and SSP585, future value of discharge and hence energy is calculated and compared with baseline scenario to understand the impact of climate change. The study is expected to help the learners, planners, developers, researchers and government bodies to know the current and probable future hydrological condition of Trishuli river basin and energy generation status of Upper Trishuli 3A hydropower plant. This will support for adopting adaptation measures in UT3A which can reduce risks associated with change in hydrological flow in Trishuli river.

**Keywords:**

Climate change, Trishuli basin, SWAT, UT3A

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# Development and Evaluation of Building Construction Quality Index for Public RC Building Construction in Kathmandu Valley, Nepal

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**Abstract:**

Building Construction Quality is important to construct safe, durable and functional structures in public RC building construction. Construction quality is compromised by many factors like poor material handling, substandard workmanship, inadequate quality control, etc. This study aims to develop a Building Construction Quality Index (BCQI) for public RC building construction in Kathmandu Valley. First, the key factors that affect construction quality are identified, focusing on reinforcement, concrete and infill wall. Then, the factors are validated through expert interviews and weightages are assigned to these factors using Analytic Hierarchy Process (AHP). This provides a quantitative measure of building construction quality. The model is validated and tested through expert opinion and case studies. The findings of this research are expected to help policymakers, engineers, construction managers and quality control technicians to improve construction practices, ensure quality compliance with established specifications and standards and promote durability and structural integrity in public RC building construction in the Kathmandu Valley.

**Keywords:**

Building Construction Quality Index, RC Building, AHP, Analytic Hierarchy Process, Modeling

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# To Pre-identify the Probable Sick Project during the Bid Document Evaluation Phase

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**Abstract:**

Delay in construction project is the well-known issue in all the construction projects either in national or in international sector. In Nepal, major construction projects are all delayed twice, three times, or more than the initial contract duration, either in the road, building, irrigation sector, etc. CIAA(Commission for the Investigation of Abuse of Authority) had conducted a detailed study on sick projects and had concluded a total of 442 health building projects as a sick project constructed by DUDBC (Department of Urban Development and Building Construction), Nepal, from 2061 / 062 to 2075 / 076. Sick projects lead to economic strain, material shortages and price increases, social disruption and public distrust, etc. We always search for the solution of the problem after the problem arises, but never try to figure it out earlier before the contracting phase. This paper is focused on preparing a model to pre-identify the probable sick projects during the bid document evaluation phase. In due concern the literature review has been done from initially published articles, journals, papers, books, news etc. The Sick (listed by the CIAA) and non-sick projects are carried out in health buildings constructed by DUDBC from 2061/062 to date and a questionnaire survey is carried out to validate the model. The model reveals that two predictors, *i.e*, the estimated contract duration and percentage below the initial estimated amount, play the major role in making the project sick.

**Keywords:**

Sick project, Estimated amount, Contract duration, Model, Validate

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# A Comparative Analysis of Prevailing and BIM-based Construction Scheduling Process in context of Nepal

*Jenisha Maharjan* [a], *Sunil Suwal* [b]

**Abstract:**

This thesis investigates the practical implementation of BIM-based scheduling, specifically 4D BIM, in the Nepali construction industry.The research aims to evaluate the potential of BIM technology to enhance the scheduling process by integrating time and 3D model elements facilitating more efficient project planning, visualization, and resource management.Using a case study of a commercial building,the study develops a 4D BIM model that links the project's architectural and structural design with the construction schedule.The 4D simulation enables early clash detection, improves communication and collaboration among stakeholders, and provides a more accurate visualization of construction sequences.After accounting for 50% irrelevant clashes, it was estimated that 408 relevant clashes led to a rework risk of 15–20%, while Solibri's accurate identification of non-geometric conflicts provided an extra 5–10% time savings.In the absence of BIM,conventional methodologies would have overlooked these conflicts, resulting in intensified delays and expenses.The research illustrated the advantages of 4D BIM for facilitating stakeholder collaboration via real-time visualization on platforms such as Trimble Connect, thereby diminishing misunderstandings and strengthening coordination.However, the research also highlights substantial challenges to BIM adoption in Nepal, including the high cost of software and the limited availability of skilled professionals.Despite these obstacles,the study concludes that the practical application of BIM-based scheduling can greatly enhance project outcomes in Nepal,provided there is increased investment in BIM education and professional development.

**Keywords:**

Construction Schedule, Building Information Modeling(BIM), 4D BIM

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# Projected Drought Conditions in Mustang, Nepal: A Quantitative Assessment of Historical and Future SPI Trends Using CMIP6 Models

*Apechhya Aryal* [a], *Dhiraj Pradhananga* [b]

**Abstract:**

Climate change has significantly intensified extreme weather events worldwide, with drought emerging as one of the most severe threats to water security, agriculture, and livelihoods, particularly in arid and semi-arid regions. These regions experience prolonged dry spells due to limited precipitation and rising temperatures, exacerbating socio-economic vulnerabilities. Mustang, Nepal, situated in the trans-Himalayan rain-shadow region, is especially prone to prolonged droughts due to its unique geographical and climatic conditions. The region receives minimal annual precipitation, and increasing temperatures have further amplified the frequency and severity of drought events, posing significant challenges to local communities that rely on traditional farming and livestock rearing.

This study evaluates historical and future drought conditions in Mustang using the Standardized Precipitation Index (SPI) and bias-corrected simulations from CMIP6 climate models. Historical drought patterns from 1980 to 2014 are analyzed using observed meteorological data to assess changes in drought frequency, duration, and intensity. These findings are then compared with future projections under the SSP2-4.5 and SSP5-8.5 climate scenarios to understand how drought characteristics may evolve over time. The analysis reveals a noticeable increase in severe and extreme drought events, particularly in the latter half of the 21st century, with a pronounced intensification after 2050. Under higher emission scenarios, drought durations are projected to lengthen, and the frequency of consecutive dry years is expected to rise, leading to greater water stress for agriculture, ecosystems, and human settlements. Additionally, policymakers should prioritize long-term climate adaptation planning, including early warning systems and community-based water governance frameworks, to ensure sustainable water availability in the face of increasing climate variability. By integrating scientific research with local adaptation efforts, it is possible to enhance the resilience of Mustang's communities and ecosystems to the growing threats posed by climate change-induced droughts.

**Keywords:**

Drought assessment, CMIP6 projections, Standardized Precipitation Index (SPI),Himalayan climate variability

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# Assessing the Applicability of the Lee and Colley Review Package for Evaluation of EIA Reports in Nepal: A Pilot Study on Building Projects of 2020 in Bagmati Province

*Sovit Raj Basnet* [a], *Niranjan Shrestha* [b]

**Abstract:**

Environmental Impact Assessment (EIA) is critical for promoting sustainable development by identifying and addressing environmental and socio-economic impacts. In Nepal, rapid urbanization and federal governance reforms have amplified infrastructure demands, underscoring the importance of high-quality EIA reports. This study investigates the applicability of the Lee and Colley review package, a globally recognized assessment instrument, for assessing the quality of EIA reports prepared in 2020 for building projects in Bagmati Province. The assessment found strong points in communication and layout but revealed gaps in baseline data collection and alternatives analysis, highlighting areas that need significant improvement for better effectiveness. All reports were rated borderline, meeting only minimal standards. Systemic challenges, including insufficient technical rigor, limited socio-economic integration, and lack of transparency, hinder Nepal's EIA process, signaling a need for significant improvements. This pilot study demonstrates the applicability of the Lee and Colley review package in the Nepalese context. It provides actionable recommendations, including enhanced baseline data collection, improved transparency, stakeholder capacity building, and the adoption of advanced tools like predictive modeling. These insights aim to support policymakers and practitioners in refining Nepal's EIA practices, ensuring that infrastructure development aligns with sustainability principles and benefits both the environment and communities.

**Keywords:**

EIA report quality, Lee and Colley review package, Nepal

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# Assessing the Impact of Land Use Land Cover (LULC) Change on Groundwater Storage in Godawari Municipality

*Mukunda Prasad Agaasti* [a], *Ram Krishna Regmi* [b], *Bhesh Kumar Karki* [c], *Govinda Prasad Poudel* [d], *Shukra Raj Paudel* [e]

**Abstract:**

Rapid Land Use Land Cover (LULC) changes driven by urbanization, deforestation, and agricultural expansion have significantly impacted groundwater dynamics, reducing recharge rates and increasing water stress. This study assesses the influence of LULC changes on groundwater storage (GWS) in Godawari Municipality using GRACE satellite data from 2002 to 2019. By integrating remote sensing techniques with Python-based statistical analysis, including Sen's slope estimator and Pearson correlation, the study quantifies the impact of LULC transitions on groundwater depletion. Results indicate a significant decline in groundwater storage, with a depletion rate of -19.25 mm/year ($p < 0.05$). Forest cover exhibits a strong positive correlation with groundwater storage ($r \approx +0.82$), while built-up areas ($r \approx -0.72$), cropland, grassland, and bare soil contribute to groundwater depletion. These findings emphasize the urgent need for sustainable land and water management strategies, including afforestation, urban green infrastructure, artificial groundwater recharge, and enhanced water conservation policies. Additionally, this research provides a foundation for incorporating high-resolution hydrological models, advanced remote sensing, and in-situ validation to improve groundwater monitoring and inform evidence-based decision-making for sustainable water resource management.

**Keywords:**

Land Use Land Cover (LULC) Change, Groundwater Storage (GWS), GRACE Satellite Data, Sen's Slope Estimator, Sustainable Groundwater Management

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# Efficiency Evaluation of Constructed Wetland Planted with *Canna indica* For Treatment of Hospital WasteWater

*Aakriti Bhattarai* [a], *Bhesh Kumar Karki* [b], *Kaji Ram Karki* [c]

**Abstract:**

Constructed wetlands are low-cost and simple treatment technologies used for treatment of varieties of wastewater. Constructed wetlands have been highly effective in removing pollutants. This study was conducted with laboratory scale vertical flow constructed wetland (VFCW). A laboratory setup was established with gravel and sand as media. Raw wastewater as well as effluent were tested for pH, BOD, COD, total dissolved solids (TDS), total solids (TS), ammonia and phosphorus. The average COD removal efficiency was found to be 86.17% while 81.34% of $BOD_5$ was removed in average. High ammonia removal was observed as 99.5% in average and the setup showed an efficiency of 96.39% in phosphorus removal. However, total solids and total dissolved solids removal efficiency was observed to be low as compared to other parameters. Total solids removal efficiency was 38.32% and total dissolved solids removal efficiency was 42.5% . The laboratory setup showed high removal efficiency for organics as well as nutrient, but limited solids removal capacity. Further studies can be conducted in larger scale outdoor settings considering seasonal variations and climatic impacts.

**Keywords:**

Constructed wetlands, Vertical flow, hospital wastewater

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# Assessment of Groundwater Storage Potential in Western Part of Madhesh Province

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**Abstract:**

Groundwater is a critical water resource for domestic, agricultural, and industrial purposes in the Terai region of Nepal. This study assesses groundwater storage potential in Madhesh Province, focusing on the districts of Parsa, Bara, and Rautahat. Utilizing Geographic Information System (GIS), remote sensing (RS), and machine learning techniques, particularly the Random Forest model, the study integrates multiple thematic layers, including land use/land cover (LULC), drainage density, soil composition, rainfall, groundwater level depth, and aquifer thickness. The model was trained using data from Bara and Rautahat and validated using data from Parsa, achieving an area under the curve (AUC) value of 0.8002, indicating high predictive accuracy. The results classify the study area into four groundwater potential zones—low, moderate, high, and very high—revealing significant storage potential, particularly in Parsa and Bara districts. This research highlights the effectiveness of GIS, RS, and machine learning in groundwater assessment and provides valuable insights for sustainable water resource management in the region.

**Keywords:**

Geographic Information System, Groundwater Potential Zone, Groundwater Table, Machine Learning, Remote Sensing

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# Emission Calculation and Economic Analysis of different Construction Materials based on Clean Development Mechanism for an apartment building at Pokhara

*Shisab Pant* [a], *Nawraj Bhattarai* [b]

**Abstract:**

This paper focuses on the economic aspects of climate change, with a particular emphasis on the economics of mitigation, adaptation, loss, and damage. It delves into greenhouse gas (GHG) emissions and emission reduction contributions, specifically highlighting the significant impact of real estate on global carbon footprints. The study was conducted based on the Framework Convention on Climate Change (UNFCCC)'s approved guidelines of Clean Development Mechanism (CDM) in calculating the emission of Building Construction Materials at Himalaya Homes Apartment, Pokhara. The methodology adopted for this project is AMS-III. Z, which is the small-scale methodology for fuel switch, process improvement, and energy efficiency in brick manufacture. Using this methodology, the baseline emission during the construction phase was found to be 200 T of CO2, and an emission reduction of 107 T of CO2 can be achieved using CSEB whereas 200 T of CO2 emission can be reduced using stone walls as construction materials. After the economic analysis of the project, the CSEB wall is recommended as the best economic material, which gives a benefit/Cost (B/C) value of 1.22, whereas the stone wall was the best material for sustainability which has the highest (200 T) emission reduction. The study proposed the use of alternative construction materials rather than conventional brick to reduce carbon emissions from the building sector. The potential economic benefits of implementing CDM, including CO2 trading and cost savings from sustainable materials are explored. The calculation of operation time emission, analysis of non-marketable benefits and study of other available CDMs using different approved methodologies are some of the limitations in the study. This paper advocates for the urgent need for sustainable practices and adoption of CDM's, particularly in building construction, to mitigate environmental pollution and climate vulnerabilities.

**Keywords:**

Emission, energy efficiency, CDM, AMS-III. Z, CER, UNFCCC

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# Characterization and Impact of Heatwave in Saptari District, Nepal

*Anish KC* [a], *Vishnu Prasad Pandey* [b],

**Abstract:**

This study analyzes the increasing occurrence and impact of heatwaves in the Saptari District of Eastern Terai, Nepal. Using temperature-based extreme indices and remote sensing data, the research quantifies long-term trends in heatwave frequency, intensity, and duration from 2003 to 2020. Findings indicate a significant rise in both daytime and nighttime temperatures, with a notable increase in heatwave occurrences, particularly in urban and lowland areas. The study introduces a Composite Heatwave Index and a Heat Risk Index to assess social vulnerability, revealing that populations under 15 and over 65 are at the highest risk. The results highlight the urgent need for climate adaptation strategies, improved forecasting systems, and targeted policy interventions to mitigate the socio-economic and health impacts of extreme heat events. This research provides critical insights into regional climate trends and contributes to the development of sustainable resilience frameworks in Nepal.

**Keywords:**

Heatwave, Temperature Trends, Socio-Economic Impact, Climate Change, Eastern Terai, Nepal

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# Energy Conservation Potential of Decentralised Wastewater Treatment Systems in Kathmandu Valley: Comparison of Activated Sludge Wastewater System and Constructed Wetlands

*Benison Pradhan* [a], *Nawraj Bhattarai* [b]

**Abstract:**

This thesis investigates the energy conservation potential of wastewater treatment systems in the Kathmandu Valley, specifically comparing the conventional Activated Sludge System at the Guheshwori Wastewater Treatment Plant with a decentralized Constructed Wetland system implemented at Dhulikhel Hospital. The research reveals that conventional systems are energy-intensive, leading to significant operational costs and environmental implications. The activated sludge process relies heavily on electricity for aeration and pumping, resulting in a high average energy consumption of approximately 1.7 kWh per cubic meter of treated wastewater, with energy demands further exacerbated by frequent power shortages. In contrast, the constructed wetland system demonstrated an impressive reduction in energy consumption, utilizing natural processes and greenery to treat wastewater with minimal energy input. Results indicate that the CW system achieved a BOD5 reduction of over 85 percentage and a COD reduction of around 65 percentage, showcasing its efficacy in wastewater treatment while significantly lowering energy dependencies. The findings highlight that implementing decentralized treatment systems like constructed wetlands can effectively address the growing wastewater management challenges in urban Kathmandu. These systems not only enhance treatment efficiency but also foster sustainability by reducing the environmental impact associated with conventional methods. This study underscores the necessity for urban policymakers to consider and integrate low-energy, decentralized wastewater treatment solutions in their planning efforts to promote sustainable urban development in Nepal.

**Keywords:**

Energy efficiency, Decentralized Wastewater Treatment, Constructed Wetlands, Sustainable Water Management, Nepal

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# Optimizing Waste Management at Airports: A Case Study of Tribhuvan International Airport's Sustainable Waste-to-Energy Transition

*Anil Gupta* [a], *Anita Prajapati* [b], *Tek Raj Subedi* [c]

**Abstract:**

Airports face significant waste management challenges due to increasing passenger traffic and diverse waste streams. Tribhuvan International Airport (TIA), Nepal's busiest hub, generates approximately 200 tons of waste monthly but operates with outdated incineration systems that lack energy recovery and effective waste segregation, leading to environmental degradation and elevated emissions. This study investigates strategies to modernize TIA's waste management practices by integrating advanced Waste-to-Energy (WtE) technologies, circular economy principles, and real-time emissions monitoring. Findings from waste audits reveal high volumes of high-calorific-value waste, such as plastics and paper, alongside significant organic waste, highlighting potential for energy recovery and composting initiatives. Emissions data indicate high levels of pollutants, including carbon monoxide and nitrogen oxides, necessitating the adoption of advanced emission control technologies like selective catalytic reduction and Continuous Emissions Monitoring Systems (CEMS). Drawing insights from global benchmarks, including Kansai and Istanbul Airports, this research emphasizes the use of technologies such as Organic Rankine Cycle (ORC) systems, cogeneration, and automated waste sorting. These measures, combined with policy interventions and stakeholder engagement, could reduce landfill dependency by 40%, generate 500 MWh of renewable energy annually, and align TIA with international environmental standards. This study positions TIA as a model for sustainable airport operations in South Asia.

**Keywords:**

Waste Management, Tribhuvan International Airport, Waste-to-Energy, Emissions Control, Circular Economy, Renewable Energy, Sustainable Aviation

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# Assessment of Potential Factors Influencing Functionality of Community Based Water Supply Projects

*Pawan Subedi* [a], *Rajit Ojha* [b], *Rabin Maharjan* [c]

**Abstract:**

This study used relative importance index (RII) ranking to identify the most significant financial, technical, social, institutional and other factors influencing functionality with Likert's five scale questionnaire survey. The Chi square test and the multi-nominal logistic regression model were used to analyze the factors that influence the functionality of 288 community-based water supply projects from two municipalities and four rural municipalities of Syangja district, Gandaki Province, Nepal. The data indicate that 26.4 percent of the projects were at high risk, 8.7 percent projects were at some risk, and 64.9 percent projects were at no or less risk of functionality. The Chi-square showed the institutional factors to be the most significant factor in determining the risk of functionality. The highly effective or active Water Supply User's Committee (WSUC) and proper management, monitoring and controlling system were positively associated with functionality. The projects that provide adequate water supply to meet the daily needs of consumers showed a lower risk of functionality issues. If the beneficiaries do not pay for water, the chances of non-functioning increases compared to the systems with payable connections. Gravity systems have better chances of being functional, and projects older than 20 years have significant negative effect on functionality. Better management, activeness of WSUC, tariff collection and use of tariff on regular maintenance of systems and focusing on adequacy reduces the risk of functionality of systems. Multinominal logistic regression showed 59.6 percent variance of the risk of functionality of water supply systems. This study provides insights into the implementation of community-based water supply projects in an area, which could inform similar initiatives in other comparable contexts too.

**Keywords:**

Community-based water supply system, Functionality, Relative Importance Index (RII), Chi-Squared test, Logistic regression

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# Spatial Variability of soil properties using geostatistical technique: A case study of Birtamode Municipality, Jhapa Nepal

*Suman Thapa [a], Animesh Khadka [b], Aditya Dhakal [c], Jawed Alam [d]*

**Abstract:**

Food security and fertilizer application are an inherent part of agricultural sustainability. This study has presented a sample-based geostatistical and statistical analysis of soil ingredients i.e., available phosphorous (P), organic matter (OM), total nitrogen (N), pH, and available potassium (K) is obtained from paddy fields of Birtamode Municipality, Nepal. The purpose of the study is to examine the soil's properties and how they vary across different regions of study field. This study is carried out with 116 soil samples randomly taken and tested in laboratory. The coordinate has been traced using Global Postioning System (GPS). Statistical and geostatistical analysis has been performed. Further, the results are cross-validated using ArcGIS. Kriging interpolation developed using semivariogram model is used for the preparation of soil fertility maps. The results show that the pH range was 5.16 to 5.92, which is strongly acidic in most of the areas. Organic matter is found 2.19%, nitrogen 0.11% and phosphorus 47.116 kg/ha on average. The available potassium varied from 46.2 to 365.15 kg/ha, with an average of 146.8kg/ha. Results shows that pH has coefficient of variance of 3.77 results least variance, while Potassium has the most variance of 50%. The OM and Nitrogen was fitted in the Gauss model, potassium and pH fits on spherical model and phosphorous fits the exponential model. Moreover, strong spatial dependence for nitrogen, phosphorous, pH and potassium and moderate for organic matter has been determined. Spatial distribution maps obtained from kriging interpolation shows that the majority of the study area has a strongly acidic pH, medium nitrogen and low organic matter. This study may help farmers to apply fertilizers and adopting management practices to agricultural lands to increase agricultural production.

**Keywords:**

semivariogram, kriging, geostatistical, spatial distribution map

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# Stability Assessment of Surge shaft in Weak Rock mass Conditions- A Case Study of Tanahu Hydropower Project

*Amrend Prasad Shah* [a], *Yagendra Thapa* [b], *Sandeep Shrestha* [c]

**Abstract:**

Surge shaft excavation in weak rock mass presents significant challenges due to the low strength and high deformability of the rock. Careful geotechnical investigation, applying appropriate excavation methods, implementation of effective support system and continuous monitoring system are essential tools to assess and mitigate risks associated with weak geological conditions.This study evaluates the stability of the surge shaft in the Tanahu Hydropower Project using a combination of empirical, semi-analytical, analytical, and numerical methods. Empirical methods, including the Q-system and Rock Mass Rating (RMR), provide preliminary support recommendations, while semi-analytical approaches, such as the Hoek and Marinos method, assess potential squeezing behavior. The analytical evaluation, conducted using Unwedge software, examines structurally controlled failures. Numerical modeling with RS2 compares plain strain and axisymmetric analyses to assess deformation characteristics and support requirements. The results indicate minor squeezing potential in certain sections, but field observations confirm overall stability with appropriate support measures. The study underscores the importance of integrating multiple assessment techniques to ensure safe and efficient surge shaft construction in weak rock conditions.

**Keywords:**

Surge shaft, weak rock mass, numerical modeling, stability analysis .

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# Multi-Criteria Analysis of Spatial and Social Dimensions of Landslide Risk: A Case Study of Sangurigadhi Gaupalika, Dhankuta

*Pranish Adhikari [a], Basanta Raj Adhikari [b], Akhilesh Kumar Karna [c]*

**Abstract:**

The Nepalese natural landscape often suffers substantial damage from landslides at multiple levels due to topographical and geological factors, as well as heavy monsoon rainfall, which triggers these events. The study used a multi-criteria analysis using Geographic Information System (GIS) to evaluate the landslide risk in Sangurigadhi gaupalika. The study considered ten causative factors such as slope, aspect, tangent curvature, profile curvature, distance to rivers and roads, relative relief, rainfall, land cover and geology to assess landslide susceptibility. The models were prepared for both the district and the gaupalika to provide broader insights and also to validate the findings, compare regional trends and aid in disaster management planning. The study confirmed that 45% of areas of both Dhankuta and Sangurigadhi fall into low susceptibility zone while 15% of the areas of Dhankuta and Sangurigadhi fall under high susceptibility zone. The models were validated using the Receiver Operating Characteristic (ROC) prediction curve showing reliable model performance through 80.33% and 74.10% Area Under Curve (AUC) values for Dhankuta and Sangurigadhi, respectively. Similarly, the vulnerability assessment revealed Wards 4 and 6 as the most physically vulnerable and Ward 2 as the most socially vulnerable along with Ward 10 as the most economically vulnerable. The study can provide a basis for risk-informed decisions and disaster mitigation and can assist in risk-informed actions in similar exposed regions.

**Keywords:**

Landslide Susceptibility, GIS, Multi-Criteria Evaluation, AHP, Vulnerability Assessment, Risk Analysis

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# Dam Break Induced Flood Hazard Assessment: A Case Study Middle Mewa Hydropower Project

*Pujan Gurung* [a], *Vishnu Prasad Pandey* [b]

**Abstract:**

Dams are vital for hydropower generation, water supply, and flood control, but their failure can cause catastrophic flooding, loss of life, and infrastructure damage. This study evaluates the risk of dam break induced flooding at the Middle Mewa Hydropower Project (HPP), located in a seismically active and hydrologically dynamic region of Nepal. A comprehensive hydrometeorological analysis was conducted as a preliminary step in assessing potential loss and damage. Topographic and hydrologic analyses characterized the Mewa Khola catchment using high-resolution 5×5m DEM data. Probable Maximum Precipitation (PMP) was estimated from historical data (1970–2024) using Hershfield's method, while the Probable Maximum Flood (PMF) hydrograph, developed via Snyder's method and IDF curves, indicated a peak discharge of 2773.18 $m^3/s$ within 10 hours post-storm. HEC-RAS modeling simulated flood wave propagation, identifying approximately 2 $km^2$ of inundated land, including major settlements and infrastructure in Dovan and Sankrante. Hazard mapping based on flood depth and velocity classified affected areas from low to high. This assessment is crucial for informing structural reinforcements, enhancing early warning systems, and developing evacuation plans to mitigate dam break-induced flood risks.

**Keywords:**

Dam break, Flood Hazard, HEC-RAS, Middle Mewa HPP

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# Reliability and Availability Evaluation of Peaking Run of River (PRoR) Hydropower Plant Owned by NEA

*Bipin Silwal* [a], *Basanta Kumar Gautam* [b]

**Abstract:**

Hydropower plant is highly important in Nepal's electricity generation, that plays a vital role for grid stability and energy security. This paper conducts a systematic evaluation of Nepal Electricity Authority (NEA)-owned peaking run-of-river (PRoR) hydropower plants in terms of their availability, reliability and efficiency of operation. Using historical operational data from Fiscal Years 2076/77 to 2080/81, key reliability indices such as Mean Time Between Failures, Mean Time to Repair, Repair Rates and Failure Rates were determined through statistical data and reliability and availability was determined using Markov state modeling approaches. The study identifies major outage causes, categorizing them into scheduled maintenance, generator failures, turbine issues, switchgear failures and auxiliary system malfunctions. The results indicate that NEA's PRoR plants maintain reliability and availability levels above 98%, with scheduled outages being the primary contributors to reduced availability. Findings highlight the importance of optimized maintenance strategies to minimize forced outages and enhance plant performance. The study's insights contribute to improved hydropower management practices, ensuring long-term sustainability and operational efficiency.

**Keywords:**

Hydropower, Peaking Run-of-River (PRoR) Plants, Reliability and Availability Evaluation, Markov Modeling.

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# Evaluation of the intake configurations based on trapping efficiency with short transition layout between intake and settling basin using Physical Modeling: A case Study of Seti Khola HEP

*Prajwal Poudel* [a], *Ram K Regmi* [b]

**Abstract:**

The design of hydraulic components of a hydropower project needs to be site specific considering constraints of project layout, geology, space and cost. The size of intake, desander are larger on a high discharge project like Seti Khola Hydroelectric Project, a Run of the river project. The criteria of sizes of components cannot be met for a specific project, however the functionality and law need to be met as per the guidelines. Seti Khola HEP having design discharge of 39.93 $m^3/s$, with limited space between Intake and settling basin exists a transition curve of 75°.The horizontal and vertical transitions are crucial on overall functionality of desander. This study focuses on improving the intake design considering this scenario. For this, we built a physical model of the river and headworks on site to test different intake orientations to determine the best intake configuration that allow the maximum trapping efficiency on the settling basin. Frontal intake and side intake were the two main intake configurations used in the study. There were two minor modifications made to each major configuration. The model, built at a 1:50 scale based on Froude scaling law, successfully replicated the hydraulic behavior of the Seti River and was validated through calibration against numerical simulations. In case of side intake, the horizontal transition with inner curve and outer curve leading to different bay of desander resulted discharge variation, the bay led from inner bent created high flow due to short horizontal transition and vice versa. The frontal intake with no horizontal transition resulted the symmetrical flow from both the bay of desander. The flow variation on two bays of desander in case of side intake reduced the efficiency of bay led from inner curve resulting the overall trap efficiency of 85% while the overall trap efficiency of settling basin corresponding to frontal intake was found to be 93% based on camp method of trap efficiency considering design parameters. The study highlights the importance of flexible intake designs that can adapt to changing river conditions, ensuring long-term efficiency and sustainability for hydropower projects in sediment-heavy rivers.

**Keywords:**

Physical Modelling,Intake Configurations, Settling Basin, Inlet Transition, Trap Efficiency

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# Landslide Susceptibility Mapping and Risk Zonation of Netrawati Dabjong Rural Municipality

*Ashish Luitel* [a], *Bhim Kumar Dahal* [b]

**Abstract:**

Nepal faces severe challenges due to landslide occurrences, and the study area, Netrawati Dabjong Rural Municipality, is no exception. The main purpose of this study is: (1) to prepare the multi-temporal landslide inventory map using geospatial platforms in the data-scarce environment; (2) to evaluate the landslide susceptibility map using Weights of Evidence (WoE) and Information Value (IV) method in the Geographical Information System (GIS) environment at the municipality level. Firstly, 107 landslide polygons were manually digitized using the Google Earth from year 2002 to 2022. Secondly, a total of 12 landslide causative factors were selected based on literature review and site conditions. Then, the WoE and IV method were applied to assign the weights for each class of causative factors to obtain a landslide susceptibility map. Afterward, the final landslide susceptibility map was divided into three susceptibility classes (high, medium, and low class). The landslide susceptibility distribution shows that a significant portion of the area falls within high 32.10 percent susceptibility zones, indicating a considerable risk of landslides in these regions. The largest share 37.66 percent, is classified as medium susceptibility and low susceptibility areas account for about 30.24 percent. The risk analysis underscores the urgent need for targeted mitigation measures, especially in high-susceptibility zones, to reduce potential losses and enhance resilience. Thus, this landslide susceptibility map could help the local governments in landslide hazard mitigation, land use planning, and landscape protection.

**Keywords:**

Landslide Susceptibility, Weight of Evidence (WoE), Information Value (IV), Geographic Information System (GIS)

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# Steady-State Physically-Based Regional Shallow Landslide Hazard Modelling: Model Set-up and Validation in Panauti Municipality, Nepal

*Puja Chaudhary* [a], *Ananta Man Singh Pradhan* [b], *Bhim Kumar Dahal* [c]

**Abstract:**

Rainfall-induced shallow landslides are a major hazard in mountainous regions like Nepal. This study evaluates landslide susceptibility in Panauti Municipality using a steady-state physically based model, which combines the infinite-slope technique with a hydrological model to assess slope stability based on soil parameters, hydrological data, and Digital Elevation Models (DEMs). Data from DMG and NDRRMA were used to create a landslide inventory through remote sensing. The results show that prolonged rainfall causes slope failure in areas with weak geology, while some unstable areas remain despite strong geological formations, possibly due to accumulated rainfall over three days. The model was validated using Receiver Operating Characteristic (ROC) analysis, achieving an Area Under Curve (AUC) of 0.774, indicating good predictive ability.

**Keywords:**

Landslide; physically-based; hazard; rainfall; validation

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# Landslide Susceptibility Mapping Using Frequency Ratio and Random Forest Models: A Case Study of the Butwal-Tansen Section, Siddhartha Highway

*Sachin Rayamajhi [a], Padam Bahadur Subedi [b], Ashok Adhikari [c], Anisha Subedi [d], Sangam Gautam [e], Buddhi Raj Joshi [f], Niraj KC [g*]*

**Abstract:**

Landslides represent a major obstacle to development, and they cause huge economic losses and large numbers of causalities every year in Nepal. The occurrence of landslides is due to a combination of steep mountains and unstable slopes. Slope failure along highways is a crucial problem in hilly regions. The Butwal-Tansen Section of the Siddhartha Highway is one of the areas. This study aims to understand different factors influencing landslides and to find the best landslide susceptibility mapping (LSM) of this area using the Random forest (RF) and Frequency ratio (FR) model. The data of Slope, Aspect, Soil, Curvature, NDVI, Rainfall, Geology, Distance from Stream, LULC, Distance from fault, TWI, and Distance from the road were used respectively as causative factors for landslides. A total of 390 landslide points and 390 non-landslide points were identified using Google Earth Pro, among which were classified binary and sampled on 312(80%) and 78(20%) for training points and the testing points using a random sampling method. A database was created from the causative factors and the landslide inventory points. Two factor-screening methods, namely, the information Keywords gain (IG), and the Pearson correlation coefficient (PCC), were selected to screen the factors using training inventory points. Information Gain is used to evaluate the importance of each factor in predicting landslides while the Pearson correlation coefficient (PCC) is used to analyze the statistical relationship between factors to identify redundancy. The reclassified maps after weighting values of Frequency Ratio and Random Forest were applied to get a result. The result was divided into five classes such as very low, low, moderate, high, and very high. After the complete analysis, two different maps of susceptible areas for landslide based on the FR and RF methods were obtained. The AUC-ROC values, Recall, Accuracy, Precision, and F-score, were used for testing the model performance. From analysis, the accuracy of both models was found to be FR (0.824) and RF (0.884), indicating the model's good performance. The generated output landslide susceptibility map can help to support the precise planning, land use planning, disaster risk reduction and implementation of safety that minimizes human and property loss.

**Keywords:**

Landslide Susceptibility Map, Frequency Ratio, Random Forest, Siddhartha Highway, AUC-ROC

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# Comparative Analysis of Bivariate, Multivariate Statistical Model and Machine Learning Model for Landslide Susceptibility Mapping in Kaski District

[a] *Sagar Adhikari,* [b] *Saurav Gautam*

**Abstract:**

Landslides pose a significant threat to infrastructure, human lives, and the environment, particularly in mountainous regions such as the Kaski district of Nepal. Effective landslide susceptibility mapping (LSM) is crucial for hazard mitigation and land-use planning. This study employs four different models: Multiple Logistic Regression (MLR), Random Forest (RF), Frequency Ratio (FR), and Support Vector Machine (SVM) to assess and compare landslide susceptibility in the region. A comprehensive geodatabase was developed using various causative factors, including slope, aspect, curvature, elevation, NDVI, distance to roads, distance to rivers, distance to lineaments, stream power index, and topographic wetness index. Landslide inventory data was used for training and validation of the models. The performance of each model was evaluated using statistical accuracy metrics, including the Area Under the Receiver Operating Characteristic Curve (AUC-ROC). The results indicate that machine learning-based models (RF and SVM) outperform statistical approaches (MLR and FR) in predictive capability. Nevertheless, the exclusion of certain critical parameters, such as soil type, lithology, and precipitation, may have affected the overall model performance. Future studies incorporating these additional factors could enhance predictive accuracy and robustness. The generated susceptibility maps provide valuable insights for decision-makers, contributing to sustainable land-use planning and disaster risk reduction in landslide-prone areas.

**Keywords:**

landslide, susceptibility, statistical model, machine learning

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# Building Construction Site Safety Framework Using Lean Construction Principles

*Jaya Maharjan [a], Santosh Kumar Shrestha [b], Nagendra Bahadur Amatya [c]*

**Abstract:**

Construction safety remains a significant challenge in Nepal, with high accident rates due to inadequate safety management, lack of awareness, and poor enforcement of regulations. Lean construction principles, which focus on waste minimization and process efficiency, have been shown to enhance safety performance in construction projects globally. This study aims to assess the level of awareness and the application of lean construction tools, including the Last Planner System (LPS), Visual Management, 5S Process, Error Proofing (Poka-Yoke), and Daily Huddle Meetings, on building construction sites of Kathmandu. A structured questionnaire survey was conducted among key stakeholders, including clients, contractors, and consultants working inside the Kathmandu Valley. The results indicated that while awareness of lean construction remained low, the lean tools are being implemented knowingly or unknowingly at a certain level. Statistical analysis revealed a strong positive correlation between the application of lean tools and improved safety performance. The findings highlight the need for structured training programs and policy interventions to integrate lean construction principles into Nepal's construction sector for enhanced safety and productivity.

**Keywords:**

Building Construction Site Safety, Waste Minimization, Lean Construction, Lean Construction Tools

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# Assessment of Factors Affecting the Implementation of Occupational Health and Safety Measures in High Rise Building Projects of Kathmandu

*Bidushi Koirala* [a], *Mahendra Raj Dhital* [b]

**Abstract:**

Workplace safety in high-rise buildings remains a critical concern, particularly in the construction sector of Kathmandu. This study aims to assess the current status of Occupational Health and Safety (OHS) in high-rise buildings by evaluating key factors such as employee training and education, organizational commitment, and the prioritization of safety within organizations. A mixed-method research approach was employed, combining quantitative surveys and qualitative techniques, including Key Informant Interviews (KII) and Focus Group Discussions (FGD), to gather comprehensive insights. The findings reveal that OHS conditions are perceived more positively by management compared to workers, with supervisors holding an intermediate position. A one-way ANOVA test confirmed significant differences in perceptions among these groups, with the enforcement of safety rules emerging as the most variable factor. Additionally, expert opinions further highlighted gaps in policy implementation and compliance. Based on the results, it is recommended that employee training programs be strengthened, organizational commitment to safety be reinforced, and stricter enforcement of safety regulations be ensured. Measures to bridge the perception gap among different organizational levels should also be prioritized. Further research is suggested to assess the long-term impact of safety interventions and develop a more robust OHS framework tailored to high-rise construction environments.

**Keywords:**

Occupational Health and Safety, Construction Industry, High-Rise Buildings, Kathmandu, Safety Measures, Worker Well-Being.

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# Assessment of the Current Status of Skilled Workers in the Building Construction Industry within Kathmandu Valley

*Baikunth Yadav* [a], *Santosh Kumar Shrestha*[b], *Nagendra Bahadur Amatey* [c]

**Abstract:**

The lack of competent labor is a major obstacle for the building sector, despite the fact that it is essential to economic growth. This study looks at the situation of skilled laborers in the construction sector in the Kathmandu Valley and how it affects project cost performance. This study outlines the main labor-intensive crafts that are facing shortages, such as carpentry, flooring/tile work, and ironworking, using survey data gathered from construction professionals. There is a strong association between labor shortages and higher project costs, according to statistical analyses such as Spearman's rank correlation and the two-sample Z-test. According to the results, deals with greater shortages typically have a more noticeable financial impact, which causes inefficiencies and delays in projects. The dependence on foreign labor emphasizes even more how inadequate the domestic workforce is to satisfy business demands. Furthermore, the ongoing skill gap is exacerbated by the fact that current training programs frequently lack real-world experience. In order to address labor shortages, this report emphasizes the critical need for improved vocational training, legislative changes, and workforce retention tactics. Resolving these problems will promote sustained economic growth in addition to increasing the efficiency of construction projects.

**Keywords:**

Construction Industry, Skilled Labor Status, Cost Performance, Kathmandu Valley, Workforce Composition

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# Seismic Performance Analysis of Diagrid Structural Systems in High-Rise Buildings in Kathmandu Valley

*Puskar Koirla* [a], *Gokarna Bahadur Motra* [b]

**Abstract:**

Nepal lies in a seismically active region as it is situated in between the Eurasian and Indian tectonic plate. Due to the relative movement of these plates, occurrence of earthquake in this region is frequent, resulting in damage, failure and/or collapse of the infrastructure. A large number of buildings/infrastructures were damaged-along with loss of life and properties – during the recent 2015 Gorkha earthquake.

Moreover, in case of urban areas, like Kathmandu, where land area is limited and population residing is growing every year, chances of horizontal expansion of city is low in near future due to the lack of land. Therefore, there is no option but to go for vertical expansion of building, with large number of live able space.

As there is risk of occurrence of earthquake with large intensity in Nepal, and also dire need for vertical expansion, tall building shall structurally safe and serviceably live able. As the structure gets taller, ensuring the stability and performance becomes increasingly complex. Among the various structural systems employed to enhance the performance of tall buildings, the diagrid system stands out for its effectiveness in improving lateral stiffness and reducing structural sway. As the horizontal displacement of the high rise building increases with increasing height, there has to be some solution to limit the displacement and drift to acceptable limit as specified in different building code like NBC: 105-2020, IS1893-2016. Provision of diagrid system at certain location could be an option for this.

The study of numerical finite element modelling of building system with and without diagrid s system using ETABS 2019 has been carried out to find the seismic performance of diagrid s system in Kathmandu Valley. Response spectrum analysis as suggested by IS1893:2016 was adopted for the analysis of seismic forces. It is observed that using of diagrid system reduces the overall building deflection.

**Keywords:**

Diagrid system, dynamic analysis, structural performance and deformation parameters etc.

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# Seismic Vulnerability Assessment of Traditional Earthen Buildings in Medieval Walled City of Lo Manthang

*Subhash Gupta*[a], *Prem Nath Maskey*[b]

**Abstract:**

This study addresses the critical knowledge gap in the seismic vulnerability assessment of traditional earthen buildings in Lo Manthang. Focusing on the structural components, particularly bricks, the research investigates their material properties and seismic performance through field surveys, laboratory tests, and structural analysis. Undisturbed samples were tested using methods such as the specific gravity bottle test, hydrometer analysis, and compressive strength test conducted with a Universal Testing Machine (UTM). The collected data were used for modeling, calculation, and analysis to evaluate the structural characteristics and vulnerabilities of these buildings. The findings reveal critical weaknesses in construction and provide insights into failure mechanisms under seismic loads. This research contributes to heritage conservation efforts by informing preservation strategies and mitigating the risk of catastrophic loss during future earthquakes. The results underscore the importance of integrating traditional knowledge with modern engineering techniques to safeguard Lo Manthang's unique architectural heritage.

**Keywords:**

seismic vulnerability, earthen buildings, Lo Manthang, heritage conservation, structural analysis, compressive strength test

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# Identification of Risks Associated with Existing Trail Suspended Bridge in Nepal

*Sushrut Gautam* [a], *Kshitij Charana Shrestha* [b]

**Abstract:**

The trail suspended bridges in Nepal which are the vital lifelines for the people of rural areas face significant risks due to aging infrastructure, natural hazards and human induced factors. The failure of these bridges each year pose serious threat to the safety of users and hinders economic development. This paper identifies the various risks associated with existing trail suspended bridges in Nepal. To identify these risks, first checklist form was prepared with the help of Literature survey for field observation of possible hazards. The checklist acted as a baseline to prepare a questionnaire targeted to the engineers of Department of Local Infrastructure Development (DoLID), who are primarily responsible for the design, construction and maintenance of these bridges. The identified risks were classified into three subtypes viz. Natural, Human Induced and Structural Integrity and a hierarchy of these identified risks was also developed. After the analysis of the data, it was found that Flood pose highest risk to these bridges while Precipitation poses lowest risk. The results also showed that Local government should be responsible for the maintenance of these bridges and proper guidelines should be made for maintenance and inspection practices. The findings of this study will be useful for further study to prepare a proper Risk Assessment Framework for these bridges.

**Keywords:**

Suspended Bridge, Risk, Maintenance, Inspection

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# Performance Evaluation of Steel Moment-Resisting Frames with Varying Beam-Column Joint Rigidities

*Ankit Bastakoti* [a], *Gokarna Bahadur Motra* [b]

**Abstract:**

Steel moment-resisting frames (MRFs) are widely used in seismic regions due to their ductility and energy dissipation capacity. The performance of these frames is significantly influenced by the stiffness of beam-column joints, which govern force transfer between structural members and influence the overall structural response. While many design codes, including Nepal's NBC: 105:2020, assume fully rigid connections, real-world joints exhibit varying degrees of flexibility due to material behavior, connection detailing, and construction tolerances. This study investigates the seismic performance of steel MRFs with different beam-column joint rigidities, addressing a critical gap in the NBC: 105:2020, which lacks explicit stiffness criteria for such joints. Using nonlinear analysis, including Incremental Dynamic Analysis (IDA), this research evaluates the impact of joint flexibility on structural parameters such as base shear, fundamental time period and inter-story drift ratio. Results indicate that semi-rigid connections lead to increased structural flexibility, longer fundamental periods, and higher drift ratios, which may compromise seismic resilience. From IDA results, it can be seen that the NBC-specified drift limit of 2.5% is reached at 0.6g for fully rigid joint, whereas for flexible joints, this limit is reached at progressively decreasing PGA values, ranging from 0.3g to 0.25g. The study provides recommendations for incorporating joint stiffness considerations into design codes, thereby enhancing the safety and performance of steel structures in seismically active regions like Nepal.

**Keywords:**

Steel MRF, Connection Stiffness, Moment-rotation (M-$\phi$), NBC: 105:2020, Incremental Dynamic Analysis (IDA)

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# Seismic Performance Evaluation of Bridges

*Saugat Shrestha* [a], *Gokarna Bahadur Motra* [b]

**Abstract:**

This paper presents a comparison of the seismic vulnerabilities between two different types of piers: multiple column and wall piers, of a typical two spanned RCC T-beam super-structured bridge with a total length of 31.6 m, each span length of 15.8m. The bridge is modeled on finite element analysis-based program Abaqus CAE. Six different earthquake motions are considered for the non-linear time history analysis of the bridge. Drift ratios are taken as the parameter to check the damage states (DS) and the performance limits. Fragility curves are developed considering the non-linear time history analysis for two different types of piers and hence respective results are compared. In case of multiple column piers, the fragility curve showed that at 0.6g PGA, the probability that the bridge undergoing slight, moderate, extensive and complete damage was 0.95, 0.58, 0.32 and 0.08 respectively while in case of rectangular pier, at 0.6g PGA, the probability that the bridge suffering slight, moderate, extensive and complete damage is 0.89, 0.4, 0.18 and 0.03 respectively.

**Keywords:**

Seismic Vulnerability, Fragility curves, Abaqus/CAE, RCC T-grider bridge, multiple column piers, wall piers

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# Dynamic Behaviour of Machine Foundation Subjected to Harmonic Excitation.

*Sunil Karki* [a], *Prem Nath Maskey* [b]

**Abstract:**

Due to the dynamic force acting on machine foundations, it is essential to analyze the load-foundation-soil interaction as a necessary factor for the overall performance and stability of the system. The dynamic response of a block foundation placed on soft, medium and hard soil types is analyzed in this research using the method based on elastic soil spring constants. The effect soil stiffness and excitation frequency on the dynamic response are observed. Steady state response analysis was carried out analytically to observe the response behavior at post-resonance, pre-resonance and resonant conditions. Understanding the influence of soil properties on dynamic response is important for optimizing machine foundation design. These insight helps avoiding resonance effects and excessive vibrations particularly in industrial applications where rotating or reciprocating machinery operates under dynamic loading conditions.

It was observed that the soft soil amplifies vibration at lower frequencies making it more susceptible to dynamic excitation but hard soil reduces the vibration response significantly at the same exciting frequency. The performance on medium soil lies between these two extremes. With an increase in soil stiffness the demand for harmonic loading frequency is observed increasing to meet the resonance primarily due to increased soil stiffness. The paper investigates the dynamic response of machine foundations on soft, medium, and hard soils and analyses the vibrational behavior under varying excitation frequencies.

**Keywords:**

Machine Foundation, Response, Resonance, Frequency, Harmonic Excitation

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# Comparative Analysis of Laterally Loaded Pile Foundation using Beams-on-Elastic Foundation Approach and 2D Numerical Model

*Aadarsha Dhakal* [a], *Indra Prasad Acharya* [b]

**Abstract:**

Pile foundation is often subjected to lateral load. The test required for analysis of laterally loaded pile can be observed and compared through various analytical as well as numerical model approach. This study investigates the behavior of a laterally loaded free-headed pile using the Beams on Elastic Foundation approach. Results obtained through analytical methods are compared with those from numerical modeling using Plaxis 2D and codal provisions (IS 2911 Part 2). The analysis explores deflection, internal forces, and the applicability of various methodologies for pile design in clay.

**Keywords:**

Winkler's foundation, Soil subgrade modulus, Embedded beam, deflection

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# Comparative Linear and Non-Linear Seismic Response of Shear wall with Openings

*Goma Lamichhane [a], Gokarna Bahadur Motra [b], Thaman Bahadur Khadka [c]*

**Abstract:**

Nepal lies between the Tibetan and Indian tectonic plates where many dangerous earthquakes have occurred. Shelter and building infrastructure are essential due to the scarcity and high cost of land. Reinforced Concrete Moment Resisting Frame (RC-MRF) featuring planar shear walls is widely used because of its cost-effectiveness, ease of construction and ability to provide resistance to both earthquake and gravity loads. In this study, a 15-storey building was selected to observe the building's seismic behavior. A shear wall is placed at the corner of the building to make the building's design safe and torsionally symmetrical. The Finite Element Method (FEM) is used for analyzing the structural behavior of the building. The present study is carried out using Equivalent Static Load Analysis, Response Spectrum Analysis and Non-linear Pushover Analysis of buildings with shear walls that have openings (doors and windows) on the edge of the shear wall varying the size of the opening percentages (10, 15, 20, 25, and 30) in ETABS version 21.0.1. This study investigates the influence of variations in the size, type and location of openings in reinforced concrete (RC) shear walls on the fundamental time periods, lateral deflection, drift, base shear and stiffness of these structural walls. From the Equivalent and Response Spectrum analysis procedures, structural responses such as maximum drift, displacement, time period and base shear have been calculated and comparisons have been made. It was found that with a 25 percentage opening size in the shear wall the overall building's top displacement and drift values are near the permissible limit as per the Indian Standard (IS) code. For shear walls with 30 Percentage opening size (windows and doors) the overall building's top displacement and drift values exceed the failure value as per IS 1893:2016. Shear walls with window-type openings exhibit more top deflection than those with door-type openings even with the same percentage of opening. Additionally, shear walls with openings in the center of the panel experience more top deflection compared to those with openings at the edge of the shear wall.

**Keywords:**

Moment resisting frame,Dual frame shearwall, Opening size ,Linear, Non-linear push over analysis,Base shear,Deflection,Drift,Time period

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# Evaluating the Road Development Trends and it's impact on Landslide Susceptibility- A case study of Shivapuri Rural Municipality

*Krishna Prasad Silwal* [a], *Bhim Kumar Dahal* [b]

**Abstract:**

Landslides pose significant risks to infrastructure and communities, particularly in mountainous regions. This study gives the road development trends of study area, relationship between road and landslide by method of intersection (of road network and landslide inventory by creating buffer zone) using a landslide inventory from 2012 to 2022 and road network, also employs the Information Value (IV) method to develop a landslide susceptibility map for Shivapuri Rural Municipality. The analysis reveals a peak in landslide occurrences during 2016-2018, coinciding with extensive road construction, indicating a strong correlation between human activities and slope instability. More than 75 percentage of recorded landslides were within 100m of roads, highlighting their influence on triggering slope failures. Various conditioning factors, including slope steepness, relative relief, land cover, soil saturation, and proximity to roads and rivers, were analyzed. Results indicate that areas with moderate relative relief, steep slopes, barren lands, and high soil moisture exhibit higher landslide susceptibility, whereas regions with dense vegetation and stable geological formations show lower susceptibility. The final susceptibility map categorizes the study area into five levels, with nearly 40 percentage of the region classified as highly susceptible.It is seen that major Landslide susceptible zones lie near road networks (within 50m). These findings emphasize the need for proactive disaster risk reduction strategies, such as slope stabilization, controlled road expansion, proper drainage systems.

**Keywords:**

Landslide Susceptibility, Landslide Inventory, Information Value, Buffer Zone, Geographic Information System (GIS).

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# Evaluation of Parking Type Preferences Behavior Based on Parking Fare: A Case Study of Patan Dhoka Road, Lalitpur

*Surendra Ojha* [a], *Anil Marsani* [b]

**Abstract:**

Parking is shaped by drivers' decisions regarding the type of parking they choose and their readiness to pay for it. Typically, parking options are categorized as off-street or on-street facilities. The key factors influencing drivers' preferences for parking types include characteristics related to the driver, the vehicle, the nature of the trip, and the parking itself. The study is done on the barking behavior of two-wheeler drivers in Patan Dhoka Street of Lalitpur, Nepal. The findings of the study indicate that a greater number of factors affect the preference for parking type in the case of free parking compared to paid parking. This study found that 48.02% of drivers favor free parking and rest prefer paid parking. The selection of parking type plays a key role in determining how parking demand is distributed across an area and guiding improvements in parking availability.

**Keywords:**

Parking behavior, Parking preference, paid parking, free parking

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# Design and Implementation of Microcontroller Based Mini Oscilloscope

*Ashim Panthi* [a], *Bishal Khadka* [b], *Samir Khanal* [c], *Sworup Karki* [d], *Binod Sapkota* [e]

**Abstract:**

A Microcontroller Based Mini Oscilloscope is an affordable and practical solution for electronics enthusiasts and students seeking to analyze and understand electronic signals. Built around the popular microcontroller available in the market; Arduino Nano, the device leverages its integrated 10-bit ADC and an OLED display to visualize input signals. User-friendly switches enhance the overall usability of the oscilloscope. With a 10-bit resolution, a bandwidth of 10 kHz, and the ability to handle input voltages ranging from 0.2 to 50 volts, this compact tool can plot various waveforms effectively. The project focuses on graphically displaying waveforms while also measuring their amplitude and frequency, providing valuable insights into signal characteristics. Its cost-effectiveness, intuitive design, and versatile functionality make it an excellent tool for learning, experimentation, and hands-on exploration in electronics.

**Keywords:**

ADC, Amplitude, Arduino Nano,Sampling Frequency, Oscilloscope, OLED, Waveform

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# Development of a Remote NICU for Rural application with Real-Time Monitoring of Vital metrics

*Abhishek Yadav [a], Aarju Mahata [b], Deepak Singh Thagunna [c], Mukeshar Yadav [d], Mazhar Ali [e]*

**Abstract:**

Neonatal Intensive Care Units (NICUs) are critical to reducing neonatal mortality. However, NICU facilities are often unavailable in rural areas, leading to treatment delays and high costs that make care unaffordable for many. To address these challenges, we developed a remote NICU system with real-time monitoring and control, leveraging Internet of Things (IoT) technology to track vital parameters such as incubator temperature, humidity, neonate oxygen saturation ($SpO_2$),neonate heart rate, neonate respiratory rate, neonate body weight, and neonate blood CBC counts. Our system incorporates a data fusion algorithm that achieved 93.5% accuracy in early detection of neonatal abnormalities, such as apnea, seizures, and hypoxemia, by cross-referencing sensor inputs. Additionally, an AI-based blood cell counting model demonstrated high precision, with 99.4% accuracy for WBCs, 96.7% for RBCs, and 97.8% for platelets. Automated feedback mechanisms ensure optimal environmental conditions, while remote data access enables healthcare professionals to monitor neonates in real time. This proof-of-concept (PoC) offers a low-cost, dual-powered incubator designed for resource-poor regions, bridging the gap between advanced NICUs and remote healthcare facilities. The system aims to reduce neonatal mortality and treatment costs, with future work focused on clinical validation and further optimization.

**Keywords:**

Remote NICU, Neonatal Care, IoT, Data Fusion Algorithm, Infant Monitoring, Healthcare Accessibility

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# Obstacle Detection for Visually Impaired

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**Abstract:**

Vision is a fundamental aspect of our lives, allowing us to perceive and understand the world. However, visually impaired individuals confront several difficulties in their daily lives. In response to this, our proposed system aims to assist visually impaired individuals by providing information about nearby objects and warning them about unforeseen obstacles, ensuring their safety and comfort. Our proposed system includes a camera, Raspberry Pi, vibration motor module, speaker, and battery. The Raspberry Pi processes video images captured by the camera in real-time, and the user is provided with audio feedback and vibration alerts to provide information about their surroundings. Our system utilizes the You Only Look Once (YOLO) algorithm for real-time object detection, enabling it to identify objects in the environment accurately and efficiently. By providing real-time obstacle warnings, our proposed system aims to enhance the safety and mobility of individuals with visual impairments.

**Keywords:**

Vision, visually impaired, object detection, obstacle warning, Raspberry Pi, YOLO

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# Historical Sites Explorer Using BLE Technology

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**Abstract:**

The paper illustrates the utilization of Bluetooth Low Energy(BLE) technology to create a system that provides users with detailed historical information about the buildings or exhibits as the user moves around a outdoor site using interactive features like Text to speech, images and videos. The system precisely detects signal from BLE beacon and fetches relevant information based on the UUID of ESP32 placed in a multi-node network structure. The system uses log distance path loss model to calculate approximate distance. The signal received is highly fluctuating due to environmental factors,shadowing effect, and other interferences. So,to reduce the dynamic effect of environment Kalman Filtering is used for stabilizing received signal strength. Proximity detection using BLE has been utilized for indoor applications. However,outdoor use requires additional considerations due to signal attenuation and environmental interference. To overcome these challenges, the system implements a carefully planned BLE deployment in an open heritage site. Strategically placed ESP32-based BLE beacons at points of interest ensures constant signal reception without much interferences.

**Keywords:**

BLE, ESP32, Kalman Filter, LDPL, Multinode, Server

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# Open RAN and AI's Roles In 6G Networks

*Bikash Kandel [a], Bibek Gautam [b], Jeewan Bhandari [c], Sanam Adhikari [d], Anku Jaiswal [e]*

**Abstract:**

Through function disaggregation, open interface adoption, and the instantiation of a hierarchical closed-loop control architecture overseen by Radio Access Network Intelligent Controllers (RICs) entities, the latest Open-Radio Access Network (O-RAN) standards support the evolution of Radio Access Network (RAN) architecture. This opens the door to innovative programmable logic-based data-driven network management techniques. With the use of machine learning (ML) and artificial intelligence (AI), it is possible to develop solutions for RAN management problems that have not yet been resolved. The majority of current research and specifications focus on 5G Open RAN security. The function of Open RAN in 6G is covered in this study, with particular attention to three areas: security, privacy, and trust. Additionally, we highlight the main research initiatives pertaining to trust and privacy in Open RAN, with a focus on their advancement towards 6G. We go over the difficulties in moving from traditional to future RAN, such as interoperability, mobility, performance problems, complexity, and regulatory standards, and we provide potential solutions for these difficulties.

**Keywords:**

Open RAN, 6G, Security, Privacy, Trust, RAN Architecture

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# Restaurant Recommendation System using DistilBERT-NCF Model

*Shreekar Tiwari* [a], *Arun Kumar Timalsina* [b]

**Abstract:**

Recommendation Systems are among the most popular AI tools in the modern world which are used to predict user's likenesses and suggest them the products and items on the basis of that prediction. Traditional filtering methods solve most problems related to recommendation systems. Collaborative Filtering first came to the fore, wherein items were predicted based on preferences of similar users. Content-Based Filtering improved in terms of novelty and also in terms of addressing the cold start problem. Hybrid Filtering combined the best of both worlds, but the issue persisted with a highly sparse dataset.

Efficacy of traditional recommendation systems also diminishes if natural language processing is required. As such, a novel approach is proposed here to help forward the evolution of recommendation systems. It involves a BERT model, called DistilBERT, which is used to extract parameters for users and restaurants from the reviews, and Neural Collaborative Filtering (NCF) for suggesting the restaurants based on the preferences of the users. This model was trained and tested on the dataset available at Yelp.com. With an incredible top-N precision (for N=10) of over 97%, DistilBERT-NCF model outperforms SVR as well as other traditional recommendation systems and does seem promising to say the least for future applications.

**Keywords:**

Recommendation System, Machine Learning, Transformers, BERT, DistilBERT, NCF, CF

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# Depression-Alleviating Music Detection Using Krumhansl-Schmuckler Key-Finding Algorithm and Musical Key Characteristics

*Youbraj Kafle* [a]

**Abstract:**

Depression is a chronic mental illness and one of the most common health problems affecting all age groups. It is also a major risk factor for suicide and self-harm. As a result, music therapy has emerged as an alternative medicine technique for alleviating depression, gaining significant attention from medical practitioners and researchers. In this article, we propose an Artificial Neural Network (ANN)-enabled model to detect depression-alleviating music, which can be integrated into music recommendation systems for music therapy. We developed this model using the Krumhansl-Schmuckler key-finding algorithm and musical key characteristics, where the algorithm uses the Krumhansl-Kessler key profile to identify the key in the musical audio. The process involves generating a spectrogram of the musical audio using the constant Q transform to determine the tuning pitch, extracting note partial components to create a pitch profile, and processing these profiles through the Krumhansl-Schmuckler algorithm to determine the musical key. Finally, Shubart's musical key characteristics are applied to identify depression-alleviating music based on the detected musical key.

**Keywords:**

depression, music therapy, musical key characteristics, Krumhansl-Schmuckler key-finding algorithm, artificial neural network

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# Sentiment Analysis of Nepali Airlines Companies

*Pradeep BC* [a], *Nischal Acharya* [b], *Ram Krishna Maharjan* [c]

**Abstract:**

Airlines have become the first choice for people to travel because of the convenience and safety.Analyzing the opinions trends of the people traveling can assist airline companies to identify the lacking, improve services and gain competitive edge.Therefore this research task aims to observe the sentiment surrounding the Nepali airlines companies using the traditional machine learning techniques based on the reviews given by the travelers and classify these review texts into positive, negative and neutral sentiments. We apply "Synthetic Minority Over-Sampling Technique(SMOTE)" for solving the challenge of imbalanced dataset. Then our proposed methodology is evaluated against the dataset relevance judgement, yielding promising results against the evaluation metrics.

**Keywords:**

Sentiment, Classifier, SMOTE, NLTK, Tokens, Word Vector, TF-IDF, Confusion Matrix

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# AI-Based Online Exam Proctoring System

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**Abstract:**

This research paper is presented to introduce an AI-based online examination proctoring system which is designed to tackle the alarming increase in the challenges of maintaining the integrity of remote examinations. This system is equipped with advanced AI technologies, including YoLov8 to detect objects, Media pipe to detect the gaze of eyes, and pyaudio for audio analysis, to detect and protect from cheating practices like: unauthorized tab switching, the use of restricted objects( example: smartphones, books) and the presence of several other faces or objects in the exam environment. using Django Framework with PostgreSQL to manage database, this system provides a user-friendly interface for learners, students, and administrators, ensuring the easy registration, login, and real-time examination monitoring. Suspicious activities like gaze diversion, unfamiliar sounds, object detection, several person detections, and tab switching are logged and reported through an admin providing a smooth user experience. Future enhancements that aim to improve accuracy, scalability, and compatibility among devices and to introduce more features like keystroke dynamics analysis. This project remarks the potential of AI so as to create a secure, fair, and effective online exam environment, which helps to make this system a useful tool for educational institutions worldwide.

**Keywords:**

AI-Based Proctoring, Browser Tab Monitoring, Object Detection, YOLOv8, Gaze Tracking, Mediapipe, Audio Analysis, Remote Examination, AI in Education, Academic Integrity, Secure Assessments

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# User-centric Serverless Deployment Architecture using AWS Lambda

*Amrit Kumar Jha* [a], *Baburam Dawadi* [b]

**Abstract:**

The advent of cloud computing as the new standard IT computing paradigm has led to a new view of the compute reference model and services design that create new paths. Serverless computing has taken shape as a significant paradigm shift in cloud environments, unlike previous architectures, in having notable scale, lower costs and ease of productivity for developers. Serverless computing is an execution model in which the cloud service provider dynamically manages the allocation of compute resources of the server. The consumer pays for the actual processed volume, as opposed to selecting (pre-purchasing up front), units of compute capacity. This approach arose from the need for producing optimal cost, minimum configuration overheads, and improved ability for an application to scale. The significance of the serverless compute model is recognized by the largest cloud service providers and is demonstrated in the adoption the serverless computing paradigm. This paper work contains a thorough investigation of serverless computing architecture, to the extent that it also demonstrates an experiment of the serverless computing working model from the AWS Lambda reference model. Several areas of research inquiry into serverless computing are identified and discussed. Ultimately, Serverless computing, as part of cloud computing, holds the promise of a flexible and efficient means of developing and deploying applications.

**Keywords:**

Serverless Computing, AWS Lambda, Digital Transformation, Configuration Overhead, Compute Capacity, Performance Optimization

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# GAN Augmented Deep Learning For Lung Disease Classification

*Nikesh Neupane* [a], *Diwakar Raj Pant* [b]

**Abstract:**

Generative Adversarial Networks (GANs) provide a powerful solution for addressing challenges like limited and imbalanced datasets by generating realistic synthetic images for data augmentation. This study uses GANs to generate high-quality synthetic chest X-rays for an augmented dataset. This study explores the integration of Generative Adversarial Networks (GANs) to enhance deep learning models for lung disease classification. The primary focus is on training VGG16 and VGG19 models exclusively on the augmented dataset generated by the GAN. These models are fine-tuned to learn from the synthetic data to improve accuracy in detecting various lung diseases, including COVID-19, Pneumonia, and Tuberculosis. After training solely on the augmented data, the models were evaluated on both original and original plus augmented test sets, enabling a thorough analysis of their performance in real-world scenarios versus synthetic ones. VGG16 achieved an accuracy of 86.2 %. This shows the model generalizes reasonably well when tested on real, unseen images. When tested on the combined dataset real plus augmented, the accuracy improved to 90.81 %. VGG19 outperformed VGG16 on the real test dataset, achieving an accuracy of 89.43 %. The accuracy further improved to 93.07 %, showing that VGG19 benefited more from including augmented data in the test set compared to VGG16.VGG19 showed superior performance over VGG16 in both scenarios.

**Keywords:**

Convolution Neural Network, Deep Learning, Generative Adversarial Networks, Lung Diseases, Visual Geometric Group

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# Detection of Strawberry Leaf Spot Diseases Using Faster R-CNN on Kakani Farm Dataset

*Subash Pandey* [a], *Santosh Giri* [b]

**Abstract:**

Strawberry farming has become an important agricultural activity in Nepal, particularly in the mid-hill areas, and it contributes considerably to the livelihood of smallholder farmers. Strawberry cultivation in Nepal is expanding as a revenue-generating industry, but it confronts various obstacles, including leaf spot disease caused by the fungus Mycosphaerella fragariae, which reduces crop yields and fruit quality. Traditional disease detection process are laborious and time-consuming, demanding modern solutions. To address this, a deep learning-based algorithm was developed to automatically detect dot and angular spot infections in strawberry leaves. The model was trained with 310 strawberry leaves collected at nearby kakani strawberry farm. Faster RCNN pre-trained model are implemented and evaluate the accuracy. The model's average precision @IOU is 32.378 for segmentation and 67.597 for bbox, indicating high detection accuracy. The Faster R-CNN architecture was chosen for its superior ability to localize and classify small-scale lesion patterns, which are common in early-stage infections. The model was implemented using the Detectron2 framework, which allowed efficient training and visualization. Evaluation showed stronger results for dot spot detection (AP = 40.922) compared to angular spot (AP = 24.555), reflecting differences in visual consistency across lesion types. The model demonstrated robust performance under diverse field conditions, suggesting its potential as a practical tool for early disease diagnosis. This approach aims to empower farmers with accessible AI-driven tools for real-time disease monitoring, contributing to improved yield, reduced losses, and sustainable strawberry cultivation in Nepal.

**Keywords:**

strawberry leaf disease, Deep learning mode, Detectron2, Agricuture, Faster R-CNN

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# Pose estimation for cricket bowler using CNN , Heatmap regression and DeeplabV3

*Avay Kafle [a], Sashi Puri [b], Manoj Kumar Guragain [c], Dharti Raj Shah [d]*

**Abstract:**

This paper presents a novel approach to hand pose estimation for cricket bowlers during the delivery stride when hand posture significantly affects ball trajectory, spin, and speed. Leveraging Convolutional Neural Networks (CNNs) with DeepLabV3 and Atrous Spatial Pyramid Pooling (ASPP), the proposed model enhances feature learning and accurately localizes hand joints in active, occlusion conditions. Trained and tested on the FreiHAND dataset, the model displays consistent performance in hand region segmentation and pose estimation, with metrics like Intersection over Union (IoU) and pixel accuracy demonstrating its effectiveness. The research circumvents challenges such as rapid hand movement and occlusions typical of cricket bowling, presenting a useful tool for performance evaluation, technique refinement, and prevention of injury. The future will cross-validate the model on real images of cricket bowlers and incorporate attention mechanisms to increase generalization across diverse bowling styles. The work fills the gap between computer vision and sports analytics and has the potential to be applied to other sports involving a lot of hand movement.

**Keywords:**

Hand pose estimation, cricket bowling, Convolutional Neural Networks, DeepLabV3, Atrous Spatial Pyramid Pooling, sports analytics, FreiHAND dataset, occlusion handling, performance analysis, CNNs, DeepLabV3, ASPP, ResNet50

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# Real-Time Employee Face Recognition with MTCNN, FaceNet, and Extreme Value Machine (EVM) Techniques

*Niranjan Shrestha [a], Sharad K Ghimire [b], Pascal Rai [c], Dristi Sigdel [d]*

**Abstract:**

Face recognition has become an essential technology in various industries, including corporate offices, supermarkets, and hospitals, for security, human-machine interaction, and surveillance. Employee face recognition systems are crucial for ensuring secure access control and differentiating employees from unauthorized individuals. However, real-time face recognition remains challenging due to variations in lighting conditions, facial expressions, occlusions, and pose variations. To address these challenges, this study presents a real-time employee face recognition system using deep learning-based techniques. The proposed approach integrates MTCNN for accurate face detection, FaceNet for feature extraction, and the Extreme Value Machine (EVM) for classification. This combination enables robust and efficient face recognition while maintaining high accuracy. The system was tested on a dataset consisting of 75 employees and achieved 92.99% accuracy, 93.09% precision, 92.99% recall and 92.96% f1-score in real-time face recognition. Performance evaluation was conducted using a receiver operating characteristic (ROC) curve and tested on employee images as real data, demonstrating a clear distinction between employees and non-employees. The results highlight the effectiveness of the proposed method in practical applications, making it a reliable solution for automated identity verification in various organizational settings.

**Keywords:**

Face Recognition, Deep Learning, MTCNN, FaceNet, Extreme Value Machine (EVM), Accuracy, Automated Identity Verification

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# Thermal Infrared-to-RGB Image Translation based on GAN Architecture

*Deepak Bastola* [a], *Hom Nath Tiwari* [b], *Smita Adhikari* [c]

**Abstract:**

Thermal Infrared (TIR) imaging is essential for uses like night vision, surveillance, and identifying obstacles. Nonetheless, TIR images do not contain color data, which reduces their interpretability for human eyesight and various computer vision algorithms. This research introduces an innovative framework based on Generative Adversarial Networks (GANs) for converting TIR images to RGB images, ensuring that structural and textural details are maintained. In contrast to conventional methods, the suggested model utilizes a triplet generator-discriminator framework, where each generator separately handles the red, green, and blue channels. Moreover, a perceptual loss function derived from VGG19 improves high-frequency texture features. The model undergoes training and evaluation using the KAIST dataset, attaining a Peak Signal-to-Noise Ratio (PSNR) of 14.20 dB and a Structural Similarity Index Measure (SSIM) of 0.4586. While these findings show notable progress in maintaining structure, challenges persist in attaining high-quality colorization. The results indicate that multi-channel GAN architectures present a promising avenue for thermal-to-RGB image translation, although additional enhancements are required for practical application.

**Keywords:**

Deep learning, Generative Adversarial Network (GAN), Image colorization, Perceptual loss, RGB image synthesis, Thermal infrared image translation

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# Facial Emotion Recognition System Tailored For Diverse Nepali Ethnic Group

*Sriyanka Baral [a], Suchana Subedi [b], Kalpana Acharya [c], Sharon Adhikari [d], Nabaraj Subedi [e], Khem Raj Koirala [f], Nabin Lamichhane [g]*

**Abstract:**

Emotion recognition plays a crucial role in different application such as human-robot interaction, mental health analysis and sentiment detection. This research work presents an advanced facial emotion detection system designed specially for diverse Nepali ethnic groups. A new dataset was generated through a systematic data collection effort across various Nepali ethnic groups which was later integrated into original FER2013 dataset. A deep learning model was then trained on the modified dataset utilizing transfer learning with VGG16 model. The proposed method holds VGG16's pretrained feature extraction capabilities, fine tuning the model on a dataset specifically collected from diverse Nepali ethnic groups like Brahmin,Gurung,Newar,Tharu,Rai to classify facial emotions accurately while considering variations in facial structures, skin tones and expressions. The model achieved an efficiency of 71.4 %, which is comparable to the performance range of state-of-the-art emotion recognition models built on FER2013 dataset. For real-time face detection, MediaPipe and OpenCV were integrated ensuring efficient and robust facial feature extraction and recognition. This study emphasizes the importance of considering variations in facial structures, skin tones and expressions within various ethnic groups to enhance the accuracy of emotion recognition system in multicultural contexts.

**Keywords:**

Facial Emotion Recognition, Transfer Learning, Nepali Ethnic Groups Dataset, Deeplearning, VGG16

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# Permission-Based Risk Assessment of Nepali Mobile Applications Using VAE and DistilBERT

*Poshan Karki* [a], *Kobid Karkee* [b]

**Abstract:**

Mobile apps have become a key part of everyday life, but more and more applications are requesting unnecessary and critical permissions, raising security and privacy concerns. Developers often struggle to balance functionality with minimal permissions, while businesses risk losing user trust if their apps seem intrusive. Compliance with privacy regulations adds another challenge, making it essential to ensure that apps request only what they truly need. For users, excessive permissions can lead to data misuse and security risks. This paper introduces a hybrid approach that combines Variational Autoencoders (VAE) to analyze structured permission data and DistilBERT to process app descriptions and privacy policies. By detecting inconsistencies between an app's purpose and the permissions it requests, the model helps identify potentially misleading or risky applications. Using real-world data from Nepali app stores, the proposed hybrid framework achieves 78% accuracy in risk classification across various app categories. By offering a context-aware risk assessment, this research improves mobile security awareness, supports compliance efforts, and empowers users to make safer choices when installing apps.

**Keywords:**

Variational Autoencoder, DistilBERT, App permissions, Risk assessment

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# Resource Impact of Application Layer DDoS Attacks on ESP32 Using LSTM for Prediction

*Saroj Doranga [a], Hari Prasad Pokhrel [b]*

**Abstract:**

ESP32 devices are increasingly vulnerable to application-layer Distributed Denial of Service (DDoS) attacks, posing significant risks to IoT security. This research proposes a Long Short-Term Memory (LSTM) model to analyze attack intensity by capturing sequential patterns in network traffic. Unlike traditional Recurrent Neural Networks (RNNs), LSTM integrates gating mechanisms—Input, Forget, and Output Gates—to regulate information flow and prevent vanishing gradients, enhancing classification accuracy. The system was implemented on an ESP32 microcontroller, which logged system activity using FreeRTOS APIs and transmitted data to a remote server. A central server authenticated via SSH controlled three bot machines (zombies) to launch HTTP Flood attacks, overwhelming the ESP32's resources. Performance metrics, including CPU usage, memory consumption, and network traffic, were recorded in a log file and processed using an LSTM-based model in Google Colab. The model classified attack severity into low, medium, and high levels, demonstrating reliable anomaly detection with a Precision-Recall (PR) score of 0.937 and an ROC AUC score of 0.86. Compared to traditional detection methods, the proposed AI-driven approach enhances real-time detection accuracy, providing a robust framework for mitigating DDoS threats in resource-constrained IoT systems.

**Keywords:**

DDoS Attacks, ESP32, FreeRTOS, IoT Security, LSTM, Resource Usage

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# A Solution to the Face DeepFake Detection Challenge using ResNet

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**Abstract:**

The emergence of deepfake technology, fueled by advancements in deep learning, has opened a new frontier for digital image manipulation. The goal was to develop a deep-learning model capable of identifying manipulated facial images with high accuracy. The methodologies currently available with respect to deep-fake technologies and detection have been thoroughly analyzed. 15,000 Real and Fake Images from the Face Deepfake Detection Challenge were used as the source dataset and expanded to a total of 50,000 images for model training. A CNN architecture with residual blocks was utilized in the deep-fake detection process, specifically emphasizing training and rigorous model testing. The model achieved an accuracy of 93.8% outperforming all other models proposed in the challenge.

**Keywords:**

Deepfake technology, Deep learning, Digital image manipulation, CNN

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# Enhanced Retrieval for QA System Tailored for Nepali Legal Documents Focusing on PSC Examinations Using GPT-4 and RAG Framework

*Nabin Bhusal* [a], *Daya Sagar Baral* [b]

**Abstract:**

This study focuses on developing a Question Answering(QA) system utilizing Retrieval Augmented Generation (RAG) specifically tailored for Nepali legal documents relevant to the syllabus of Public Service Commission(PSC) examinations held in Nepal. By integrating advanced natural language processing techniques, leveraging the power of pre-trained large language model GPT-4, the system retrieves pertinent legal documents and generates coherent responses aligned with the user's query. This study explores the extraction of Nepali text from PDFs, generation of high-dimensional embeddings using the *text-embedding-3-large* embedding model, a composite of rule-based text retrieval and semantic retrieval approaches, and the generation of answers to the query with an F1 score of 0.69. The study addresses the challenge of efficiently accessing and interpreting legal information in Nepali, contributing to the accessibility of legal resources, and improving understanding of legal concepts among various stakeholders.

**Keywords:**

QA system, Nepali Legal Documents, Information Retrieval, GPT-4, RAG, Langchain

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# Context-Aware Question Answering for EDI Datasets Using a Generative Approach

*Tika Sah* [a], *Suwarna Lingden* [b]

**Abstract:**

Electronic Data Interchange (EDI) is a fundamental technology for automating business-to-business transactions, enabling seamless data exchange between computers of two partners in a standard electronic format. Due to rigid and structured formats of EDI , extracting meaningful insights from EDI directly remains challenging.Many organizations rely on manual querying of information from EDI , which are time-consuming and prone to errors. This paper proposes a novel approach for the development of a context-aware Question-Answering system using a generative artificial intelligence model on EDI datasets.This paper presents a system using a fine-tuned T5 language model (a pre-trained text generation model) to help non EDI experts users to understand about EDI transactions. The model was trained on specialized question-answer pairs covering common EDI formats like purchase orders (EDI 850), acknowledgements (EDI 855) , shipping notices (EDI 856) and invoices (EDI 810). The primary objective of this system is to enhance the accessibility and usability of EDI datasets, making them more interpretable for business users without technical expertise in EDI. Performance was measured using standard text-generation metrics, ROUGE , BLEU scores and BERTScore , showing strong accuracy and relevance in responses. The results indicate that the model achieves a significant level of accuracy and contextual relevance in responding to EDI-related queries, by making EDI information more accessible.

**Keywords:**

Electronic Data Interchange , Question Answering System, T5 Model, Natural Language Processing

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# Detection of Fake News in Nepali Language Using Transformer-Based Natural Language Processing Models

*Bishal Mahjarjan* [a], *Anup Shrestha* [b]

**Abstract:**

The spread of fake news is a severe problem in Nepal, particularly on social media. It is further complicated by the fact that Nepal uses 'Nepanglish', a mixed language that standard detection mechanisms can't deal with. That is why we propose applying a new approach to the detection of false news in Nepali based on a state-of-the-art language model called mBert. A major issue is that there is not much Nepali language data available for training such models. We avoid this by using advanced methods of creating additional training data. We will train our model on the increased data and test on standard performance metrics. We aim to build a highly accurate and efficient Nepali fake news detector. Apart from this specific application, our study indicates that robust language models can prove to be very useful to under-represented languages with minimal digital footprints, providing an effective tool for other under-represented languages. The research will help in realizing the spread of disinformation in Nepali social media and provide an effective tool for media organizations, educators, fact-checkers, and policy-makers to combat the spread of fake news and improve social relationships in Nepal.

**Keywords:**

Low-resource, mBERT, NLP, Nepanglish, Transformer

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# Fine-Tuning Wav2Vec2 for Nepali Speech Emotion Recognition: Leveraging a Pre-Trained English Model

*Rashika Karki* [a], *Basanta Joshi* [b]

**Abstract:**

Speech emotion recognition (SER) is a crucial task in human-computer interaction, particularly for low-resource languages like Nepali. In this study, we fine-tune the wav2vec2-lg-xlsr-en-speech-emotion-recognition model, originally trained on an English dataset, to recognize emotions in Nepali speech. Our dataset comprises 240 audio recordings collected from four speakers, each expressing four emotional states: neutral, angry, sad, and surprised, across 15 predefined sentences. The data underwent rigorous preprocessing, including bandpass filtering, volume normalization, silence removal, and noise reduction, ensuring high-quality inputs for model training. The fine-tuned model achieved an accuracy of 89.58%, demonstrating the potential of transfer learning for low-resource languages. These results suggest that cross-lingual adaptation of pre-trained models can effectively enhance Nepali speech emotion recognition, paving the way for further improvements in human-computer interaction and affective computing in underrepresented languages.

**Keywords:**

Speech Emotion Recognition, Wav2Vec2, Nepali Speech, Low-Resource Language, Fine-Tuning, Transfer Learning, Cross-Lingual Adaptation, Human-Computer Interaction

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# Leveraging Indic Speech Models for Nepali Automatic Speech Recognition

*Ashish Devkota* [a], *Basanta Joshi* [b]

**Abstract:**

Attention models pre-trained on speech audio alone followed by fine-tuning on limited labelled speech have shown promising results in Automatic Speech Recognition tasks in recent years. Additionally, multilingual models have shown better results than monolingual models. In this work, we explore the benefits of these techniques for low-resource language Nepali by using two wav2vec 2.0 models pre-trained on multilingual Indic speech. Experiments on benchmark OpenSLR dataset show accuracies comparable with state-of-the-art Nepali models whilst using significantly less amount of labelled dataset and no language model. Notable findings include WER of 18.1 and 14.1 on SLR54 dataset. This demonstrates the effectiveness and potential of using Indic resources for Nepali Speech Recognition tasks.

**Keywords:**

NLP, Nepali Speech Recognition, Low-resource ASR, E2E

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# IntelliTax: Transformer based Question-Answering System for Tax Regulations of Nepal

*Rupesh Poudel* [a], *Umesh Kanta Ghimire* [b]

**Abstract:**

This research aims to develop a domain-specific Q&A system for tax regulations in Nepal focused specifically on Income Tax. For this, a transformer-based large language model, LLaMA 3, is to be used, having been fine-tuned on a curated dataset consisting of tax laws, rules, and guidelines from the Inland Revenue Department (IRD) of Nepal. The system will not only retrieve accurate, context-specific answers to income tax-related queries but also generate detailed and context-aware responses, simplifying the comprehension and accessibility of Nepal's complex and frequently updated tax regulations. This research will enhance efficiency for taxpayers, businesses, and legal practitioners by automating information retrieval, reducing reliance on manual searches and professional consultations. Ultimately, this research contributes to the integration of natural language processing in Nepal's taxation domain, improving compliance and accessibility.

**Keywords:**

LLM, Nepal Taxation, Question-Answering, Transformer

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# Performance Evaluation of Intersection: A Case Study of Rastra Bank Chowk

*Sanjeev Dhakal* [a], *Prem Nath Bastola* [b], *Sandip Duwadi* [c]

**Abstract:**

This study evaluates the performance of the Rastra Bank Chowk intersection in Pokhara, Nepal, focusing on traffic efficiency during peak hours. The intersection serves as a critical commuter route and economic hub, experiencing significant delays and frustrations for vehicles and pedestrians due to high traffic demand. A detailed analysis is conducted to identify the underlying issues that contribute to traffic congestion, including cumulative delays and inefficient vehicle movement. The study aims to analyze traffic conditions at the intersection, providing information on vehicle and pedestrian movements, which are crucial for traffic management and safety. Data were collected through video surveys over three days, capturing traffic movements during peak hours. The data is classified and converted to passenger car units (PCUs) for analysis. The research examines various intersection characteristics, including geometric, traffic volume, and signal control aspects, to determine the necessity of traffic control signals. The study highlights the need for a traffic signal system at the Rastra Bank Chowk intersection, as well as that the intersection legs operate with a Level of Service (LOS) ranging from A to C. In general, the intersection indicates or experiences moderate congestion, which means some delay. The study recommends installing a traffic signal system in Rastra Bank Chowk to improve traffic control, improve safety, and optimize signal timings for efficient vehicular and pedestrian movement.

**Keywords:**

Indo-HCM, Intersection, Level of Service, Passenger Car Unit (PCU), Signal Warrant

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# Evaluation of Rockmass Permeability in Tunnel - A Case Study From Setikhola Hpp, 22mw

*Suraj Shreesh [a], Krishna Kanta Panthi [b], Kusum Pudasaini [c]*

**Abstract:**

This research work focuses on the evaluation of permeability and leakage potential from the shotcrete-lined tunnel lying in the Lesser Himalayas (Seti Khola HPP, 22MW) by correlating results from the Lugeon test to findings from empirical methods. Three main methods of leakage assessment, such as the Lugeon test, the Panthi approach and the Tokheim and Janbu method are used for calculating and estimating leakages from the selected study area. A total of 167 Lugeon values are obtained from the Lugeon test conducted over a 698.5 m tunnel section (chainage 1+954.60 m to 2+654.10 m), where only 13 Sections are considered critical sections from a leakage point of view, as Lugeon values exceed 5, indicating the presence of a few partly open to many open Joints. Further, permeability is estimated by using the methods described in Panthi approach and Tokheim and Janbu method in the same specified study area. By correlating the results from field tests with findings from empirical approaches, conclusions and recommendations for tunnel design have been derived, as well as the leakage potential in similar geological conditions. The study results validate Panthi's finding, which states that water leakages are maximum near the surface and leakages decrease as the depth from the surface increases. Hence, empirical approaches can be used to estimate water leakages in the early planning phase if field tests are impractical and sufficient geological and hydrological data exist. Still, field tests should be performed to validate them before making critical engineering decisions.

**Keywords:**

Rock mass permeability, Lugeon test, Q system, RMR, HRT, SKHPP

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# Assessment of Stability Issues in Tunnel : A Case Study from Rahughat Mangale Hydroelectric Project

*Taranga Baral [a], Kangada Prasai [b], Sudip Adhikari [c]*

**Abstract:**

This paper presents a comprehensive assessment of tunnel stability along the headrace tunnel of the Rahughat Mangale Hydroelectric Project, located in the Lesser Himalaya of Nepal. The study focuses on critical issues of squeezing and overbreak encountered during excavation. Rock mass classification using the Q-system revealed several sections with extremely poor to exceptionally poor ground conditions. A prominent squeezing zone was observed between chainages 3+616.599 m and 3+642.696 m, where high deformation potential was confirmed through empirical methods developed by Singh et al. and Goel et al. Deformation behavior was further evaluated using the Hoek–Marinos approach, the Panthi and Shrestha method, and the numerical RocSupport (CCM) model. The results demonstrated varying levels of predicted convergence, offering valuable insights into tunnel behavior under weak rock conditions. Additionally, overbreak analysis using Barton's empirical formula successfully identified vulnerable sections, including a major incident at chainage 0+276 m. The study emphasizes the importance of integrating empirical and analytical methods with field-based observations to improve the reliability of tunnel design and support strategies in challenging Himalayan geology.

**Keywords:**

Tunnel squeezing, Overbreak, Headrace tunnel, Q-system classification, Tunnel deformation, Empirical methods, RocSupport,Himalayan tunneling

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# Stability Analysis and Support Design on Sub-Surface Mine: A Case Study of Ganesh Himal Mine of Nepal Himalaya

*Pramesh Paudel* [a], *Ghan Bahadur Shrestha* [b], *Chhatra Bahadur Basnet* [c]

**Abstract:**

This study presents a comprehensive stability analysis and support design for the Ganesh Himal zinc-lead mine in Nepal. The mine, which has been inactive for over 20 years, faces significant challenges due to its high altitude (4100m), steep topography, and lack of modern support systems. Stability was assessed using geological mapping, empirical classification methods (RMR, Q-system, MRMR), and numerical modeling (Unwedge 3.0 and RS2) to evaluate wedge failure and deformation behavior. The results indicate that the mine remains stable under current conditions. Wedge analysis confirmed the structural integrity of the tunnel, while deformation modeling showed minimal displacement, suggesting that simple rock bolt and shotcrete support is sufficient. Support recommendations were derived from empirical systems to ensure stability with minimal intervention. The study concludes that the mine can be safely reopened and contribute to Nepal's economic growth with proper monitoring and implementation of recommended support measures. However, due to the remote and geologically complex nature of the site, regular maintenance and safety inspections are essential for sustainable operation.

**Keywords:**

MRMR, Q-System, RMR, RS2, Sub-Surface Mine, Unwedge 3.0

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# Geotechnical Assessment of Tunnels in Soft Ground: Case Studies of Hydropower Tunnels from the Himalaya

*Sabin Adhikari* [a], *Chhatra Bahadur Basnet* [b], *Santosh Kumar Yadav* [c]

**Abstract:**

This study focuses on the geotechnical challenges of tunneling in soft ground conditions within the Himalayas. Using the headrace tunnel of the Sanjen Hydroelectric Project and the tailrace tunnel of the Rasuwagadhi Hydroelectric Project as case studies, the research evaluates the performance of a composite support system through finite element numerical modeling. The study investigates the critical geotechnical parameters of soil that significantly influence the stability of soft ground tunnels and emphasizes the need for timely support application following stress redistribution, particularly in weak and faulted ground conditions. The results aim to propose cost-effective and technically efficient solutions to ensure tunnel stability in soft ground environments.

**Keywords:**

Soft Ground Tunneling, Tunnel Support Design, Composite Liner, Numerical Modeling

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# Comparison Between Japanese (NEXCO) and Q-System of Rock Mass Classification - A Case Study from Nagdhunga Road Tunnel

*Dipa Poudel* [a], *Krishna Kanta Panthi* [b], *Bimala Piya Shrestha* [c]

**Abstract:**

This study examines the effectiveness of the NEXCO and Q Systems in rock mass classification and support design for the Nagdhunga Tunnel Construction Project. The comparison across various chainages reveals both alignment and notable differences between the systems in terms of rock classification and recommended support measures. Total five chainages have been selected for the project work with varying geological features.The study concludes that a hybrid approach, integrating the detailed analysis of the Q System with NEXCO's straight forward classification, is recommended to ensure effective and comprehensive decision-making in tunneling projects.

**Keywords:**

Rock mass classification, Support measures, NEXCO System, Q System, hybrid approach

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# Rock Engineering Challenges and Support System Design for Hydropower Tunnels in Weak Rock Conditions: A Case Study of the Khimti-2 Hydroelectric Project, Nepal

*Sagar Acharya* [a], *Tara Nath Sapkota* [b], *Uttam Lamsal* [c], *Tapraj Bhatta* [d]

**Abstract:**

Nepal's hydropower potential faces challenges due to complex geological conditions, particularly in the Lesser Himalayan region, where weak rock formations and tectonic activity increase the risk of tunnel instability. This paper investigates rock engineering issues encountered during the construction of the Khimti-2 Hydroelectric Project's headrace tunnel, focusing on support system design in weak rock. Differences between predicted and real rock mass quality, attributed to inadequate initial geological investigations, highlighted the need for adaptive strategies. Site verification and stability analyses revealed prevalent stability issues, including deformation and potential wedge failures. Numerical modeling using Rocscience package RS2 program demonstrated that the design support system, combined with a heading and benching excavation approach, significantly reduced plastic zone depth and total deformation compared to alternative support designs. The findings emphasize the importance of comprehensive geological investigations, adaptive construction methods, and robust support system design to ensure tunnel stability and safety in challenging Himalayan geological settings, ultimately contributing to efficient hydropower energy generation.

**Keywords:**

Hydropower Tunnel, Weak rock, Support system design, Numerical Modelling

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# Probabilistic Assessment of Rock Mass Quality in a Tunnel: A Case Study of Karuwa Seti Hydropower Project

*Sudip Adhikari [a], Sandeep Shrestha [b], Aalok Yadav [c], Taranga Baral [d]*

**Abstract:**

Accurate rock mass quality assessment is crucial for the stability of underground structures in complex geological settings. This study presents a comprehensive probabilistic evaluation of rock mass quality along a segment of the headrace tunnel of the Karuwa Seti Hydropower Project in Nepal. By incorporating geological uncertainty by treating the six parameters of the Q system as random variables. Monte Carlo simulations were performed to generate a distribution of the Q-index and a Sobol global sensitivity analysis was performed to identify the most influential parameters. The model was validated against the field-observed Q value, and the results show close agreement. A substantial portion of the tunnel rock mass falls into the category of "Very Poor", indicating an elevated stability risk. Among the input factors, SRF emerged as the most critical parameter, accounting for 31% of the variance in Q, with RQD and Jn as the next significant contributors. These results underscore the dominant role of in-situ stress and jointing conditions on tunnel stability. The probabilistic framework provides a more reliable risk assessment than traditional deterministic methods by encompassing the full range of geological variability. The study's outcomes encourage the implementation of real-time monitoring and adaptive tunnel support design, and the approach can be adapted to similar tunneling projects facing geological uncertainties.

**Keywords:**

Probabilistic Assessment, Monte Carlo Simulation, Sensitivity Analysis, Uncertainty, Tunnel Stability.

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# Assessment of Water Ingress in Underground Mining: A Case Study of Ganesh Himal Zinc-Lead Mine

*Anil Nepal [a], Chhatra Bahadur Basnet [b], Ghan Bahadur Shrestha [c]*

**Abstract:**

Water ingress in underground mining poses significant challenges, particularly in Himalayan regions like the Ganesh Himal Zinc-Lead Mine in Nepal. This study evaluates factors influencing water inflow, including geological weakness zones, climatic conditions, surface water interactions, and abandoned mine pools, while comparing three analytical methods for predicting water ingress: the Kuniaki Sato Formula, Railway Empirical Formula, and Darcy's Law. Field data collected during monsoon (Shrawan) and dry (Mangsir) seasons revealed seasonal variations in inflow rates, with a persistent water source likely linked to snow melt or confined aquifers. Results demonstrated that the Kuniaki Sato Formula, which incorporates site-specific hydraulic and geological parameters, provided the closest alignment to field measurements. The findings underscore the importance of selecting context-appropriate methods for accurate water ingress prediction, critical for ensuring tunnel safety, operational efficiency, and hazard mitigation in underground mining projects.

**Keywords:**

water ingress, AMD, Kuniaki Sato formula

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# Impact of Kanke Deaurali Concrete Gravity Dam Breaching

*Bharat Raj Pandey* [a], *Agraj Khakurel* [b]

**Abstract:**

The hydraulic structures such as dam and spillway always pose a devastating threat to the people living in the downstream of the dams. Those structures are used for various purpose such as reservoir impoundment for generating hydroelectricity, fulfilling the demand of water supply and irrigation and for the flood control. The Kanke Deaurali Reservoir impounding concrete gravity dam project is one of them, mainly for drinking water supply to Gulmi District of Nepal. There are several reasons that this dam could fail such as due to high magnitude of earthquake ground motion, excessive seepage form the foundation rock fissures which could lead to a foundation settlement and excessive erosion to dam body from overtopping. This situation could lead to a devastating damage to the downstream communities. The HEC-RAS model was used to analyze the situation of maximum flow depth, peak flow and the travel time to the downstream. However, the maximum peak flow and its depth was found up to 17kM downstream and the flow was normalized. There was no inhabitance living up to this affected distance so there is no danger alarm to the downstream communities in the event of breaching this dam.

**Keywords:**

Dam Breaching, Breach Shape, Breach Development time, Downstream Peak Attenuation

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# Ranking and Evaluation of CMIP6 Climate Models Using Extreme Climate Indices: Application to the Seti Gandaki River Basin

*Susmita Khanal* [a], *Babu Ram Tiwari* [b]

**Abstract:**

Climate change has led to an increase in extreme weather events, significantly impacting ecosystems, infrastructure, and public health. General Circulation Models (GCMs) play a crucial role in predicting climate variability and supporting adaptation strategies. However, their performance varies across different regions and climate variables, necessitating model evaluation before application in impact assessments. This study assesses the effectiveness of selected CMIP6 GCMs—ACCESS-ESM1.5, EC-EARTH3-VEG, INM-CM4.8, MIROC6, MPI-ESM1.2-LR, MRI-ESM2.0, and NESM3—in simulating temperature and precipitation patterns in the Seti Gandaki River Basin, Nepal. The study employs observed climate data from meteorological stations to evaluate the models based on statistical performance metrics, including Correlation Coefficient (CC), Normalized Root Mean Square Deviation (NMRSD), Absolute Normalized Root Mean Square Deviation (ANMRSD), and Average Absolute Relative Deviation (AARD). Additionally, the models were ranked using an entropy-weighted decision-making approach to determine their suitability in representing extreme climate indices such as Consecutive Dry Days (CDD), Consecutive Wet Days (CWD), and Heavy Precipitation Days (R10). The results indicate significant variability in model performance across different climate indices and stations. MIROC6 consistently ranked as the most reliable model, particularly in simulating CWD, whereas INM-CM4.8 exhibited the highest deviations, making it the least reliable. EC-EARTH3-VEG and MRI-ESM2.0 showed moderate accuracy, while ACCESS-ESM1.5 demonstrated higher deviations, especially for CDD and R10. Spatial analysis revealed that Station 1004 exhibited the lowest deviations and highest correlations, indicating better model reliability compared to Stations 804 and 808. These findings underscore the necessity of selecting region-specific models and employing a multi-metric evaluation approach for improved climate projections. Future research should focus on refining model performance through bias correction techniques, enhanced downscaling methods, and integration of additional observational datasets. This study provides valuable insights into optimizing GCM selection for more reliable climate impact assessments and policy planning.

**Keywords:**

Climate Variability, Performance Indicator, Model Inter-comparison

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# Disaster Resilience through Historic Water Management System: A Case Study of Historical City Dolakha Bazaar, Bhimeshwor municipality

*Sonika Pote Shrestha* [a], *Hari Darshan Shrestha* [b]

**Abstract:**

This study investigates the historical water management system of Dolakha Bazaar, a traditional Newari settlement. By exploring traditional water reservoirs and their interconnected canals, the study examines how these systems contributed to disaster resilience. The findings reveal that historical Dolakha Bazaar's water management system not only supported daily water needs but also played a crucial role in disaster mitigation and emergency response, enhancing the town's capacity to bounce back from crises. This study demonstrates the value of integrating traditional knowledge into resilience strategies.

**Keywords:**

Resilience, sustainability, historic water management

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# Hydrodynamic Modelling of Imja Lake Outburst Flood and Its Impact on Downstream Dudhkoshi-9 Hydropower Project

*Binay Rimal* [a], *Mukesh Raj Kafle* [b]

**Abstract:**

This study assesses the potential flooding resulting from the dam breach of the Dudhkoshi-9 Hydropower Project, triggered by an Imja Glacial Lake Outburst Flood (GLOF). Previous studies have analysed the Imja Lake outburst flood, downstream impacts on the Dudhkoshi-9 hydroelectric dam have not been specifically addressed, so the purpose of this study is to study the dam break of Dudhkoshi-9 with the Imja glacier lake outburst flood. In this research, HEC-RAS 2D, integrated with ArcGIS, is used to simulate the flood scenario. ALOS PALSAR 12.5 m digital elevation model (DEM) is used in HEC-RAS Mapper, along with the geometric data of the Dudhkoshi-9 hydroelectric dam and the Imja flood hydrograph provided by ICIMOD, serving as the unsteady flow input.

The HEC-RAS model was calibrated using a previous study of Imja GLOF by ICIMOD in 2011, adjusting Manning's n values within the allowed limits. Following calibration, dam breach scenarios are simulated by varying breach parameters, including breach widths (20 m, 30 m, and 40 m), breach formation times (0.16 h, 0.26 h, 0.36 h, 0.46 h) and weir coefficients (1.1, 1.3, 1.5, and 1.7). The maximum discharge of 2403 $m^3/s$ occurs with the worst-case scenario of breach width of 40 m, weir coefficient of 1.7, and breach formation time of 0.16 hours of the Dudhkoshi-9 hydroelectric dam.

For the maximum breach case of the hydroelectric dam, inundation mapping, flood arrival time mapping, and water surface elevation mapping are performed. In addition, a local sensitivity analysis is conducted for two scenarios. Case 1 (breach width 40 m, formation time 0.16 h, weir coefficient 1.7) and Case 2 (breach width 20 m, formation time 0.46 h, weir coefficient 1.1). The sensitivity of each parameter is classified as high, moderate, or low based on its influence on discharge, velocity, and WSE.

**Keywords:**

Glacier lake outburst flood, Hec-Ras2d, Dam Breach, Inundation Mapping

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# Application of GRACE product at a local scale: A Case Study of the Lower Koshi Region

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**Abstract:**

A comprehensive understanding of the spatio-temporal variation of groundwater is essential for sustainable water resources management. This is especially important in the context of Nepal, given the recent focus on the conjunctive use of groundwater and surface water for irrigation, addressing the demands of population growth, and adapting to climate variability and extreme weather events. Effective water resources management requires long-term, spatially distributed groundwater observation at high spatial resolution. Due to the lack of extensive data, we utilize GRACE data to assess the spatio-temporal changes in groundwater. To address the coarse resolution of GRACE data at a local basin scale, the data was downscaled using the Random Forest Model (RFM). This downscaling was applied to the Lower Koshi area of Nepal, encompassing the recharge zone of the Chure region. The RFM showed a good correlation between the original and downscaled Total Water Storage Anomaly. Additionally, the Groundwater Storage Anomaly was derived and compared against observed Groundwater Level Anomaly at monitoring wells. The correlation between the datasets ranged from 0.25 to 0.60. The spatial distribution of groundwater depletion was also determined, revealing a depletion rate of up to 0.190 cm/month in the Terai region of Nepal. The spatial map of groundwater storage also shows depletion in the overall basin. The method used to downscale GRACE data is highly scalable, and the insights gained from the study area are valuable for managing and planning sustainable groundwater management.

**Keywords:**

GRACE, Groundwater, Koshi basin, Random Forest

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# Predicting permafrost distribution using Analytical,Statistical, And Machine Learning models

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**Abstract:**

This research combining the machine advances high-altitude permafrost mapping (¿2,000 m ASL) in the Gandaki province of Nepal Himalayas by integrating weighted multi-criteria decision-making methods (AHP and FR) with machine learning models. Through factor dominance analysis, it identifies key environmental drivers, with thermal controls such as MAAT (AHP: 0.205; FR: 12.49) and LST (0.1598; 16.03) showing strong linear correlation (MAAT = 0.92×LST + 1.2; $R^2$ = 0.89). Topographic factors, notably DEM (FR: 16.65) and Slope (0.0721; 6.065), and cryospheric indicators like NDSI (FR: 18.52 — the most influential) and PISR (0.105; 5.26) were also critical. Machine learning models, especially Random Forest (AUC: 0.947) and Logistic Regression (AUC: 0.944), significantly outperformed traditional approaches, detecting very high-risk permafrost zones 136–247% more effectively (ML: 28.5–48.2% vs AHP: 10.2%). The DEM-NDSI-LST triad alone accounted for 82% of spatial variability, while curvature (FR: 1.0) had minimal impact. The model was validated using rock glacier inventories, enhancing its reliability. This hybrid framework not only establishes a definitive hierarchy of permafrost drivers in the Himalayas but also offers ML-optimized thresholds for infrastructure risk zoning. Adaptable to other high-mountain regions, it provides a climate-resilient and transferable methodology, bridging science and engineering for improved hazard mitigation and policy planning.

**Keywords:**

Permafrost, Machine Learning, Potential incoming solar radiation (PISR), Land surface temperature (LST), Mean annual average temperature (MAAT)

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# Probabilistic Load Flow Analysis of INPS using Monte Carlo Simulation

*Sujan Khanal [a], Keshab Khatri [b], Netra Pakash Aryal [c], Sujan Subedi [d]*

**Abstract:**

This study explores the application of probabilistic load flow (PLF) analysis using the Monte Carlo simulation (MCS) technique to assess the steady-state behavior of power systems under uncertainty. Traditional deterministic load flow methods, while useful for fixed operating conditions, are inadequate for addressing the uncertainties inherent in modern power systems, such as fluctuating load demands, variable renewable energy generation, and network topology changes. This research applies PLF to the IEEE 14-bus test system and the Integrated Nepal Power System (INPS), incorporating uncertainties in load demand and generation. Through MCS with 8,500 iterations, the study provides statistical insights into key parameters, including bus voltages, line loadings, and system losses. The results highlight the effectiveness of PLF in predicting system behavior under varying conditions, offering valuable tools for system planning and operation. Additionally, the study addresses the challenges of renewable energy integration and proposes strategies to enhance system reliability and efficiency. The findings contribute to advancing probabilistic methods in power system analysis and provide a framework for future research in regions undergoing energy transitions.

**Keywords:**

Monte carlo simulation, Load flow, INPS, PLF, etc

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# Optimal Location of Electric Vehicle Charging Station on Khaireni Feeder-Lekhnath, Pokhara using PSO Algorithm

*Shreedhar Dangi* [a], *Shandeep Dhami* [b], *Basant Raj Tiwari* [c], *Milan Rimal* [d]

**Abstract:**

In recent years the concern towards environment quality protection has become a burning topic and researchers are working tremendously on protection of environment. Several concepts have been proposed justifying the acceptance of EV as a prime solution and consequently the world has started switching towards the use of EV. As to charge these EVs, installation of EVCS should be done technically and economically feasible. Mostly the EV charging station placed at radial distribution network are installed without prior detailed system analysis. This paper primarily focuses on finding the optimal location based on minimizing the active power loss along with favoring the weighted zones in the feeder, complying with different constraints like voltage regulation, network loading capacity,and distance between two EVCS. The optimal placement problem of EVCS is optimized by using Particle Swarm Optimization Algorithm. The optimization is performed for IEEE 34 bus system and real radial feeder called Khaireni Feeder. Load forecasting is also performed during 2086 B.S and 2091 B.S for latter feeder. Various metrics like voltage profile, APL and THD are assessed and compared for single and dual EVCS placement for 2081 B.S and 2086 B.S. From the results obtained single and Dual EVCS placement are viable during 2081 B.S, while only single EVCS is feasible during 2086 B.S.

**Keywords:**

Optimal location ,Particle Swarm Optimization, Active Power Loss,Voltage Sensitivity Factor

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# Analysis of PV and Wind System Microgrid in Grid Connected and Islanding Mode of Operation

*Shamsher Kumar Singh* [a], *Sandeep Dhami* [b], *Binod Sharma* [c]

**Abstract:**

Renewable energy sources can be utilized during times of energy scarcity to meet demand. A system designed to optimize the use of renewable energy is called a microgrid. A microgrid can operate in two modes: grid-connected mode and islanding mode. Under normal conditions, the microgrid remains connected to the main grid, and during this time, it uses the current control method to deliver power efficiently. When a fault occurs in the main grid, the microgrid switches to islanding mode. In this mode, the microgrid can supply power generated from its local sources to feed the local load.

Intentional islanding is primarily carried out to maintain grid voltage stability. This paper also highlights that during intentional islanding, the voltage levels of both the DC and AC grids are maintained. When the microgrid is in grid-connected mode, the battery storage system charges, and when it transitions to islanding mode, the battery storage system supplies power to the local load. Simulation is performed using MATLAB/Simulink software. Simulation control method is present in this paper.

**Keywords:**

Islanding, Microgrid system, Current reference control, Voltage control

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# Optimizing EV Charging station with RL based Solar DER integration

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**Abstract:**

Electric vehicles in Nepal are seen to be increasing, both private and public sector transportation are seen adopting electric vehicles as a means of transport. While analyzing the present energy demand and energy supply scenario of charging station, the profit is found very low. If similar supply demand scenario persists the profit will be negative and there might be situation of shutdown of private charging station. But with the introduction of a Micro grid-based model, Charging stations could be scheduled properly. If along with Main Power Grid other energy sources like solar, Battery storage system are added to the charging station then the demand can be fulfilled without extra load to MPG.This paper presents model of charging station, there are three different models of EV charging stations. The first model is a stand-alone model, where the EV receives energy from the main power grid. Similarly, other models are microgrid-based models and solar-based models. In the microgrid-based model players such as MPG, ESS, and Solar operate in unison to fulfill the demand for charging stations. Besides, the solar-based model has solar as the prime energy source to fulfill the demand for charging stations. All these models are operated and trained using Reinforcement Learning. With application of DDQN algorithm for scheduling the charging station, Microgrid based model showed the highest revenue of all three models.

**Keywords:**

Main Power Grid(MPG)–Energy Storage System(ESS)–Electric vehicle Charging Station (EVCS) –Distributed Energy Resources (DER)–Reinforcement Learning–Double Deep Q Learning (DDQN)

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# Power Quality Improvement using Shunt Active Power Filter

*Nimesh Risal* [a], *Prakash Pandey* [b]

**Abstract:**

The increasing use of non-linear loads in modern power systems has led to significant power quality issues, particularly harmonic distortion, which adversely affects system performance and efficiency. This paper presents the design and implementation of a Shunt Active Power Filter (SAPF) for Total Harmonic Distortion (THD) reduction in electrical networks. The SAPF is based on a robust control strategy that effectively compensates for harmonic components generated by non-linear loads, ensuring improved power quality. The proposed system utilizes a current control approach, Instantaneous Reactive Power Theory (p-q theory) for accurate harmonic extraction. Simulation results demonstrate the effectiveness of the SAPF in mitigating harmonics and improving the overall stability of the power system. The findings confirm that the SAPF is a viable solution for enhancing power quality in industrial and commercial applications.

**Keywords:**

Shunt Active Power Filter, Total Harmonic Distortion, Power Quality, Non-Linear Load, Harmonic Mitigation

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# Voltage Stability Assessment of Integrated Nepal Power System

*Bimal Adhikari* [a], *Jeetendra Chaudhary* [b]

**Abstract:**

Voltage stability is a critical concern in rapidly expanding power grids like the Integrated Nepal Power System (INPS), where localized instability can escalate into a system-wide collapse. This study introduces a novel Voltage Stability Index (VSI) based on Thevenin equivalent theory and maximum loading capability to assess voltage collapse risks. The analysis covers all nine grid divisions of the INPS, focusing on load buses above 132 kV across five key divisions. The study identifies critical buses, such as Bus 14 in Kathmandu and Bus 104 in Attaria, where VSI drops significantly between 100-300 MVAr loading, indicating vulnerability. In Kathmandu, VSI at Bus 14 decreased to 0.08 at a reactive power loading of 1040 MVAr, while the Voltage Collapse Proximity Index (VCPI) increased to 0.12, signaling proximity to collapse. MATLAB-based simulations demonstrate that VSI provides a computationally efficient alternative to traditional methods like VCPI and P-V curves for identifying weak buses. The findings offer valuable insights for Nepal's power system operators, supporting targeted transmission reinforcement strategies and real-time voltage stability monitoring.

**Keywords:**

Power System Stability, Voltage Instability, Reactive Power Management, Critical Bus Identification, Transmission Network Analysis, Voltage Collapse Prediction, Power Flow Study, Online Stability Monitoring, Phasor Measurement Unit (PMU).

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# Techno-economic analysis of vehicle to grid technology in Nepal

*Niroj Bahadur Bhujel* [a], *Jeetendra Chaudhary* [b], *Sujan Adhikari* [c]

**Abstract:**

The study develops a novel numerical model for performing an economic evaluation of Vehicle-to-Grid (V2G) services. The model takes into account several parameters in its calculations, such as battery degradation, distance traveled, charging frequency, the number of V2G charge-discharge cycles, electricity purchase and sale prices, and the cost of new batteries which helps to make it analogous to real world scenario. To validate this model, the EV users are classified into four distinct groups with unique features—'Elder', 'Job holder', 'Cabman' and 'Busman'— aiming to identify the situations in which offering this energy storage service is most advantageous for EV users. For each group, the typical brand of EV used in nepal is taken. Currently, there is no established tariff rate for selling electricity through V2G technology in Nepal. Therefore, we evaluated and compared three hypothetical electricity selling price scenarios: Rs. 9/kWh, Rs. 11.7/kWh (equivalent to the existing highest electricity purchasing tariff rate for EVs in Nepal), and Rs. 17/kWh, and conducted a sensitivity analysis. The objective is that, by the time a user needs to replace their battery due to degradation, they will have earned enough from the V2G service to cover the cost of a new battery and still make a profit. The results show that the total net profit from the V2G service, after accounting for the cost of a new battery, is significantly negative for all groups in each scenario. At selling rate Rs. 17/KWh, the highest loss is Rs. 15,37,930 for Busman and lowest loss is Rs 1,66,336 for Elder user. Though, the hypothetical rate Rs. 17/KWh is high tariff in the context of nepal, it becomes impractical for all users to continue degrading their battery and replacing after 1 to 3 years in this rate.

**Keywords:**

Electric vehicles, V2G, Economic earnings, Battery degradation

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# Harmonic Analysis and Mitigation Strategies for EV Charging Station Integration in Distribution System Network

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**Abstract:**

Electric Vehicles (EVs) are making its way on the mainstream in the automobile industry due to their low CO2 emissions, simple maintenance and low operating costs. As the number of electric vehicles increases, the charging demand affects the distribution network features. The augmentation of electric vehicle infrastructure has brought different challenges in terms of power quality such as harmonic distortion on the distribution network. The employment of modern power electronics equipment in chargers causes variation of loads which is the cause of distortion of normal sinusoidal pattern of the current and voltage waveforms thus leading to hinderance in the system known as harmonics. This research concentrates on analysis of total harmonic distortion (THD) introduced by EVs charging station on real distribution feeder. In this paper, Sanepa distribution feeder is modelled and the shunt active power filter with instantaneous reactive power theory is brought to use allowing to compensate the harmonic currents at the point of common coupling (PCC). The proposed approach is implemented and the outcome shows that the THD is significantly reduced to 1.34% from 31.22%. The modelling and simulation is carried out in MATLAB/Simulink platform.

**Keywords:**

Electric Vehicle, Total Harmonic Distortion(THD), Shunt Active Power Filter, Point of Common Coupling(PCC), Voltage Source Inverter(VSI)

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# Design, Fabrication and Testing of a Smart Heating Table

*Madhab Kumar Thapa [a], Santosh Pokhrel [b], Shishir Chhetri [c], Niroj Rana [d], Samrat Devkota [e], Tanka Prasad Gaihre [f], Prabij Joshi [g]*

**Abstract:**

This paper presents the design, fabrication, and thermal analysis of a smart heating table, integrating advanced heating components and intelligent control mechanisms. The system operates on the principle of Joule's Law of Heating and utilizes sensors and a temperature controller for optimal heat regulation. A wooden table (94 × 63 × 54 cm) equipped with a heater serves as a prototype for the project. The fabrication process prioritizes efficient material selection and structural optimization, ensuring durability and energy efficiency. A comprehensive Computational Fluid Dynamics (CFD) analysis is conducted to evaluate thermal behavior under the table, with temperature measurements taken at distances of 5 cm, 20 cm, 30 cm, and 45 cm from the heater center. The results show a uniform temperature distribution, as confirmed by contour mapping.Moreover, the system's energy consumption is evaluated, and the CFD results are compared with experimental data, with calculated error margins less than 2%.This study presents an energy-efficient and user-friendly heating solution, contributing to the advancement of smart heating systems that prioritize environmentally friendly and user-centric design principles.

**Keywords:**

Emphasizing, Temperature contour, Innovative.

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# Numerical Investigation of Surface Vortices in Hydropower Intakes Using OpenFOAM

*Pooja K.C* [a], *Ramkrishna Regmi* [b]

**Abstract:**

The formation of free surface vortices in hydropower intakes can significantly compromise intake discharge, leading to reduced energy production, debris entrainment, and cavitation. While previous studies have primarily focused on single intake arrangements and critical submergence, the influence of terrain geometry, intake orientation, flow velocity, and intake size on vortex formation remains underexplored. In this study, the numerical model employs the InterFoam solver coupled with the SST k-$\omega$ turbulence model to capture vortex dynamics. The simulations were validated using experimental results obtained from a physical model at Hydrolab Pvt. Ltd. Convergence was ensured with residual thresholds of $5\times10^{-9}$ for P-rgh and $1\times10^{-6}$ for velocity U, and verified through velocity stabilization at a selected monitoring point. The results demonstrated a close agreement between numerical simulations and experimental observations, with vortex characteristics matching in terms of diameter, and intensity. The findings highlight the influence of submergence depth and intake geometry on vortex formation, emphasizing the need for comprehensive design considerations beyond critical submergence levels. The study confirms the capability of the OpenFOAM framework in modeling complex hydraulic phenomena, offering insights for improved intake designs. Future research should investigate the impact of vortices on sediment withdrawal.

**Keywords:**

Numerical Modeling, Hydropower, OpenFOAM

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# Hydrodynamic Forces and their Effect on Structural Design of Vertical Lift Gate

*Ranjeet Twayna* [a], *Laxman Poudel* [b]

**Abstract:**

Vertical lift gates play a crucial role in hydraulic structures such as dams and flood control systems by regulating water flow. However, the complex hydrodynamic forces acting on these gates, particularly when partially open, present significant design challenges. This study conducts a comprehensive hydrodynamic and structural analysis of vertical lift gates using Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) to evaluate their response under various operational conditions. The methodology includes developing 2D and 3D gate models, meshing, and numerical simulations, followed by CFD analysis in ANSYS-FLUENT to examine hydrodynamic forces, with validation against analytical calculations. Structural analysis through FEA further assesses the mechanical response of the gates under these forces. The CFD results reveal considerable variations in pressure distribution and downpull forces across different gate openings, with the maximum downpull force occurring at 30% gate opening—highlighting a critical operational point where hydrodynamic forces peak. The FEA results show that these forces significantly influence maximum principal stress and deformation, underscoring the importance of precise hydrodynamic assessment in gate design to ensure structural integrity and operational efficiency.

**Keywords:**

ANSYS Fluent, CFD, Downpull, FEA, Solidworks, Total Deformation

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# A Comparative Study of NACA 23012 and 2412 Airfoils for STOL

*Osika Shakya [a], Swikriti Puri [b], Kushal Neupane [c], Arun Bikram Thapa [d]*

**Abstract:**

A comprehensive computational analysis of the aerodynamic performance of two airfoils NACA 23012 and NACA 2412 is studied for Short Takeoff and Landing (STOL) applications. Utilizing ANSYS Fluent for simulation and analysis, the research investigates the variation in coefficient of lift, drag, moment and aerodynamic efficiency as a function of the angle of attack (AoA), with the inlet velocity maintained constant at 35 m/s. Mesh independence study ensure high accuracy in capturing flow features such as pressure distributions and velocity contours. The analysis highlights key differences in aerodynamic characteristics between the two airfoils, particularly in terms of stall behavior, lift-to-drag ratios, and pressure gradients over the airfoil surfaces when AoA is varied from negative 5° to positive 15°. The results provide valuable insights for selecting airfoil in STOL aircraft according to design constraints, contributing to enhance performance in different flight phases.

**Keywords:**

STOL, NACA 23012, NACA 2412, Angle of Attack, Aerodynamic Coefficient

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# Energy consumption pattern in post disaster constructed temporary shelter: A case study of Rimna, Jajarkot

*Adhish Kumar Khadka* [a], *Sanjaya Uprety* [b], *Barsha Shrestha* [c] *Hom Bahadur Rijal* [d]

**Abstract:**

Post-disaster temporary shelters play a crucial role in providing immediate housing solutions for displaced populations. However, energy consumption patterns in these shelters are often overlooked, impacting sustainability, affordability, and environmental consequences. This study investigates energy use trends in post-disaster temporary shelters in Rimna, Jajarkot, following the 2023 Jajarkot earthquake. The research findings indicate that firewood remains the dominant energy source for cooking and heating, with 85.7% of households relying on it, raising concerns about deforestation and indoor air pollution. Although 97.6% of households have access to grid electricity, frequent power outages and voltage fluctuations force 14.28% of households to rely on solar panels as an alternative. The use of LPG for cooking is minimal, largely due to economic constraints and supply chain limitations. Furthermore, poor insulation in CGI sheet shelters exacerbates energy inefficiency, leading to increased firewood consumption for heating during winter. The study concludes that sustainable energy interventions are necessary to reduce reliance on biomass fuels and improve energy security in post-disaster shelters. Recommendations include promoting solar power systems, enhancing insulation techniques, subsidizing LPG and clean cooking technologies, strengthening energy infrastructure, and increasing community awareness on energy efficiency. These measures are essential for ensuring affordable, sustainable, and resilient energy access in post-disaster temporary settlements.

**Keywords:**

temporary shelter, energy consumption, post disaster reconstruction

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# Development and Analysis of Hybrid Renewable Energy Integration Model for a Generic Military Battalion in UN Peacekeeping Operation

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**Abstract:**

The Renewable Energy(RE) in UN Peacekeeping Operation(UNPKO) is a very pressing issue in the current peace operation spectrum. Despite the different RE policies and targets of the UN, the current status and speed of RE integration in UNPKO is way behind the expected targets. The RE integration in UNPKO can be accelerated via the military battalion(Bn) units which are the largest of the component of UNPKO by the strength and formation. This study models and proposes a Hybrid Renewable Energy integration system at 35% Power-Penetration(PP) for a generic military Bn along with the economic analysis of the same, while complying with the pertinent UN standards and reimbursement modalities. The optimum power capacity for the hybrid RE system is evaluated as 2,473KVA Diesel Generator(DG) Bank, 693KWp Solar PV and 866KW Converter capacity at maximum Monthly Wet-lease Reimbursement strategy which is calculated to be $38,274/month for the military Bn Unit. The 12-year project overview of the hybrid RE system yielded the Net Present Value of 1.67million$ with the discounted payback of 2.71 years and the Internal Rate of Return (IRR) of 25.32% while incurring the market based initial investment cost of 1.05million$.

**Keywords:**

Hybrid, Renewable, Energy, UN, Peacekeeping, Footprint, Greening, Battalion, Reimbursement

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# Impact Assessment of Photovoltaic Bulbs in Non-Electrified Rural Households: A Case of Jaimini-1, Baglung, Nepal

*Suraj Khanal* [a], *Yogesh Paudel* [b]

**Abstract:**

The purpose of the study is to perform the economic impact assessment for the replacement of poor-quality kerosene lamps with photovoltaic bulbs in non-electrified rural households to enhance lighting quality, replacing poor quality kerosene lamps. The solar lamps contribute to sustainable development by promoting social, economic, environmental, and technical improvements while displacing GHG-intensive, non-renewable electricity appliances with renewable energy technologies. The total number of non electrified household is 3, so the project doesn't involve a large-scale energy generation unit but rather focuses on a small-scale, household-level renewable energy solution in the form of PV bulbs. The analysis demonstrates a significant reduction of 25.99 tonnes of $CO_2e$ over 15 years, with benefits including fuel savings, reduced travel for kerosene procurement, and improved lighting quality. Economic indicators show a B/C ratio of 2.22 and an internal rate of return (IRR) of 56%, highlighting the financial viability of the intervention. The findings suggest that scaling up PV bulb adoption in rural areas could provide substantial environmental and economic benefits while improving quality of life.

**Keywords:**

Photovoltaic Bulbs, Renewable Energy, GHG Reduction, Sustainable Development

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# Optimizing an Agrivoltaic System through Panel Configurations and Financial Analysis

*Upama Nepal* [a]

**Abstract:**

Agrivoltaic systems are those systems that enact the dual use of land for agriculture and electricity production. These systems, through their mechanisms, can perform even in the dry lands, hence these systems are established worldwide though the conceptualization was already done before a long time. In this research, various factors contributing to the development of agrivoltaic systems are studied and analyzed so that the best route can be chosen to develop one agrivoltaic system that would fit the land area. Firstly, power production was found at various panel gaps. The power produced was 26.1 MW at a 40% panel gap, 21.7 MW at a 50% panel gap, 17.4 MW at a 60% panel gap, and 13.004 MW at a 70% panel gap. Then, crops were selected as per the literature: potato and soybean cultivated in one crop rotation. Then, the yield and revenue of potatoes were found in various panel gaps which were 3.22 tones/ha and Rs. 1167834.33 for 40% panel gap, 3.26 tones/ha and Rs. 1475295.4 for 50% panel gap, 3.22 tones/ha and Rs. 1751751.5 for 60% panel gap and 3.22 tones/ha and Rs. 2043710.1 for 70%. Likewise, in case of soybean, the crop yield is 0.6 tones/ha for 40% gap and Rs. 1258903.8 for 40% gap, 0.61 tones/ha and Rs.1590214.2 for 50%, 0.6 tones/ha and Rs.1888276.24 for 60% and 0.6 tones/ha and Rs. 2202989.58 for 70% panel gap. This states that with increasing panel gap, there is equal amount of increment of crops. A financial analysis is also done. The internal rate of return for the 40% panel gap is 63.39%, 56% for 50%, 48% for 60%, and 38% for 70%. NPV was also calculated where for 40%, 50%,60% and 70% it was positive which makes the system profitable for all panel gaps.

**Keywords:**

agrivoltaic system, power output, financial analysis

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# Optimizing Energy Efficiency and Thermal Satisfaction in Modern Residential Building: Simulation Based Approach

*Dev, Abinash* [a], *Khadka, Adhish Kumar* [b]

**Abstract:**

This study explores the optimization of energy efficiency in modern residential buildings using simulation tools Ecotect and Ladybug. With growing environmental concerns, energy-efficient residential design is crucial for sustainability. The study models and evaluates building performance, ensuring compliance with regulations while promoting eco-friendly and cost-effective solutions. It analyzes the building envelope, HVAC systems, lighting, and appliances, simulating various climate conditions and occupancy patterns. This research also emphasizes integrating renewable energy sources and optimizing daylight and ventilation. Practical recommendations for energy-efficient technologies and materials are provided for architects and engineers. By addressing energy conservation, this study contributes to reducing greenhouse gas emissions and advancing sustainable residential construction.

**Keywords:**

Thermal Satisfcation, Ecotect, modern building

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# The Role of Workplace Design in Work Satisfaction Among Architects

*Shraddha Parajuli* [a], *Ashim Ratna Bajracharya* [b]

**Abstract:**

This study explores the influence of workplace design on architect's job satisfaction within architectural firms in the Kathmandu Valley. Focusing on how various design elements, such as office layout, furniture, and spatial configuration, influence employee satisfaction and work efficiency, this study seeks to provide visions into the relationship between office design and architect job satisfaction. Using a mixed-methods approach, in-depth interviews with architects used to gather qualitative data about their perceptions of how workplace design affects architects' job satisfaction in architectural firms. Surveys used to collect quantitative data, which will then be analyzed with SPSS to determine the relationship between various design elements and architect job satisfaction. The research objectives include identifying key office design elements particularly in architectural firms, assessing the moderating role of design variables in architects job satisfaction, and proposing practical recommendations for improving workplace environments. According to the study, well-designed workspaces increase job satisfaction, and create a positive work environment. This study will contribute to the development of evidence-based design practices for architectural firms in Nepal and similar contexts, as well as actionable insights for improving architect satisfaction and performance through thoughtful office design.

**Keywords:**

Architectural firm; Activity Based Spaces; Ergonomics; Job Satisfaction; Workplace design.

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# Winter Dynamics of Urban Heat Islands in Kathmandu Valley: Assessing Impacts

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**Abstract:**

The Urban Heat Island (UHI) effect is a significant environmental issue in Kathmandu Valley, impacting local microclimates, energy consumption, and overall thermal comfort. While the UHI effect has been widely studied in summer, its dynamics during the winter months remain largely underexplored. This research focuses on examining temperature variations between urban and suburban areas of Kathmandu Valley during winter. By analysing these differences, the study aims to understand the factors contributing to UHI, including surface materials, urban density, and land cover types. The study employs a mixed-method approach, integrating both primary and secondary data sources. Primary data collection includes surveys to explore public perception of the UHI effect and its impact on the daily lives and comfort of residents. Secondary data is gathered from the Department of Hydrology and Meteorology (DHM), focusing specifically on temperature records for the month of December to identify spatial variations in temperature across different areas of the valley. Findings from the study reveal that urban areas experience slight higher temperature during winter months but not significant, primarily due to increased urban density, a lack of green spaces, and the prevalence of impervious surfaces such as concrete and asphalt. These factors contribute to the exacerbation of the UHI effect by limiting natural cooling mechanisms. The analysis also indicates that both urban areas and sub-urban areas, with old/traditional and mixed type of building contributes less to UHI effect. The key features of those buildings are their materials, open spaces and permeable pavement. This research finds that winter UHI has a less significant impact compared to summer UHI. However, it provides valuable insights into Kathmandu Valley's winter climate, offering essential data for urban planning. These findings can help enhance the city's resilience, improve thermal comfort, and support urban sustainability.

**Keywords:**

Winter Season, Urban Heat Island Effect, Urban Zone, Sub-urban Zone, Temperature, Comfort

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# Heat Map-Based Comparative Analysis of Green and Concrete Roofs for Urban Heat Island Mitigation in Kathmandu Valley

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**Abstract:**

As cities expand, the impacts of urban heat islands (UHIs) worsen, making metropolitan regions noticeably warmer and raising the energy required for cooling. This research compares the efficiency of traditional concrete roofs with green roofs in reducing urban heat island (UHI) in the Kathmandu Valley. With a cooling differential of 4.84°C on average and a peak decrease of 9.74°C, logger temperature analysis indicates that green roofs reduce surface temperatures by around 32% more effectively. In contrast to concrete roofs, which absorb and trap heat, green roofs continuously kept temperatures lower day and night, lowering heat stress and enhancing urban comfort. With a 1'6" thick substrate that was well-irrigated and vegetation that was 6" to 10", the green roof showed significant thermal advantages and utilized less energy for cooling. These findings highlight the necessity of integrating green roofs into urban design to combat UHI, enhance climate resilience, and create cooler, more sustainable cities.

**Keywords:**

Green Roof, Concrete roof, Surface temperature, Heat map, Urban heat Island (UHI), heat mitigation, Urban roofs

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# Analysis of Thermal and Visual Performance in Naturally Ventilated Secondary School Buildings in Nepal

*Shrestha, Srijana Goja* [a], *Uprety, Sanjaya* [b]

**Abstract:**

Thermal and visual comfort play an important role in enhancing the health and performance of both students and teachers in classrooms. Most Nepalese school buildings are naturally ventilated with wooden shutters or open windows, whose performance depends on external weather conditions. The daylight and thermal comfort are strongly influenced by these factors. Poor indoor environments can negatively affect the academic performance of students. Therefore, necessary actions must be taken to improve the thermal and visual performance of schools. Limited research has been conducted on indoor environmental quality related to thermal comfort in Nepalese school buildings. A field investigation was carried out at Shree Balpremi Secondary School in Madhyapur Thimi, Bhaktapur, involving temperature and daylight illuminance measurements during January 2025, together with a student survey. The findings show that the mean indoor temperature (16.4–17.1°C) is below the thermal comfort range for Kathmandu's winter. More than 56% of the students reported comfort and preferred a slightly warmer classroom. Illuminance data indicated that the south-facing classroom (grade 6) experienced fluctuating levels (723–215 lux), while the north-facing classroom (grade 7) had steadier but lower levels (811–110 lux). Both classrooms had insufficient daylight in the back, with 50% of the students reporting inadequate lighting at noon and 73% occasionally relying on artificial lighting. The results emphasize optimizing window size, orientation, and glazing to improve indoor environmental comfort. Future research incorporating simulations across different seasons and climates is recommended to better understand these factors.

**Keywords:**

Thermal and Visual Performance, Naturally Ventilated School Building, Thermal Sensation, Illuminance

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# Evaluating the Thermal Performance of Stabilized rammed earth Walls in Residential Buildings during winter:A case of Dekaido onsen, Budhanilkantha

*Bibek K.C.* [a], *Sushil Bahadur Bajracharya* [b]

**Abstract:**

This study investigates the thermal performance of stabilized rammed earth walls in maintaining a warmer temperature and more comfortable indoor environment compared to outdoor temperatures observed during winter season. The analysis demonstrates the wall's superior insulation capabilities, effectively reducing heat gain and loss, and minimizing the need for artificial heating and cooling, leading to significant energy savings. Indoor temperatures were consistently 1.09°C warmer than outdoor temperatures over an eight-day period, showcasing the wall's ability to absorb heat during the day and gradually release it when outdoor temperatures drop. The thermal dynamics observed include gradual morning heat gain, efficient afternoon heat absorption minimizing cooling needs, controlled evening heat release maintaining thermal comfort, and continued nighttime heat retention providing a warmer indoor environment. These findings highlight the thermal mass effect of stabilized rammed earth walls, which naturally moderate indoor temperatures by absorbing, storing, and releasing heat. This passive thermal regulation reduces dependence on HVAC systems, leading to lower energy consumption and minimized carbon emissions. The study underscores the potential of rammed earth walls as a low-carbon, energy-efficient building material that enhances indoor comfort and supports sustainable living. It advocates for their broader adoption in energy-efficient architectural designs, contributing to global carbon reduction goals.

**Keywords:**

Rammed earth, Stabilized rammed earth, Thermal comfort, Thermal mass, Thermal performance

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# Traditional Public Space: A case of Madhyapur Thimi

*Sujan Shrestha* [a], *Sudha Shrestha* [b]

**Abstract:**

Traditional public spaces in historic settlements are vital components of the urban fabric, fostering social cohesion, cultural expression, and communal interaction. Madhyapur Thimi, a significant Newar town in Nepal, showcases a well-structured hierarchy of public spaces, including chowks, baha, and durbar squares, which have long supported socio-cultural activities and urban continuity. However, rapid urbanization, changing lifestyles, and contemporary development pressures have led to spatial fragmentation, encroachments, and the diminishing cultural essence of these spaces. This study critically examines the morphological evolution, spatial organization, and functional transformation of traditional public spaces in Madhyapur Thimi. Through empirical research, case studies, and spatial analysis, it identifies the challenges posed by modern interventions while emphasizing the importance of retaining the architectural integrity and cultural relevance of these urban realms. The research advocates for a holistic approach to conservation, integrating adaptive reuse strategies, contextual urban planning, and participatory design frameworks to revitalize these spaces while accommodating modern needs. The findings underscore the need for policy-driven interventions that prioritize the preservation of traditional spatial structures, ensure pedestrian-oriented design, and reinforce the cultural landscape of heritage towns. By bridging historic continuity with contemporary urbanism, the study proposes strategies that sustain the livability, functionality, and socio-cultural vibrancy of Madhyapur Thimi's public spaces.

**Keywords:**

Public Spaces, Urbanization, Placeness, Preservation and Revitalization, Spatial Transformation

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# Investigating Geometric Innovations in High-Rise Architecture of Kathmandu

*Sujan Sahukhala* [a], *Sushil Bahadur Bajracharya* [b]

**Abstract:**

This study explores the role of geometric transformations in shaping high-rise architecture in Kathmandu post-2000. The transformation of Kathmandu's urban landscape has led to the increasing prominence of high-rise structures, necessitating the exploration of modern geometric principles in architectural design. The research investigates how geometric principles influence spatial organization, structural efficiency, and aesthetic expression in modern vertical developments. The research evaluates various geometric forms, including ideal, folded, blob, and formless geometries, to determine their impact on both functional performance and urban aesthetics Through a mixed-methods approach, including case studies and thematic analysis using MaxQDA, the study identifies patterns in high-rise design and their broader implications for Kathmandu's architectural identity. The research underscores the importance of context-driven geometric strategies in achieving a balanced and adaptive high-rise architecture that aligns with both traditional and contemporary urban needs. The findings suggest that contemporary high-rise designs increasingly integrate advanced geometric strategies such as parametric modeling, folded geometries, and modular facades. The study emphasizes the need for a balance between modern architectural innovations and Kathmandu's cultural identity to ensure a sustainable and contextually relevant urban skyline. The study contributes to architectural theory and practice by providing insights for architects, urban planners, and policymakers on the evolving role of geometric principles in Kathmandu's high-rise development.

**Keywords:**

Geometric transformation,geometric forms, modular facades, spatial organization

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# Assessment of Green Building Technology Attributes Preferences in Residential Building-A Case Study in Context of Pokhara

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**Abstract:**

This study assesses green building technology attribute preferences in residential buildings in Pokhara, Nepal. The research aims to evaluate preferences for environmental, social, and economic attributes of green buildings among residents, as well as assess the current adoption of green attributes in existing residential buildings. The methodology involves a questionnaire survey of 365 households in Ward 16 of Pokhara Metropolitan City, selected through random sampling. The survey uses a 5-point Likert scale to measure preferences for various green building attributes categorized into environmental, social and economic dimensions. Data analysis will employ the Relative Importance Index (RII) to rank attributes based on resident preferences. Key green attributes examined include energy efficiency, water conservation, indoor environmental quality, use of recycled materials, community engagement, and life cycle costs, among others. The study will provide insights into resident priorities for green building features in the local context of Pokhara. Findings can inform sustainable residential development practices and policies to promote green building adoption in Nepal.

**Keywords:**

Green Building, Social Attributes, Environment Attributes, Economics Attribuites

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# Infrared Thermography for Assessing Thermal Bridges in Residential Buildings: Identification and Analysis of Critical Heat Loss Locations in a Temperate Climate

*Ritik Man Shrestha* [a], *Sanjaya Uprety* [b]

**Abstract:**

Buildings are significant contributors to global energy consumption and greenhouse gas emissions, with thermal bridges playing a critical role in undermining the thermal performance of building envelopes. Thermal bridges which are areas of low thermal resistance in the building envelope, lead to increased heat transfer, higher energy consumption, and potential issues such as condensation and mold growth. This study focuses on identifying and analyzing thermal bridges in residential buildings in Kathmandu, Nepal, using infrared thermography and numerical simulation (THERM). The research examines key areas such as balcony-wall junctions, roof-wall junctions and window-frame junctions to assess their impact on energy efficiency. Through thermal imaging and 2D heat transfer analysis using THERM software, the study quantifies the linear thermal transmittance (psi value) of these thermal bridges. Thermal images of six RCC-framed structures were analyzed to identify key areas of heat loss across the building envelope. The findings reveal that roof-wall junctions are particularly prone to thermal bridging, with a calculated linear thermal transmittance of 0.5275 W/m-K, which is high compared to passivhaus standard (¡0.01 W/m-K) and other thermal bridging guides (¡0.3 W/m-K). This research highlights the importance of addressing thermal bridges in building design to improve energy efficiency, reduce heat loss, and enhance indoor comfort in the context of Nepal's rapidly urbanizing environment.

**Keywords:**

Thermal bridge, overall heat transfer coefficient, linear thermal transmittance, infrared thermography

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# Assessing the Current Patterns of Balcony Usage in High-Rise Apartments in Kathmandu

*Sabi Shrestha* [a], *Sushil Bahadur Bajracharya* [b]

**Abstract:**

Balconies serve as crucial extensions of indoor living spaces, particularly in high-rise apartments where access to open spaces is limited. This study explores the current patterns of balcony usage in high-rise apartments in Kathmandu, analyzing their role in residents' daily activities, well-being, and environmental efficiency. Data was collected through surveys, interviews, and case studies of selected apartment buildings. The findings indicate a shift in balcony usage, with increasing trends in multifunctional applications such as gardening, social interactions, and relaxation. The study highlights the implications of these trends for architectural design and urban planning, emphasizing the necessity of optimizing balcony spaces for enhanced livability.

**Keywords:**

Balcony, high-rise apartments, pattern, usage

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# Addressing Urban Water Scarcity through Community Engagement and Decentralized Solutions: A Case of Dharan

*Siddhartha Bhujel* [a], *Sangeeta Singh* [b]

**Abstract:**

Dharan, a rapidly urbanizing sub-metropolitan city in eastern Nepal, faces acute water scarcity exacerbated by population growth, aging infrastructure, and climate variability. This study explores the role of community-led decentralized water management systems, such as Water User and Sanitation Committees (Upabhokta tatha Sarsafai Samitis), in mitigating water insecurity. Using a mixed-methods approach: qualitative insights from household surveys, key informant interviews, and field observations with quantitative data to evaluate the current water supply scenario, community participation, and the effectiveness of supporting policy frameworks

The findings reveal that community-led initiatives, particularly through Water User Committees, have significantly contributed to identifying local water sources, managing distribution, and fostering a sense of ownership among residents. However, challenges such as limited technical capacity, financial constraints, and inadequate governmental support impede sustainable progress. The study emphasizes the need for integrated strategies that combine technical expertise, robust governance, and enhanced community involvement to secure long-term water security in Dharan.

**Keywords:**

Urban Water Scarcity, Community engagement, Decentralized water management, Sustainable water solutions

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# An Assessment on Public Bus Service Quality Based on Users' Perceptions: Case of Pokhara Metropolitan City

*Dipesh Thapa* [a], *Padma B. Shahi* [b]

**Abstract:**

This study aims to assess the users' perceptions on the quality of city bus in Pokhara, and, pointing out areas of improvements in public bus services to meet passengers' expectations. 145 respondents were questioned about various aspects of the bus service, including infrastructure, punctuality, customer service, safety, fare issues and information availability for 3 different bus routes throughout the city. Correlation analysis and descriptive statistics were used to analyze the results. The results show that the public bus service in the city is a complex set of challenges that affect its effectiveness and satisfaction levels. The study highlights the need for improvements in infrastructure and operational efficiency, particularly in terms of timely services and clear information dissemination. In addition, the study highlights that enhancing fare transparency and implementing digital payment systems could positively influence public transport usage.

**Keywords:**

Pokhara, public bus transport, user satisfaction, service quality, survey, bus service

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# Evaluating River Setback in Kathmandu Valley: Integrating Socio-Economic Factors into Policy Development

*Binisha Shahi*[a], *Ajay Chandra Lal* [b]

**Abstract:**

Evaluation of river setback policies in Kathmandu Valley reveals significant challenges due to rapid urbanization and encroachments on riverbanks, particularly along the Bagmati and Dhobikhola rivers. Existing setbacks, ranging from 4 to 20 meters, are inconsistent and poorly enforced, exacerbating flood risks and environmental degradation. High land values and rental rates in riverfront areas complicate enforcement, with some areas showing significant urbanization and infrastructure development. A flexible, hydrology-based approach to setback regulations is necessary, integrating flood risk assessments, green infrastructure, and socio-economic factors. Strengthened coordination among agencies and revised legal frameworks are crucial for effective implementation and balancing urban development with environmental conservation.

**Keywords:**

River Setback, River Buffer, Socio-economic factors, River Regulation, Legal framework

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# Development Management in Emerging Town Along BP Highway: A Case of Bhakundebesi

*Sandra Joshi* [a], *Ajay Chandra Lal* [b]

**Abstract:**

The construction of the BP Highway has significantly influenced the spatial and economic landscape of settlements along its route, particularly in Bhakundebesi. Originally a rural area with scattered settlements, Bhakundebesi is now rapidly urbanizing. The flatlands around Bhakundebesi are emerging as the main local market center, gradually transforming into an urban area. This shift is driven by the strategic location of Bhakundebesi along the highway, making it a crucial marketplace and service hub for surrounding rural settlements. The trend of urban growth is gaining momentum, fueled by economic activities, migration, and rising commercial opportunities along the highway. This growth is largely driven by increasing migration from remote regions, where people seek economic opportunities in trade, services, and small-scale industries. This type of growth is often accompanied by adverse effects such as environmental degradation, loss of agricultural land, and social inequities. This study utilizes a mixed-method approach, incorporating census data, field surveys, and stakeholder interviews to assess urbanization trends. Findings indicate rapid land use transformation, increasing commercial activity, and infrastructure deficits. Without proper planning, continued growth could lead to unmanaged expansion, resource strain, and environmental degradation. The study highlights the need for strategic urban planning to mitigate these challenges and ensure sustainable development along the BP Highway.

**Keywords:**

Urbanization Drivers, Urban, Development Management, Emerging Towns, Spatial Transformation, Highway-Oriented Development

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# Economic Shift and Urban Transformation of Siddhipur

*Manita Shrestha* [a], *Jiba Raj Pokharel* [b]

**Abstract:**

This study investigates economic and urban transformation of Siddhipur, as it shifts from an agrarian village to a diversified economy driven by enterprises and remittances. Along with the settlement's spatial transformation, which includes land use, housing patterns, and infrastructure development, the study focuses at changes in livelihood patterns, employment structures, and source of income. Results show a significant decline in traditional agricultural practices and handicrafts like Sukul weaving, driven by reduced demand, changing labor preferences, and more profitable alternatives. Simultaneously, urbanization and infrastructure improvements have led to a rise in residential construction, intensifying land fragmentation and complicating efforts to preserve cultural assets in the face of rapid urban growth. Focus groups and surveys highlight the vital role of foreign employment and migration in the local economy, which has also accelerated urbanization in Siddhipur. This shift underscores the need for tourism-driven cultural preservation amid rapid growth. The study enhances knowledge of how small towns like Siddhipur, seek a balance between historical preservation and economic growth by making policy recommendations to control urban growth, support sustainable development, and foster local entrepreneurship. In order to meet the needs of growing urbanization while preserving Siddhipur's distinctive socioeconomic and cultural fabric, the results are essential for urban planning initiatives.

**Keywords:**

Urban Economic Transformation, Urban Areas, Siddhipur, Economic Diversification, Remittance-driven Income, Spatial Transformation, Urbanization, Cultural Preservation

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# Regulatory Gap and Youth-Driven Adoption: A Study of Ride-Hailing Services in Kathmandu Valley, Nepal

*Ronesh Shahi* [a], *Padma B Shahi* [b]

**Abstract:**

This mixed-method study investigates the rapid adoption of ride-hailing services (RHS) in Kathmandu Valley, Nepal, and the regulatory challenges undermining their sustainable integration. Combining surveys of 548 users and stakeholder interviews, the research identifies service quality (reliability, safety, convenience), technology adoption (digital literacy, app usage), and cost sensitivity as primary adoption drivers. Findings reveal that 84% of users are aged 18–30, with 53% holding postgraduate degrees, highlighting youth and tech-savviness as critical factors. Service quality emerges as the dominant driver (28.82% variance), addressing last-mile gaps and overcrowded public transit despite 88.5% of users living near bus stops.

Regulatory analysis exposes systemic fragmentation: federal laws (e.g., Motor Vehicles Act, 1993) clash with provincial policies, creating ambiguities in operational boundaries and fare structures. However, regulatory gaps, outdated policies, and institutional inertia create legal uncertainties, affecting enforcement and user security. Weak enforcement, exclusion of stakeholders (drivers, passengers), and unaddressed safety risks (18% harassment reports, 20% offline rides) exacerbate vulnerabilities. Provincial initiatives like Bagmati's "green bluebook" lack federal backing, while data governance gaps enable unsafe practices.The study underscores the urgent need for harmonized federal-provincial regulations, inclusive policymaking, and robust enforcement to align RHS growth with equitable urban mobility goals. Without adaptive governance, Kathmandu risks perpetuating a precarious transport ecosystem, mirroring broader Global South challenges in balancing innovation and institutional accountability.

**Keywords:**

Ride-Hailing Services, Regulatory Framework, Youth Adoption, Urban Mobility, Technology Adoption, Kathmandu Valley

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# Gender-Inclusive Urban Space: Enhancing Women's Safety in Cross-Border Mobility at the Indo-Nepal Border case of Biratnagar-Jogbani

*Sujan Kumari Chaudhary* [a], *Ajay Chandra Lal* [b]

**Abstract:**

The Biratnagar-Jogbani border serves as a vital trade, market, and cultural hub but lacks gender-sensitive urban planning, making women vulnerable to harassment and insecurity. High cross-border mobility, and informal trade contribute to safety concerns. This study identifies weakness in urban design infrastructure and proposes gender-inclusive solutions to enhance women's safety and accessibility. On the other hand, drug users are common in this area, which many women feel is unsafe for girls and women. The study focuses on the border area between Biratnagar and Jogbani, which is marked by a high level of cross-border mobility, informal trade, and serious safety issues for women. In order to improve women's safety and accessibility in public areas, the study intends to pinpoint the weaknesses in the current urban infrastructure and suggest gender-inclusive design solutions. The study uses a mixed-method approach that combines quantitative and quantitative interviews to analyze the difficulties women encounter in public places, especially in Nepali border areas and transit zones. Primary sources such as site observation, key informant interviews, and stakeholder analysis, as well as secondary sources like a literature study, are used to gather the data. Key findings show that women frequently experience unsafe due to poor infrastructure like inadequate lighting, poor sanitation, overcrowd, no dedicated parking system, no Closed-circuit television (CCTV) surveillance, no dedicated pathways which contribute to their sense of insecurity. The research also highlights the role of local authorities, Non-Governmental organizations (NGOs) and law enforcement in addressing these issues, by focusing on improving surveillance, lighting and gender-sensitive infrastructure.

**Keywords:**

Gender-Inclusive Design, Women's Safety, Urban Infrastructure, Cross-Border Mobility

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# Assessing the Causes and Contributing Factors of Urban Flooding: A Case Study of Dhangadhi Sub Metropolitan City

*Kshitiz Bhatta* [a], *Sanjaya Uprety* [b]

**Abstract:**

Urban flooding in Dhangadhi Sub-Metropolitan City has become an increasingly severe challenge due to rapid urbanization, inadequate drainage infrastructure, and the compounding effects of extreme rainfall events. This study employs a mixed-methods approach to unravel the complex interplay of natural and human-induced factors driving flood risks in this low-lying urban center. Quantitative analyses of land use and land cover (LULC) data reveal that urban areas have nearly doubled from 13.5% in 2003 to 27.7% in 2023. Concurrently, reductions in water bodies and grasslands have diminished natural flood buffers. Census data indicate rapid population growth in core urban wards, further straining the capacity of outdated drainage systems. A 30-year rainfall record underscores the occurrence of extreme monsoon events that frequently trigger flooding. Statistical analysis reveals weak Pearson correlation coefficients between annual rainfall and both the number of most flood-affected wards ($r = 0.345$) and flood affected land area ($r = 0.37$), indicating that while higher rainfall slightly increases flood impacts, it is not the sole determinant. Qualitative insights from community surveys and field observations highlight the adverse impacts of unplanned development and encroachment on natural waterways. The findings illustrate a "double exposure" scenario, where climatic extremes and human activities jointly exacerbate flood risks. Based on this comprehensive analysis, the study recommends upgrading drainage systems through advanced elevation mapping, restoring natural watercourses, enforcing robust land-use regulations, and fostering community-based flood management initiatives. These strategies aim to transition Dhangadhi from reactive disaster response to proactive, sustainable urban planning, ultimately reducing flood risk and enhancing urban resilience.

**Keywords:**

Urban Flooding, Dhangadhi, Urbanization, Land Use and Land Cover, Drainage Infrastructure, Extreme Rainfall, Flood Mitigation

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# Rural Tourism Development, Spatial Change and Livelihood Dynamics: Case of Pumdikot, Pokhara

*Rashmita Ghimire* [a], *Sanjay Upreti* [b]

**Abstract:**

Pumdikot, a hill station near Pokhara, Nepal, has experienced rapid transformation following the construction of the second-tallest Shiva statue in the country. This surge in tourism has significantly impacted the livelihood dynamics of the local population. This study examines the socio-economic and spatial implications of tourism-led development in Pumdikot, focusing on shifts in income sources, employment patterns, land use, and community well-being. By utilizing satellite imagery, spatial analysis, and an assessment of architectural transformations in the study area, the research maps the changes in land use and infrastructure development. Additionally, qualitative insights from local stakeholders provide a comprehensive understanding of the community's adaptation to these transformations. The findings reveal both opportunities and challenges: while tourism has created new economic prospects, it has also contributed to land speculation, disruptions in traditional occupations, and environmental concerns. This study contributes to the broader discourse on tourism-induced rural transformation and offers recommendations for sustainable and inclusive development in emerging tourist destinations.

**Keywords:**

Rural Tourism, Sustainable Livelihood, Spatial Change

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# Revitalizing Taksar Bazar: An Urban Design Approach to Economic Regeneration through Urban Refill and Architectural Interventions

*Priyanka Karn [a], Arpan Bhattarai [b], Bipin Basnet [c], Ujjwal Dev [d], Kuber Shrestha [e]*

**Abstract:**

Taksar Bazar, located in Bhojpur District of Province No. 1, eastern Nepal, is a historic settlement that once thrived as a cultural, industrial, and economic hub. Established in 1870 B.S. due to the discovery of copper and iron mines, Taksar thrived as a financial hub and a center for coin production. However, following the decline of its economic activities, the market's cultural identity and economic vitality steadily declined due to migration, loss of traditional craftsmanship, and the introduction of modern material. The tangible and intangible aspects of Taksar are now threatened by the degradation of its architectural authenticity, the decline of traditional occupations, and the growing social disengagements.

This research seeks to address these challenges through an urban design approach that combines urban infill strategies with architectural interventions aimed at economic regeneration. This paper aims to answer the central research question: *How can urban infill and architectural interventions, driven by economic regeneration, revitalize the declining urban fabric while preserving its historical authenticity?* To address this, the research was conducted using a multifaceted approach, including field surveys and site analysis, interviews with native residents and stakeholders, a literature review of urban regeneration practices, and case studies of similar themes.

By integrating socio-cultural preservation with modern economic strategies, the proposed framework provides architectural solutions that promote local crafts through heritage museums, encourage adaptive reuse of historical buildings, for sustainable tourism, and introduce strategic interventions in social spaces to foster community engagement and cultural revitalization. The study aims to restore Taksar Bazar as a vibrant, living heritage site, thus contributing to both the economic and cultural rejuvenation of the area.

**Keywords:**

urban infill, economic regeneration, revitalization, heritage renewal

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# Spatial Distribution and Accessibility of Public Urban Green Spaces in Nagarjun Municipality, Kathmandu

*Sanjay Kumar Rokka* [a], *Ashim Bajracharya* [b]

**Abstract:**

The Kathmandu Valley is undergoing rapid urbanization, creating more pressure on its urban green spaces (UGS). This study examines the distribution and accessibility of public urban green spaces (PUGS) in Nagarjun Municipality, Kathmandu, with a focus on equity across different socio-economic groups. Using GIS (Geographic Information System)-based spatial analysis, household surveys, and key informant interviews, the research assesses the availability of PUGS, identifies accessibility gaps, and explores factors influencing their use. Findings show an uneven distribution of PUGS, with significant differences in accessibility based on residential location and income. The study highlights the need for strategic urban planning to ensure fair access, supporting both social well-being and environmental sustainability in the face of rapid urban growth.

**Keywords:**

Public Urban Green Space, Spatial Equity, Accessibility, Urban Planning

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# Resettlement Preferences of Informal Settlements along the Bagmati River in Kathmandu Valley

*Sekiya Shakya* [a], *Sanjaya Uprety* [b]

**Abstract:**

Informal settlements along the Bagmati River in Kathmandu face persistent challenges due to tenure insecurity, environmental vulnerabilities, and government-led evictions. This research examines the resettlement preferences of these communities, focusing on how socioeconomic factors shape their choices. Using a mixed-methods approach, including surveys and key informant interviews, the study identifies critical determinants such as income stability, household structure, employment opportunities, and access to essential services. Findings indicate that while land ownership remains a primary concern, preferences for resettlement models vary across demographic and economic groups. The research also evaluates past resettlement projects like Kirtipur Housing and Ichangu Housing, highlighting their limitations in meeting community needs. The study underscores the importance of participatory planning, advocating for alternative strategies such as private public partnership for affordable housing. The paper offers insights into the adaptive capacity of relocated informal settlers and provides policy recommendations to foster sustainable resettlement interventions in Kathmandu.

**Keywords:**

Informal settlements, resettlement preferences, land tenure

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