March 2022

REPORT OF THE 13TH NEAJ SYMPOSIUM ON
“Current and Future Technologies”

Nepalese Engineers Association, Japan (NEAJ)

Report of the 13th NEAJ Symposium on “Current and Future Technologies”

26 February 2022, via Zoom

Edited by

Dr. Kabir Shakya,
Er. Pradip Adhikari,
Er. Binod Kumar Shrestha

Executive Committee of NEAJ

Date of Publication: March 2022

Preface

The fifth executive committee (EXCOM) of Nepalese Engineers Association, Japan (NEAJ) is pleased to welcome all distinguished guests, presenters, and participants from Japan and Nepal, to the 13th annual symposium on "Current and Future Technologies". The aim of this symposium is to bring together the researchers and the professionals from various engineering and scientific disciplines to promote interactions, scientific discussion, and technology sharing between Japan and Nepal. This program also aim to provide a platform for research collaboration as well as discussing the experiences of the professionals for the learning to the young engineers.

The major feature of this symposium is that the scientific discussions will be made among the various disciplines in a simple and understandable manner, includes bachelor to doctor level research discussion, recent topics of new research area and development of the technology, sharing experiences, and knowledge from the keynote speakers and honest opinions from the commentators. In addition, the floor discussion are open for the participants to discuss and comment about any topics related to the symposium or provide their opinions and discuss for any possible collaboration. We strongly hope that this symposium will actively discuss the topics presented, simulates research ideas to students, enhance the research improvements in Nepal, and develop a platform for multidisciplinary discussion and technology transfer.

Table of Contents

Welcome Speech

Dr. Kabir Shakya
President-NEAJ (Chiyoda Corporation)

Good afternoon, first of all I would like to extend my warm welcome to Chargé d'affaires a. i., Embassy of Nepal in Japan, Mr. Ambika Joshi, Senior members of NEAJ, colleagues, all the participants, ladies and gentlemen. I would also express my sincere thanks to all for attending this 13th NEAJ Symposium despite of your busy schedule.

As a continuation of our previous symposiums, this year also we are organizing the symposium on the theme "Current and Future Technologies" focusing on the research activities and professional experiences of Nepalese engineers residing either in Nepal or Japan. I believe this symposium provides a platform to exchange our ideas, creative discussions and build a network among engineers in Japan and Nepal.

Today, we have total of 7 presentations out of which 4 are research oriented academic paper presentation and 3 keynote speeches that will lead us to panel discussion focusing on "Bridging Academic and Research Activities between Nepal and Japan". I believe the presented research papers from different engineering disciplines are very interesting and unique. I am looking forward to hear the presentations and lively discussion.

I cordially thanks to Prof. Sujeet Pradhan, Kurashiki University of Science and the Arts, Dr. Maheswor Shrestha, Joint Secretary, Water Resources Division, Ministry of Energy, Water Resources and Irrigation, Government of Nepal, and Assoc. Prof. Kshitij Charan Shrestha, IOE, Pulchowk Campus, for accepting our request to deliver the keynote speeches. I am also pleased to have Prof. Dr. Achyut Sapkota, National Institute of Technology, Kisarazu College, Dr. Bhoj Raj Pantha, Katahira & Engineers International, Dr. Jhabindra Prasad Ghimire, Asha Consulting Group Pvt. Ltd., Dr. Ved Prasad Kafle, National Institute of Information and Communications Technology as commentators. I got message that due to some urgent matters Prof. Sapkota and Dr. Kafle may not be available today, but I hope they will manage time and appear during the panel discussion. I am sure that after listening to all the speaker we will have lively discussion which will be helpful in broadening our mind towards bridging the academic and professional activities between Nepal and Japan.

Due to COVID, we had to postpone the symposium, however, I hope the outcome of today's symposium will be fruitful to all of us. Though the COVID restricted us from organizing the symposium on face-to-face basis, it also provided us an opportunity to listen to presenters from Nepal through the virtual platform Zoom. Today we have 5 presentations out of 7 from Nepal which itself is also an achievement in collaborating with engineers in Nepal and Japan. Without delaying, I would like to conclude my opening remarks and once again thank you all for your participation.

Introduction of NEAJ

Er. Sailendra Humagain

General Secretary of NEAJ (Kinden Corporation)

NEAJ Members Database

GROUP OF ARCHITECTURE

1. Dr Hom Bahadur Rijal (Professional)
2. Ar Pragati Baniya (Student)
3. Dr Lata Shakya (Professional)
4. Dr Shital Babu Acharya (Student)
5. Dr Suraj Pradhan (Professional)

GROUP OF CIVIL, CIVIL AND ENVIRONMENT AND PALAEONTOLOGY (GEOLOGY) ENGINEERING

1. Er. Aavash Ghimire (Student)
2. Dr Badri Bhakta Shrestha (Professional)
3. Dr Bhoj Raj Pantha (Professional)
4. Dr Bhuwneshwar Prasad Sah (Professional)
5. Dr Bibas Guragai (Professional)
6. Er Binod Bhattarai (Student)
7. Er Binod Kumar Shrestha (Student)
8. Hari Krishna Luitel (Student)
9. Er Jeena Munankarmi (Student)
10. Dr Jenisha Singh (Student)
11. Dr Kabir Shakya (Professional)
12. Er Kamal Prasad Regmi (Student)
13. Er Madan Shrestha (Professional)
14. Mishan Shrestha (Student)
15. Er. Nabaraj Shrestha (Student)
16. Er Narendra Dongol (Professional)
17. Er Naresh Subedi (Student)
18. Dr Netra Prakash Bhandary (Professional)
19. Er Niraj Malla (Student)
20. Er. Nirmal Raj Joshi (Student)
21. Dr Phatta Bahadur Thapa (Professional)
22. Er. Pradeep Adhikari (Professional)
23. Er. Priya Shrestha (Professional)
24. Dr Priza Kayestha (Professional)
25. Er. Ram Chandra Thakuri (Professional)
26. Er Rejina Joshi (Professional)
27. Dr Rocky Talchabhadel (Professional)
28. Er. Sailendra Humagain (Professional)
29. Dr Sailesh Shrestha (Professional)
30. Dr Satish Bhagat (Professional)
31. Santosh Pokharel (Student)
32. Er Shirish Hachhethu (Student)
33. Dr Sudarshan Bhandari (Professional)

New Strategy of NEAJ : Creating CLUSTERS

Civil Engineering	**COMBINED GROUP OF COMPUTER, MECHANICAL, ELECTRONICS, ELECTRICAL AND INDUSTRIAL ENGINEERING** 1. Dr Achyut Sapkota (Professional) 2. Er. Anu Aryal (Professional) 3. Er Bhupi Govinda Shrestha (Professional) 4. Er Deepak Gautam (Student) 5. Er. Dhurba Raj Dhakal (Student) 6. Dr Rajali Maharjan (Professional) 7. Dr Ramesh Pokharel (Professional) 8. Er Rishab Poudel (Professional) 9. Er Sandhya Nepal (Professional) 10.Dr Sujeet Pradhan (Professional) 11.Er Sumin Chalise (Professional) 12.Er Yubaraj Khatri (Professional) 13.Dr Ved Prasad Kafle (Professional)
Architecture	
Electronics	
Industrial/ Mechanical	

New Strategy of NEAJ : WHY CLUSTERS & Groups ?

Till now NEAJ Activities
- Annual Symposium
- Platform to share research/professional work
- To contribute to development of technologies in Nepal

Challenges
- Only one day in whole year
- Time limitation to do discussion
- Venue is concentrated in Tokyo. Other members can not participate in the Annual Symposium.

New Strategy of NEAJ : WHY CLUSTERS & Groups ?

Challenges
- Only one day in whole year
- Time limitation to do discussion
- Venue is concentrated in Tokyo. Other members can not participate to the Symposium.

Many seminar/ webinar in Many places

Only by Excom Is not Possible and not effective

SEMINAR/Webinars By Clusters

New Strategy of NEAJ : How CLUSTERS & Groups works?

HUBS: CIVIL Engineering | Architecture | Electronics

- Each cluster will have own group to held meetings/nomikai

Network building
- It will create Senpai-Kohai relation in a group
- Kohai(juniors) can learn or get valuable suggestions and feedback from seniors. Seniors can learn new technologies/challenges from Junior as well
- It will indirectly link to new job opportunities

Deep discussion on a theme
- Meaningful outcome

- NEAJ- Newsletters
- Symposiums

Build relation with other related organizations

New Strategy of NEAJ : How CLUSTERS & Groups works?

Individual cluster group can organize webinar related to their field in association with NEAJ.

1. NEAJ Architecture Cluster Webinar:

NEAJ Webinar on Architectural Planning and Design: Sharing Professional Experience and Academic Research Work
31 July (Sat), 2021

Part One: Academic Research Works
- Research on Urban Heritage Conservation and Community Role: Case on Traditional Kathmandu Valley
  Ar. Ram Shrestha, PhD Scholar at Southwest Jiaotong University of China, Sheet Bhairab Architect & Associates
- Physical Vulnerability of Courtyards as Open Space in Post-Earthquake Disaster: A case of Patan Old City Area
  Ar. Reema Joshi, (Presentation based on M.Sc. in engineering in Disaster Risk Management, Pulchowk Campus), Fast Wind Engineering Service Pvt. Ltd.
- International Community in Shared Housing
  Ar. Pragati Baniya, (Presentation based on Master in Department of Environment Science and Engineering, Setsunan University), Furniture Hub Pvt. Ltd.

Part Two: Professional Experience
- Designing Architecture and Shaping Cities
  Dr Suraj Pradhan, Petit Clarke Petit Architects Kyoto/ Ian Mitsui & Associates Inc. Architects (Chiba University)
- Disaster Risk Management of Cultural Heritage: The Concept and Case Study of Nepal
  Dr. Lata Shakya, Kitsumeikan University

Group photo during the program (24 participants).

New Strategy of NEAJ : How CLUSTERS & Groups works?

2. NEAJ Geotechnical Cluster Webinar:

NEAJ Webinar on Sharing Geotechnical Academic Research and Professional Experience
2nd October (Sat), 2021

Part One: Academic Research Works (Each 10mins Presentation, 10mins Discussion)

Seismic Liquefaction risks in the critical facilities of the Kathmandu Valley, Nepal.
Er. Prabin Acharya (Presentation based on M.Sc. in Geotechnical Engineering, IOE, Pulchowk Campus, Department of Electricity Development, Government of Nepal)

Geotechnical Seismic Isolation using Polymer Grouts.
Er. Aavash Ghimire, Graduate Scholar at Tokyo Institute of Technology, Department of Civil Engineering (Focus on Geotechnical Research).

11:05 Part Two: Professional Experience (Each 15mins Presentation, 10mins Discussion)

Construction of Jointed-Timber Piles in soft ground of Saga, Japan.
Dr. Sailesh Shrestha (Presentation based on his experience as a research engineer in Kyushu Piling Company), Adjunt Senior Lecturer at General Sir John Kotewala Defence University, Faculty of Technology, KDU)

Group photo during the program (20 participants).

New Strategy of NEAJ : How CLUSTERS & Groups works?

3. NEAJ Electronics, AI & IT Cluster Webinar:

NEAJ Webinar on Electronics, AI & IT: Sharing Professional Experience and Academic Research Work
Nov. 27 (Sat), 2021

Part One: Academic Research
Session Chair: Dr. Ramesh K. Pokharel (or Achyut Sapkota), Professor, Kyushu University, Japan.
Metamaterial Inspired High Power Wireless Power Transfer System.
Er. Rishito Goswami, Master's 2nd year, Graduate School of Information Science and Electrical Engineering, Kyushu University, Japan.

On-chip High Frequency RF System Design for THz Applications (Beyond 5G).
Er. Somwrita Kumar Pappu, PhD Scholar, Graduate School of Information Science and Electrical Engineering, Kyushu University, Japan.

Part Two: Professional Experience
Session Chair: *Dr. Ved P. Kafle, Research Manager, National Institute of Information and Communications Technology, Tokyo, Japan.*
Reinforcement Learning for Energy Harvesting Wireless Sensor Nodes.
Dr. Shaswot Shresthamali, Postdoctoral Researcher, Kondo Laboratory, Faculty of Science and Technology, Keio University, Japan.

AI for IT (Information Technology) Operations.
Er. Satish Jaiswal, Hitachi Ltd., Japan.

Recent DDoS Trends and Response Strategies.
Er. Kumar Simkhada, KDDI, Japan.

Group photo during the program (30 participants).

Other Ongoing Works:

- ❑ Preparation of minutes of meeting of every NEAJ meetings which takes place once a week on every Sunday
- ❑ NEAJ Homepage update, Facebook page update, Registration and upload ongoing on NEAJ YouTube page etc.
- ❑ Preparation of constitution amendment to control funds on unproductive activities

Thank you!

Inaugural Speech

Mr. Ambika Joshi
Chargé d'affaires a. i., Embassy of Nepal in Japan

नेपाल इन्जिनियर्स एशोसिएसन, जापानका अध्यक्ष डा. कविर शाक्यज्यू
एशोसिएसनका महासचिव शैलेन्द्र हुमागाईज्यू
सिम्पोजियमका विभिन्न सत्रमा कार्यपत्र प्रस्तुतकर्ता, सहजकर्ता तथा टिप्पणीकर्ताज्यूहरू
साथै कार्यक्रममा सहभागी सम्पूर्ण महानुभावहरूमा,
नमस्कार !

सर्वप्रथम नेपाल इन्जिनियर्स एशोसिएसन, जापानले आयोजना गरेको यस 13th Symposium on Current and Future Technologies को सफलताको शुभकामना व्यक्त गर्न चाहन्छु- मेरो व्यक्तिगत तथा नेपाली राजदूतावास परिवारको तर्फबाट।

एशोसियसनले प्रत्येक वर्ष आयोजना गर्ने Symposium इन्जिनियरिङ क्षेत्रमा विज्ञता हासिल गरी जापान वा नेपालमा कार्यरत नेपाली इन्जिनियरहरूकाबीच छलफल, विचार विमर्श एवं वहस गर्नुका साथै विभिन्न अनुसन्धान, ज्ञान र अनुभव साटासाट गर्ने एक उपयुक्त Platform भएको कुरामा राजदूतावास विश्वस्त छ।

विज्ञहरूको अनुसन्धान, छलफल र वहसको विषय मूलतः नेपालको आवश्यकता र संभावनाहरुमा केन्द्रित हुनु अझ बढी खुशीको कुरा हो।'नेपाल अपार संभावनाहरू बोकेको मुलुक हो'। सैद्धान्तिक रुपमा सबै नेपालीहरूले दोहोर्याईरहने एउटा विचार हो यो। संभावनाहरूलाई यथार्थतामा रुपान्तरण गर्न भने सम्बन्धित विषयमा पर्याप्त अध्ययन अनुसन्धान गरी सो मार्फत् प्राप्त तथ्य एवं ज्ञानमा आधारित ठोस कार्य योजना अनुरुप अघि बढ्नु अपरिहार्य हुन्छ।
यसका लागि आवश्यक वातावरण निर्माण गर्न नेपाल इन्जिनियर्स एशोसिएसन, जापानले आज आयोजना गरेको यस प्रकारका कार्यक्रमहरूको अवश्य पनि सकारात्मक भूमिका रहन्छ।

आज प्रस्तुत हुने विभिन्न कार्यपत्रहरू तथा Panel Discussion का लागि छानिएका विषयहरू मुख्य गरी नेपालको विकाससँग सम्बन्धित छन्। यस्ता अनुसन्धानमा आधारित भई गरिने छलफलबाट निस्कने निचोड सम्बन्धित क्षेत्रको विकासमा निश्चय नै उपयोगी हुनेछन् भन्ने मलाई विश्वास छ।

राष्ट्रको समुन्नति र समृद्धिका लागि स्वदेश एवं विदेशमा रहेका सबै नेपालीहरूको एकीकृत प्रयास आवश्यक छ। यस मार्गमा स्वदेश तथा विदेशमा रहेका नेपालीहरू अग्रसर हुनु पक्कै पनि सह्रानीय छ।

यसै सन्दर्भमा १२ औं Symposium मा मैले विभिन्न मुलुकहरुमा रही विभिन्न क्षेत्रमा विज्ञता हासिल गरेका नेपालीहरूलाई नेपालको विकासको हिस्सेदार बनाउने उद्देश्यले स्थापना भएको Brain Gain Center मा जोडिनका लागि आग्रह गरेको थिएँ। आशा छ धेरै भन्दा धेरै व्यक्तिहरू उक्त Center मा जोडिनु भएको छ। कोही छुट्नुभएको छ भने जोडिन अनुरोध गर्दछु।

अझै पनि हामी कोभिड-१९ महामारीको जोखिममा छौं। यसबाट जोगिने उपायहरूको अवलम्बन गर्दै आफ्नो व्यक्तिगत एवं व्यवसायिक जीवन सुचारु गर्नुपर्ने चुनौति हाम्रा सामु छ। जापानमा अझैपनि संक्रमण र मृत्युदर उच्च रहेको छ। अतः जापान सरकारले जारी गरेको स्वास्थ्य सम्बन्धी मापदण्डको पालनाका गर्नुहुन यहाँहरू सबैमा हार्दिक अनुरोध गर्न चाहन्छु।

अन्त्यमा, Symposium on Current and Future Technologies आयोजना गर्नुभएकोमा नेपाल इन्जिनियर्स एशोसिएसन, जापान तथा Symposium मा कार्यपत्र प्रस्तुतकर्ता, टिप्पणिकर्ता, सहजकर्ता लगायत विज्ञहरु तथा कार्यक्रममा सहभागी सबै विशिष्ट महानुभावहरूलाई धन्यवाद दिँदै पुनः कार्यक्रमको पूर्ण सफलताको शुभकामना दिन चाहन्छु। साथै, नेपाल र नेपालीको हितमा तपाईंहरूले गर्ने कुनै पनि प्रकारका कार्यहरूमा राजदूतावासको सदैव सद्भाव र सहयोग रहने प्रतिबद्धता व्यक्त गर्दछु।

यहाँहरु सबै दिन शुभ रहोस्।

धन्यवाद ।

13th NEAJ Symposium and Contents

Saturday, February 26, 2022
On Zoom Platform

13:00-13:20 Opening Ceremony

Welcome Speech- Dr. Kabir Shakya, President of NEAJ,
(Chiyoda Corporation)

Introduction of NEAJ- Er. Sailendra Humagain, General Secretary of NEAJ,
(Kinden Corporation)

Inaugural speech- Mr. Ambika Joshi,
Chargé d'affaires a. i., Embassy of Nepal in Japan

Group Photo Session 1

Academic Paper Presentations (Presentation 10 min, QA 5 min)
Moderator: Er. Sumin Chalise, EXCOM member of NEAJ
(TDK Corporation)

13:25-13:40 Academic Presentation 1

Assessing Green Energy Transformation in Nepal Using Hydropower-Hydrogen Integrated Power Grid Model

Khem Gyanwali[1], Aadya Bhattarai[1], Tri Ratna Bajracharya[1], Ryoichi Komiyama[2], Yasumasa Fujii[2]

[1]Institute of Engineering, Tribhuvan University, [2]Department of Nuclear Engineering and Management, The University of Tokyo

13:40-13:55 Academic Presentation 2

Row Housings in Nepal and Their Potentials to Pounding

Bikesh Sedhain, Associate Prof. Kshitij C. Shrestha, Aarosh Dahal, Aashish Pokhrel, Aayush Maan Karki, Binu Devkota and Tunisha Gyawali

Institute of Engineering, Pulchowk Campus, Tribhuvan University

13:55-14:10 Academic Presentation 3

The Role of Novel Distributed Fiber Optic Sensing for Landslide Monitoring

Ashis Acharya

Department of Geoscience, Shimane University

14:10-14:25 Academic Presentation 4

Disaster Risk Management on Educational Institutes and Its Role for Emergency Response Towards the Local Community

Ram Shrestha[1] and Lata Shakya[2]

[1]Southwest Jiaotong University, [2]Ritsumeikan University

	Group Photo Session 2
	Panel Discussion on Bridging Academic and Research Activities Between Nepal and Japan (Presentation 20 min) Moderator: Er. Pradip Adhikari, Vice President of NEAJ *(Toa Corporation)*
14:30-14:50	Keynote Speech 1 A Transition from Mechanical Engineering to Computer Science Prof. Dr. Sujeet Pradhan *Kurashiki University of Science and the Arts*
14:50-15:10	Keynote Speech 2 Research Gaps and Opportunities in Water Resources Sector of Nepal Dr. Maheswor Shrestha *Joint Secretary, Water Resources Division, Ministry of Energy, Water Resources and Irrigation, Government of Nepal*
15:10-15:30	Keynote Speech 3 Protective Systems, Advanced Earthquake Engineering and Large Scale Experimentations Associate Prof. Dr. Kshitij Charan Shrestha *IOE, Pulchowk Campus*
15:30-16:00	Comments and Floor Discussion Prof. Dr. Achyut Sapkota, *National Institute of Technology, Kisarazu College* Dr. Bhoj Raj Pantha, *Katahira & Engineers International* Dr. Jhabindra Prasad Ghimire, *Asha Consulting Group Pvt. Ltd.* Dr. Ved Prasad Kafle, *National Institute of Information and Communications Technology* *(sorted in alphabetical order)*
16:00~ 16:30	Closing Remarks & Kanpai (Virtual Nomikai) Prof. Dr. Lata Shakya, *Ritsumeikan University*

Registration link: https://forms.gle/EVDjY61TZaXkgAXF6
Zoom link: https://bit.ly/3rv6fA0
Meeting ID: 924 8726 5044
Passcode: 736567

Academic Paper Presentation

Paper Presentation 1: Assessing Green Energy Growth in Nepal with a Hydropower-Hydrogen Integrated Power Grid Model

Khem Gyanwali[1], Aadya Bhattarai[1], Tri Ratna Bajracharya[1], Ryoichi Komiyama[2], Yasumasa Fujii[2]

[1]Department of Mechanical Engineering, Institute of Engineering, Tribhuvan University, GPO Box 1175, Nepal.

[2]Department of Nuclear Engineering and Management, The University of Tokyo, Hongo 7-3-1, Bunkyo-ku, Tokyo 113-8656, Japan.

The involvement of green hydrogen in energy transformation is getting global attention. This assessment examines the hydrogen production and its utilization potential in one of the hydropower-rich regions, Nepal under various demand growth and technology intervention scenarios by developing a power grid model of 52 nodes and 68 transmission lines operating at an hourly time step. The model incorporates a grid-connected hydrogen storage system as well as charging stations for electric and hydrogen vehicles. The least-costly pathways for power grid expansion at the nodal and provincial levels are identified as a result of optimization. The operational behavior of hydrogen and its system interaction with different hydropower types is critically evaluated through sensitivity analysis on hydrogen system cost. The simulation results show that the optimum utilization of untapped hydro resources is capable of both fulfilling electricity demand and decarbonizing the transport sector. Massive exploitation of storage-based hydropower projects of western Nepal is reasonable only in export-oriented scenarios. For certain electricity demand, introducing hydrogen systems can reduce the capacity requirements of hydro storage by storing surplus power generated from pondage run-of-the-river and run-of-the-river hydropower during the rainy season and using it in the dry season.

Assessing green energy growth in Nepal with a hydropower-hydrogen integrated power grid model

Khem Gyanwali, D.Eng.
Assistant Professor
Department of Automobile and Mechanical engineering
Thapathali Campus

February 26, 2022

Contents

Declaration: The map used throughout this document is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

2

1. Introduction

Background

- The government of Nepal has anticipated rapid electricity demand growth in near future (Fig. 1).
- Potential to penetrate electric & hydrogen vehicles and power exports to neighboring countries will also eventually increase the electricity demand.
- Demand centers are unevenly distributed and the cost of available hydro resources as well as their operational characteristics also varies significantly.

Issues to address

- Identify the most cost-optimal spatial power system growth under various technology intervention scenarios.
- Evaluate what share of storage-based projects is necessary to cope seasonal variations and load balancing.
- Assess how emerging technologies (e.g., hydrogen) contribute to enhancing energy security as well as interact with hydro resources.

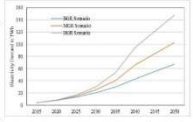


Fig. 1: Electricity demand forecast of Nepal [1]

[1] Electricity demand forecast by Water and Energy Commission Secretariat (WECS), Nepal

3

1. Introduction

Literature review

Paper	Contribution
[2]	Assessed clean energy deployment opportunity in Nepal using a single region model with special focus on the operational benefits of three different types of hydropower.
[3]	Incorporated electric vehicle within a dynamic optimal power generation mix model and performed scenario analysis on Japanese energy system.
[4]	Highlighted the prospect of hydrogen production from surplus water resources which otherwise would have been curtailed and its use in different sectors of Nepal.

Originality of the research

Model analysis

- Power grid model incorporating hydrogen energy storage system along with electric and hydrogen charging stations.

Energy system analysis

- Identified the cost-optimal technology and generation mix for different regions of Nepal under various technology intervention and power export scenarios.
- Evaluated the role of green hydrogen in energy storage and its interaction with different types of hydropower

[2] Gyanwali K, et al. "Representing hydropower in the dynamic power sector model and assessing clean energy deployment in the power generation mix of Nepal". Energy 2020;202:117793.
[3] Komiyama R, et al. "Modeling Analysis of Electric Vehicle Penetration Scenarios using Dynamic Optimal Power Generation Mix Model with High Temporal Resolution". Electr Eng Japan 2017; 199:3–16.
[4] Asian Development Bank. "A study on the Prospect of Hydropower To Hydrogen in Nepal" 2020.

4

2. Power grid model of Nepal

Model Structure | Model characteristics | Improvements

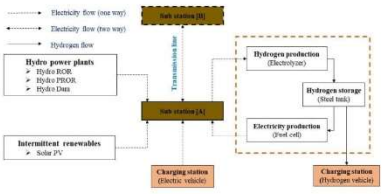


Fig. 2: Basic framework of the model

5

2. Power grid model of Nepal

Model structure | **Model characteristics** | Improvements

General logic

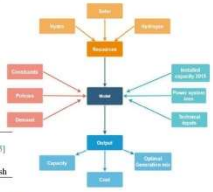
- Represented energies: Electricity
- Computational method: Linear programming
- Minimization of Net present value (NPV)
- Considers unit construction and O & M costs.

Temporal characteristics

- Study period: 2020 – 2050
- Calculation points: 2020, 2030, 2040, 2050
- Time step: Hourly

Features

- Original grid: 67 substation and 83 transmission lines [5]
- Developed grid: 52 nodes and 61 transmission lines
- Considers 6 cross border lines with India and Bangladesh



[5] Transmission development master plan, RPGCL, 2018

Fig. 3: A illustrative figure explaining the structure of the model

6

2. Power grid model of Nepal

Model structure | Model characteristics | **Improvements**

Estimated daily availability factor of each hydropower type using historical river inflows [6] for each node.

- For hydro ROR and hydro PROR, Q45 was taken as the design discharge
- For hydro dam Q25 was taken

Estimation of daily availability factor

$$af_{n,d} = \begin{cases} \frac{Q}{Q_d}, if \ \frac{Q}{Q_d} < 1 \\ 1, if \ \frac{Q}{Q_d} \geq 1 \end{cases} \quad (1)$$

$af_{n,d}$	Daily availability factor of hydropower in each node	
Q	Daily river inflow	[m³/s]
Q_d	Design discharge	[m³/s]

[6] Source: Department of hydrology and meteorology

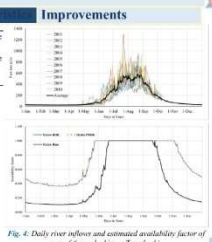


Fig. 4: Daily river inflows and estimated availability factor of one of the node, Upper Tamakoshi.

7

2. Power grid model of Nepal

Model structure | Model characteristics | **Improvements**

Electricity supply and balance

$$load_{n,t,s} + ire_{n,t,s} = \sum_{m=1}^{n} X_{n,m,t,s} + \sum_{m=1}^{n} cm_{n,m} \times (Xl_{n,t,s} - Xl_{n,t,r}) \quad (2)$$
$$= (Xe_{n,t,s} \times \frac{1}{\eta_{ed}}) - Xl_{n,t,r}$$

$$\sum_{i=1}^{10} ire_{i,t,d,s} \geq evload_{t,s,s} \quad (3)$$

$load_{n,t,s}$	Grid demand	[GW]
$hre_{n,t,s}$	Hourly optimized load of battery electric vehicle	[GW]
$X_{n,t,s,m}$	Power output from power plants	[GW]
$Xl_{n,t,s}$	Power transmission losses	[GW]
$Xf_{n,t,s}$	Power flow (forward direction)	[GW]
$Xb_{n,t,s}$	Power flow (backward direction)	[GW]
η_{ed}	Conversion efficiency of electrolyzer	-
$cm_{n,m}$	Conversion efficiency of electrolyzer	-
$evload_{t,s,s}$	Daily load of battery operated electric vehicle	[GWh]

Hydrogen demand and supply balance

$$Xe_{n,t,s} = \sum_{m=1}^{n} X_{n,t,s,m} \quad (4)$$

$$\frac{1}{\eta_{ec}} \times X_{n,t,s,1} + Lhv_{n,t,s} = Xd_{n,t,s} \quad (5)$$

$$\sum_{i=1}^{10} Lhv_{i,t,s} = hvloaid_{t,s,s} \quad (6)$$

$Xe_{n,t,s}$	Power absorbed by storage technology	[GW]
$X_{n,t,s,m}$	Power output from electrolyzer	[GW]
$X_{n,t,s}$	Power output from fuel cell	[GW]
$Xd_{n,t,s}$	Power discharged from storage technology	[GW]
$Lhv_{n,t,s,s}$	Hourly load of fuel cell vehicle	[GW]
η_{ec}	Conversion efficiency of fuel cell	-
$hvloaid_{t,s,s}$	Daily load of fuel cell vehicle	[GWh]

8

3. Model input

Resource availability | Demand | Scenario design

- Existing and potential hydropower projects [5] are connected to each node.
- 68 major transmission lines considered taking master plan as a reference.
- Maximum potential of 12.8 GW (ROR), 13.3 GW (PROR) and 28.6 GW (Dam) and 20 GW (Solar PV) is taken.
- Hourly capacity factor of solar PV is extracted from [7] taking 20% system losses.

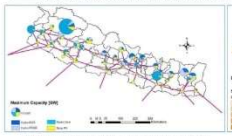


Fig. 5: Assumption on maximum potential of nodes in 2050

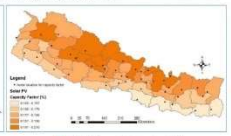


Fig. 6: Nodal capacity factor of solar PV

[5] Transmission development master plan, RPGCL, 2018
[7] www.renewableninja.com

9

3. Model input

Resource availability | **Demand** | Scenario design

- Load curve of only 9 substations were obtained from Load Dispatch Center, NEA.
- The demand profile of other nodes was categorized based on obtained data.
- The load curve is supposed to retain its shape and future demand is taken as per the demand projection in Ref. [5].

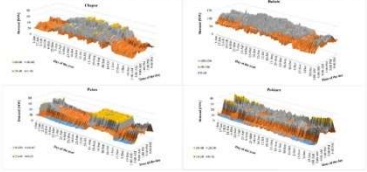


Fig. 7: Hourly demand profile of Chapur, Dhading, Patan and Pokhara respectively.

10

3. Model input

Resource availability | Demand | **Scenario design**

- The demand projection made by the government of Nepal [6] under high growth rate scenario was taken as a reference transport sector demand.
- The energy demand for each node was estimated using the current vehicle number operating at each zone and districts [8].
- The electricity equivalent transport sector demand was estimated using the following conversion factor [9] [10].
  1 PJ fossil fuel demand is equivalent to (278 X 0.36) GWh electric vehicle demand.
  1 PJ fossil fuel demand is equivalent to (278 X 0.65) GWh hydrogen vehicle demand.

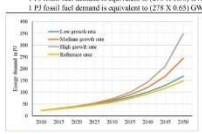


Fig. 8: Energy demand projection in transport sector

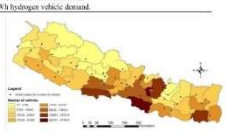


Fig. 9: Spatial distribution of number of vehicles in 2020.

11

3. Model input

Resource availability | Demand | **Scenario design**

- Four different electricity demand and technology intervention scenarios were developed.
- The technology intervention is assumed to reach 30%, 60% and 100% by 2030, 2040 and 2050 respectively.

Scenario design

Scenarios	Domestic demand	BEV share	FCV share	Export
A	√	-	-	-
B	√	100%	-	-
C	√	50%	50%	-
D	√	50%	50%	√

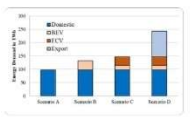


Fig. 10: Electricity demand by 2050 under four different scenarios

- Simulation was carried out using the computation facility of Fujii-Komiyama laboratory, The University of Tokyo.
- Each scenario took about 51 hours to solve 163 million constraints and 34.3 million variables and get the optimal solution

12

4. Result and discussions

- Optimal capacity mix in 2050 reaches up to 81.72 GW, 105.8 GW, 143.5 GW and 199.2 GW under scenarios A, B, C and D respectively.
- The capacity and generation mix are mainly hydro dominated with small share of hydro dam as long as cheaper hydro ROR and hydro PROR are available.
- Large scale exploitation of hydro dam is observed only in the export-oriented scenarios.
- The share of electrolyzer and hydrogen tank in scenario C and D is observed to facilitate charging of hydrogen vehicle.

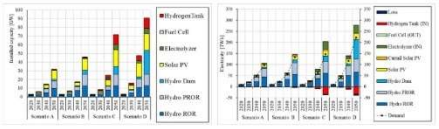


Fig. 11: Optimal growth of capacity mix and generation mix under four different scenarios

13

4. Result and discussions

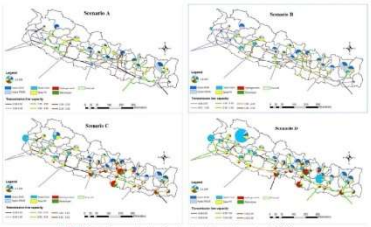


Fig. 12: Optimal capacity mix of each node under each scenarios in 2050.

14

4. Result and discussions

- Province 1 is seen to be self-sufficient to fulfill its domestic demand with limited supply capacity.
- Province 2, and Lumbini being resource deficit regions and load centers should rely on other provinces.
- Gandaki, Karnali and Sudurpaschim provinces act as major supply centers while some provinces also act as a connecting node.

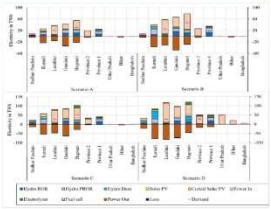


Fig. 13: Optimal generation mix of seven provinces of Nepal and power flow between nearby nodes in 2050.

15

4. Result and discussions

- Uttar Pradesh receives 580 TWh from Lumbini and 398 TWh from Sudurpaschim, Province 1 supplies 174 TWh electricity to Bihar and 120 TWh to Bangladesh while 239 TWh is evacuated from Province 2 for supply to Bihar.
- Bagmati receives 593 TWh power from Gandaki and supplies 683 TWh power to Province 2.
- Lumbini receives 896 TWh power from Karnali

The names of the nodes is written outside the circle. The three bars (%) mix refers to the outflow, inflow and their differences from the outermost to innermost circle, respectively. The color of the arc refers to the total outgoing and incoming electricity to that specific node. The flow band refers to the amount of power exchange between the nodes.

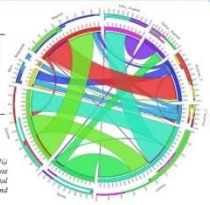


Fig. 14: Cumulative electricity flow (2020-2050) between the nodes (TWh) of seven provinces of Nepal and nearby nodes under scenario D

16

4. Result and discussions

- Sensitivity analysis on hydrogen system costs was carried out under 50% and 90% cost reduction scenarios.
- The simulation results show that hydrogen storage systems can replace hydro dam when hydrogen system cost reduces drastically.
- Similarly, the power curtailed during the wet season from hydro ROR, hydro PROR and solar PV can be stored in hydrogen tank and used during the dry season.
- The role of fuel cell becomes significant only in cost reduction scenarios.

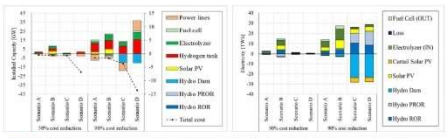


Fig. 15: Changes in capacity mix and generation mix in 2050 under four different scenarios when hydrogen system cost reduces by 90%

17

4. Result and discussions

- The simulation results show that the amount of stored hydrogen in hydrogen tank increases during the wet season and gradually gets discharged during dry season (Fig. 16).
- The smooth curve of storage profile in scenario C and D compared to scenarios A and B is due to the use of hydrogen in vehicles.

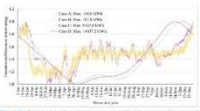


Fig. 16: Optimal hydrogen storage profile of steel tank under four different scenarios when hydrogen system costs reduces by 90%.

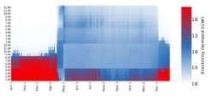


Fig. 17: Optimal charging profile of FCV under scenario C when hydrogen system costs reduces by 90%.

- The simulation results show that the most suitable time for charging hydrogen is during off-peak hours i.e., 1 am to 8 am (Fig. 17).
- But during the wet season, hydrogen can be optimally charged throughout the day.

18

5. Conclusion and policy recommendations

- A power grid model for Nepal was successfully developed incorporating hydrogen energy storage systems and charging stations for electric and hydrogen vehicles.
- Exploitation of available ROR and PROR hydropower potential seems to be a cost-optimal strategy, but a small share of hydro dam is always necessary to deal with seasonality in power generation.
- Construction of large storage-based hydropower projects is necessary for export-oriented scenarios, but it should be critically assessed with potential environmental hazards.
- Deployment of hydrogen systems in large scale requires significant reductions in its cost. In such case, hydrogen can replace hydro dam as well as it can reduce power curtailment from ROR and PROR plants during wet seasons.

19

Thank you!

Paper Presentation 2: Row Housings in Nepal and Their Potentials to Pounding

Bikesh Sedhain, Kshitij C. Shrestha, Aarosh Dahal, Aashish Pokhrel, Aayush Maan Karki, Binu Devkota, Tunisha Gyawali

Department of Civil Engineering, Pulchowk Campus, Institute of Engineering, Tribhuwan University

Nepal sits atop the actively convergent boundary of Indo-Australian and Eurasian plates. As a result, Nepal has been subjected to numerous high magnitude earthquakes in the past. Despite the grave consequences of the 2015 Gorkha earthquake, the pounding effect observed in the Kathmandu valley was less than anticipated, while taking into account the rampant unprofessional building practices. Higher predominant time period and low peak ground acceleration (PGA) of the earthquake have been accredited as the reasons for the same (Goda et al., 2015). This has further bolstered people's faith in the accustomed building practices with new buildings being constructed without provisions of separation gaps for minimizing pounding effects, hence, increasing risk susceptibility should higher PGA and lower period earthquakes corresponding to most buildings in Kathmandu occur in the future. Major earthquakes around the world (Loma Prieta, Kobe, etc.) bear witness to the severity of the damage that can result if the aforementioned issues go unchecked (Kasai & Maison, 1997; Otsuka et al., 1996; Cole et al., 2012). This study aims to focus on the degree of pounding due to the Gorkha Earthquake and its comparison with that of other earthquakes namely Kobe, Loma Prieta and El Centro earthquake.

Row housings in Nepal and their potentials to pounding

Bikesh Sedhain, Kshitij C. Shrestha, Aarosh Dahal, Aashish_Pokhrel, Aayush M. Karki,, Binu Devkota, Tunisha Gyawali

Department of Civil Engineering, Pulchowk Campus, Institute of Engineering, Tribhuvan University

13th NEAJ Annual Symposium 2022

Pounding Damage in Nepal

- In Gorkha Earthquake, basin amplification in the KTM valley resulted in higher time period, so pounding was mostly observed in *high rise buildings*(around 10 storey building).
- Due to less number of high rise buildings, instances of pounding damages were also few.

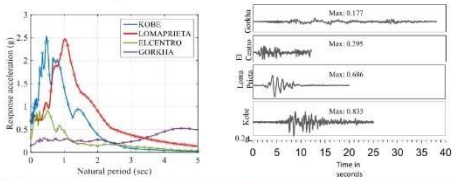
But we were ***fortunate***. What if large number of high rise buildings were constructed?

Peak Ground Acceleration (PGAs)	Dominant Time Period (sec)
0.158g	4.55 (E-W)
0.164g	0.43 and 4.85 (N-S)
0.186g	0.08 (U-D)

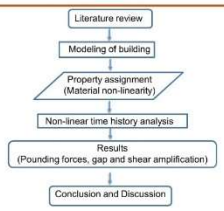
Fig: Pounding damage a) at same level and b) at top floor and c) between two beams (Shrestha et.al, 2018)

Response Spectrum and Time history

- Will row houses and high rise buildings in Nepal be able to sustain this damage should other earthquakes occur?



Methodology



Material Characterization

Material Properties

Materials	Strength Parameters	Material Model(s)
Concrete	• Grade = M30 • Elastic Modulus = 27,386 MPa • Peak compressive stress of 30MPa at a strain of 0.002191	• Mander's unlaxial material model • Takeda hysteresis model
Steel Rebars	• Yield Stress = 415 MPa • Elastic Modulus = 200 Gpa • 0.02 strain at onset of strain hardening and 0.12 ultimate strain	• Kinematic hysteresis model

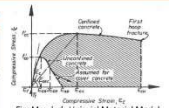


Fig: Mander's Unlaxial Material Model

Element Properties

Element	Property
Frame (Column and Beams)	2 nodes, (line)
Shell (Slab)	4 nodes (plane)

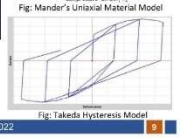


Fig: Takeda Hysteresis Model

FE Model and Selected Earthquakes

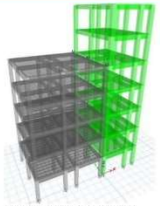


Fig: Finite Element Model in ETABS

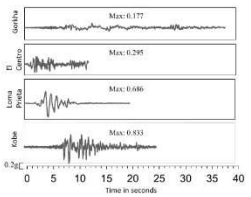


Fig: Acceleration Time Histories of Earthquakes Studied

Pounding

- *Impulse due to the transfer of momentum* when adjacent buildings collide during an earthquake due to the difference in time periods and drift.
- Seismic gap as per probability of occurrence of design earthquake over the lifespan for economic design
- *Essence of Seperation Gap*
  - Eliminate pounding at different levels
  - Safer and economical building design

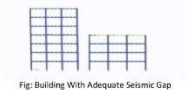


Fig: Building With Adequate Seismic Gap

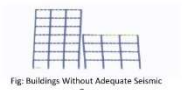


Fig: Buildings Without Adequate Seismic Gap

Fig: Building Behavior During Pounding

Practice of Row Housing

- Lower damage of the Gorkha earthquake has further bolstered ***people's faith*** in accustomed building practices including construction of row housing.

Fig: Row housing in Sankata, Kathmandu

Fig: Newly constructed building without separation gap

Objectives

Assess the potential of pounding damage in row houses for different earthquakes' scenario.

Specific Objectives:

- To evaluate the variation of link force with separation of the buildings.
- To suggest seismic gap for zero pounding force for considered earthquakes.
- To evaluate the variation of seismic gap requirement with different *PGA's* of Gorkha earthquake
- To observe the storey shear amplification caused due to Gorkha earthquake.
- To compare the case specific seismic gap requirement obtained from FEM(ETABS) with codal provision.

Adopted Representative Building Models

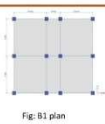


Fig: B1 plan

Fig: B1 3D view

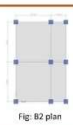


Fig: B2 plan

Fig: B2 3D view

Building Design Data (As per IS code)						
Buildings	Layout Dimension (m)	No. of Storey	Slab Thickness (mm)	Beam Dimension (mm)	Column Dimensions (mm)	Natural Time Period (sec.)	Remarks
B1	8.5*8	5	135	300*450	400*400	0.854	Storey height = 3m
B2	5*8	7	135	400*500 (upto 3rd floor) 300*450 (4th to 7th floor)	450*450	0.754	

Adopted Nonlinear Modelling Strategies

Non-Linear Properties

Column Hinges:
- Fiber P-M2-M3 hinge
- Dimension- 0.1 of element length at each end

Beam Hinges:
M3 hinge
At each end

Link Element:
- Non-linear gap element
- Governing equation:

$$f = \begin{cases} k(d - open) & if\ (d - open) < 0 \\ 0 & otherwise \end{cases}$$

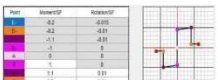


Fig: Backbone Curve for Plastic (M3) Hinge (Table 10-7 in ASEC 41-17)

where,
d = relative displacement of adjacent joints
open = separation between joints
k = stiffness of gap element
$= \frac{K_1 * K_2}{K_1 + K_2}$ (Masmoum, M. S., & Alama, M. S. (2018))
K_1, K_2 = story stiffness of adjacent stories

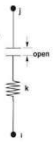
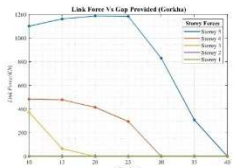
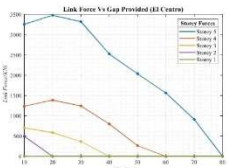


Fig: Schematic Diagram of Gap Element

Results: Link force Vs Gap Provided

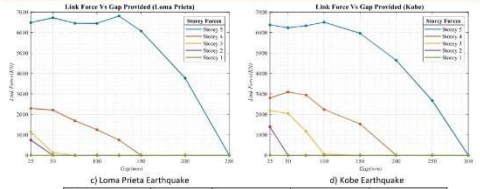


a) Gorkha Earthquake



b) El Centro Earthquake

Results: Link force Vs Gap Provided



c) Loma Prieta Earthquake d) Kobe Earthquake

Earthquakes	Gorkha	El Centro	Loma Prieta	Kobe
Seismic Gap (mm)	40	80	250	300

Result: Shear Amplification Factor for Gorkha Earthquake

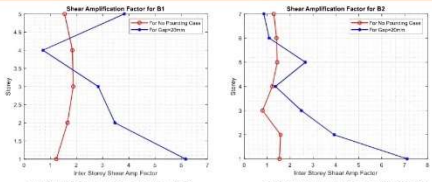


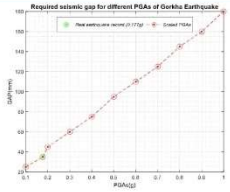
Fig: Storey Shear amplification factor for B1 Fig: Storey Shear amplification factor for B2

$$Shear\ Amplification\ Factor = \frac{Storey\ Shear\ from\ Time\ History\ Analysis}{Storey\ Shear\ from\ Response\ Spectrum\ Analysis}$$

References

1. Jankowski, R., & Mahmoud, S. (2015). *Earthquake-induced structural pounding*. Springer International Publishing.
2. Shrestha, B., & Hao, H. (2018). Building Pounding Damages Observed during the 2015 Gorkha Earthquake. Journal Of Performance Of Constructed Facilities, 32(2), 04018006. doi: 10.1061/(asce)cf.1943-5509.0001134.
3. CSI (2017). Analysis Reference Manual. Computers and Structures Inc., USA.
4. Mander et al. (1988). Theoretical stress-strain model for confined concrete. J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804–1826.
5. Ministry of Urban Development. Seismic Design of Buildings in Nepal (NBC: 105: 2020): Ministry of Urban Development: Kathmandu, Nepal, 2077
6. ACI Committee 318 (2019) Building code requirements for structural concrete (ACI 318-08) and commentary. American Concrete Institute.
7. Masmoum, M. S., & Alama, M. S. (2018). Required separation to mitigate pounding of adjacent building blocks. *Engineering, Technology & Applied Science Research*, *8*(6), 3565–3569. https://doi.org/10.48084/etasr.2386

Results: Seismic gap for different PGAs



Gap Required:

- $NBC\ 105{:}2020$
  $R_1 * \Delta_1 + R_2 * \Delta_2$
  = **198.724 mm**
- $IS\ 1893(Part\ 1){:}2016$:
  $R_1 * \Delta_1 + R_2 * \Delta_2$;
  R = *Response Reduction factor*
  = **248.405 mm**

Fig: Required seismic gap for different PGAs of the Gorkha Earthquake

Conclusion and Discussion

- Codal provision in NBC and IS suffices the seismic gap requirement for the case of Gorkha and El_centro Earthquakes but is insufficient for the other two considered earthquakes.
- Story shear is significantly amplified by pounding making it necessary to control pounding. For this if possible sufficient gaps should be provided otherwise alternative mitigating measures have to be applied i.e. increasing stiffness of building using shear walls,bracing,etc.
- A potential motivation towards similar studies on pounding in other urban settlements of Nepal for repair and maintenance of vast existing building stocks.
- Awareness on the severity of pounding damage that may result if the current rampant building practice continues.

Limitations of research

- *Soil structure interaction* was not taken into account.
- *Stiffness of infill wall* was also not considered.
- Analysis of only one specific case limits the generalization of results.

THANK YOU!

Dr. Kshitij C. Shrestha

Aarosh Dahal

Aashish Pokhrel

Aayush M. Karki

Bikesh Sedhain

Binu Devkota

Tunisha Gyawali

Paper Presentation 3: The Role of Novel Distributed Fiber Optic Sensing for Landslide Monitoring

Ashis Acharya

Department of Geoscience, Shimane University, 1060 Nishikawatsu-cho, Matsue, Shimane 690-8504, Japan

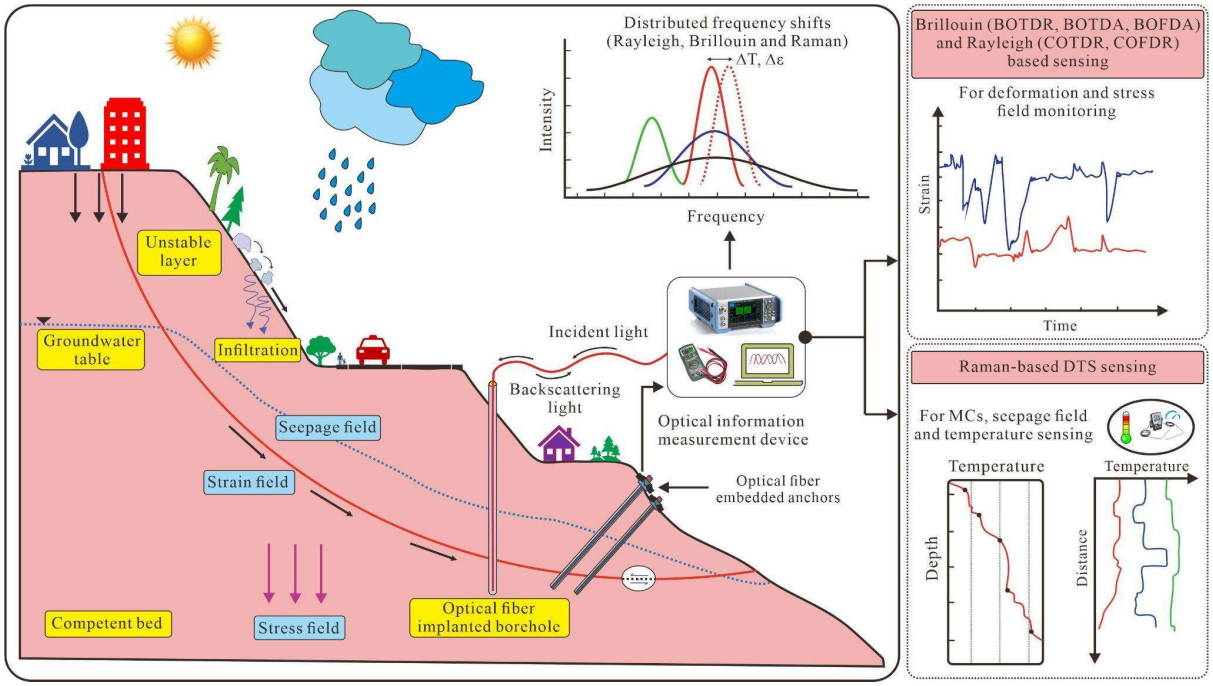
Landslides are one of the most frequent and catastrophic natural phenomena that affect the topography of the Earth's surface, water quality as well as innumerable loss of human life and habitat globally. Landslides can occur at a variety of rates, from almost imperceptibly slow (mm/year) to almost incomprehensibly rapid (up to hundreds of km/hr), therefore determining their dynamics is critical to reducing the overall impact on the ecosystem. The landslide study and analysis are in a period of exponential growth, concentrating mainly on techniques and solutions for the stabilizing, preventing, and categorizing the most vulnerable. Among the several landslide risk mitigation strategies, the early warning system is the most cost-effective and allows for better planning of mitigation measures for rapid landslides. For many decades, several conventional and novel technologies have been applied in surface and sub-surface slope monitoring such as; remote sensing, geographic information systems, acoustic emission, microseismic, inclinometers and so on. All of these techniques have their own set of benefits and drawbacks, but the fiber-optic (FO) system has a distinct advantage over them.

For the past 20 years, various FO sensing technology has developed rapidly in monitoring structural health, geo-hazard assessment, industrial engineering, and environment. However, distributed fiber optic sensing (DFOS) techniques have developed expeditiously over the recent decades in multiple technical fields including slope engineering as they furnish a number of advantages over conventional landslide monitoring approaches. Moreover, DFOS can operate as a "Nervous System" for slopes by sensing the tensile strain of the soil/rock they're embedded in.

The FO cables can be embedded in a shallow trench or buried in a borehole in order to detect precursory signs of failure well before the collapse. By measuring the sent and backscattered light, the FO system detects mass movement that occurs from changes on the cable, so that the early warning measurements can be done. In the time or frequency domain, DFOS probes Rayleigh, Raman, or Brillouin scattering for the measurement of parameters such as temperature, stress, strain, and other acoustic properties. This sensing technology has been widely used due to a range of unique benefits over conventional geotechnical sensors, including

small size, high sensitivity, long-term durability, long-distance, real-time monitoring, cost-effectiveness, compatibility, and resistibility.

In this presentation, fundamentals of an optical fiber will be briefly discussed, followed by the compendious explanation of the sensing principle of various DFOS techniques (Rayleigh, Brillouin, and Raman backscattering). The recent developments on the applications of DFOS on slope stability assessment, including strain, stress, and temperature field monitoring will be discussed in great detail prospecting the possibility of the implementation of this techniques in the fragile geology of Nepal Himalaya. Ultimately, some challenges associated with DFOS sensing and prospects of future development will be discussed.



Paper Presentation 4: Disaster Risk Management on Educational Institutes and its Role for Emergency Response Toward the Local Community

Ram Shrestha[1], Lata shakya[2]

[1]*Southwest Jiaotong University,* [2]*Ritsumeikan University*

A disaster, including natural or human made is an event that occurs unexpectedly and consequence the serious destruction. It impacts people's life and mostly mental health and education attainment/achievement of children. The nee of disaster risk management focused on children and its learning environment is essential. The educational institutions are the major actor for the activities to play the great role towards it. On the other hand, since educational institutes are used as evacuation shelters by the local people during the disaster, educational institutes are very essential facility for neighborhood area. Nepal government has developed many policies related to disaster risk management from province level to local government level after 2015 Gorkha earthquake.

In this paper, firstly, we clarified what kinds of policies are made related to DRM of educational institutions through literature review. Then we examined how much these policies are acknowledged by educational institutes, through literature review. Then we examined how much these polices are acknowledged by educational institutes through the field survey including interview survey on three educational institutes. We found the lack of awareness, lack of information flow, and several issues towards the implementation of the policies.

Disaster Risk Management on Educational Institutes and its Role for Emergency Response toward the Local Community

Author :-
*Presenter : **Ar. Ram Shrestha***
(PhD scholar Student from Southwest Jiaotong University, and lecturer (Part time)of Thapathali Campus)
Dr. Lata Shakya
(Associate professor at Institute of Disaster Mitigation for Urban Cultural Heritage (DMUCH), Ritsumeikan University)

Disaster Risk Management on Educational Institutes and its Role for Emergency Response toward the Local Community

Abstract: A disaster, including natural or human made is an event that occurs unexpectedly and consequence the serious destruction. It impacts people's life and mostly mental health and education attainment/achievement of children. The nee of disaster risk management focused on children and its learning environment is essential. The educational institutions are the major actor for the activities to play the great role towards it. On the other hand, since educational institutes are used as evacuation shelters by the local people during the disaster, educational institutes are very essential facility for neighborhood area. Nepal government has developed many policies related to disaster risk management from province level to local government level after 2015 Gorkha earthquake.

In this paper, firstly, we clarified what kinds of policies are made related to DRM of educational institutions through literature review. Then we examined how much these policies are acknowledged by educational institutes, through literature review. Then we examined how much these polices are acknowledged by educational institutes through the field survey including interview survey on three educational institutes. We found the lack of awareness, lack of information flow, and several issues towards the implementation of the policies.

Keywords: Disaster Risk, Management, Local Government, COVID-19, school

1.1 Background

According to the Post Disaster Need Assessment Report (NPC, 2015),

Indicator	Total student
Student studying	334,000.00
Lost classroom	137,000.00
Minor damage	260000
Student Killed	337

- Due to natural disasters, per day at **least two** people lose their life in Nepal on an average. The record of lost lives due to various types of disasters in Nepal in the last 25 years (MoHA, 2018).

Presentation Outline

Content

1. Introduction

Disaster? "Sudden or great misfortune" or "simply "any unfortunate event" → "an event whose timing is unexpected" → **Consequences are seriously Destructive**

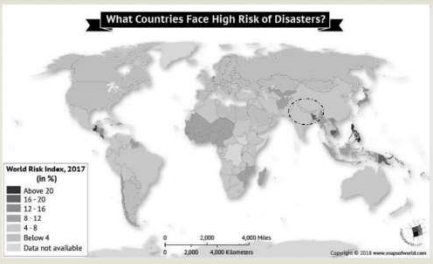
1.2 Research Question

How to respond by school after disaster?
What kind of preparation should the school do?
Who should do what after disaster?
What kind of role could done by toward local community?

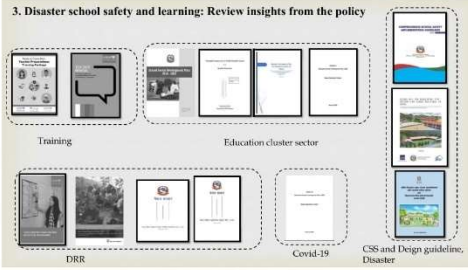
1.3 Scope and Purpose
The limitation of this study is base on collected document only and survey.

2. Research Methodology

-reviewing related document, field survey: interview, case study



3. Disaster school safety and learning: Review insights from the policy



Disaster school safety and learning: Review insights from the policy

3.1 Disaster Risk Management on Educational Institutes

What is Supplementary Training Manual on Annual SIP Updating and Reference Materials for disaster Preparedness in School Mission 2072

Contents
- Annual School improvement planning
- School disaster preparation equipment

Sample Design Disaster response Plan

Disaster school safety and learning: Review insights from the policy

What is Guidelines for Developing type designs for school Buildings in Nepal

Published -2073-The Government of Nepal Ministry of Education Science and Technology, Singhadurbar

Contents
1. Identification of the Needs to met
2. Architectural and Space Planning Requirements
3. Integrated DR and ES Considerations
4. Child, gender and differently-able (CGD) friendly consideration
5. Material and Construction Technology Considerations
6. Structural Design Considerations
7. Site Infrastructure and landscape Design Considerations
8. Basic landscape design Considerations
9. Climate smart design Considerations

Disaster school safety and learning: Review insights from the policy

1. Identification of the Needs to met
- Design student Number
- Classroom Size
- School size Categories

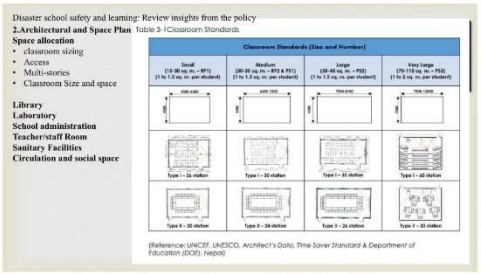
Room Size Categories

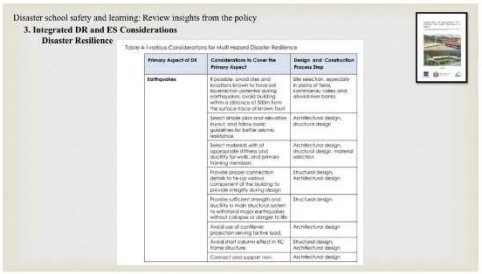
Room Type	Number of Students			Suitable For Grades	Nominal Area (Sq. M)
	Design	Minimum	Maximum		
RP1	12	5	15	G 1-5	12
RP2	25	20	30	G 1-5	25
RP3	40	30	45	G 1-5	40
RS1	25	20	35	G 6-12	35
RS2	40	30	45	G 6-12	45
RS3	60	40	70	G 6-12	70

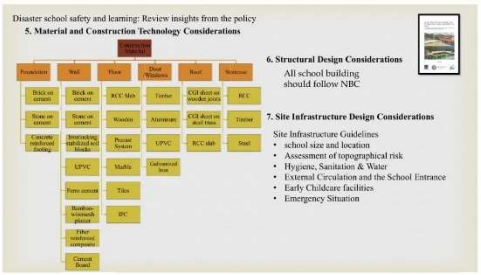
RP1 = Room for Primary Schools- Type-1
RP2 = Room for Primary Schools-Type-2
RP3 = Room for Primary Schools-Type-3
RS1 = Room for Secondary School- Type-1
RS2 = Room for Secondary School- Type-2
RS3 = Room for Secondary School- Type-3

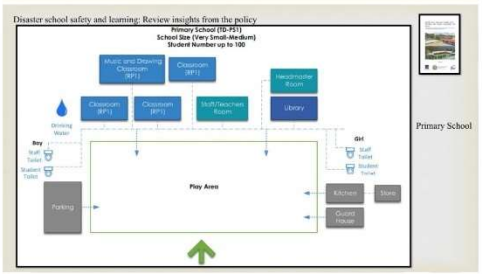
Table 2-2 School Type and Room Size Combination

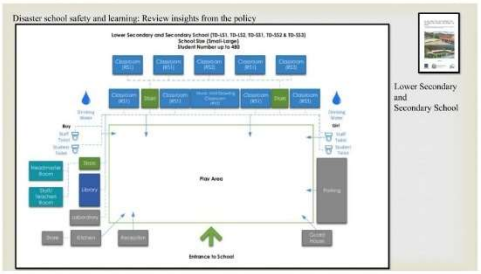
School Type	Type Code	Design Student Nos.	Number		Possible Room Combination	Provided Student Capacity
			Grade	Rooms		
Primary-1	T0-PS1	40	5	5	4RP1	40
Primary-2	T0-PS2	90	5	4	4RP2	100
Lower Secondary-1	T0-LS1	140	8	8	8RS1	200
Lower Secondary-2	T0-LS2	220	8	8	4RS1+2RS2+2RS3	320
Secondary-1	T0-SS1	280	10	10	6RS1+2RS2+2RS3	350
Secondary-2	T0-SS2	360	10	10	4RS1+3RS2+3RS3	430
Secondary-3	T0-SS3	480	10	14	6RS1+4RS2+4RS3	550
Higher Secondary-1	T0-HS1	400	12	12	4RS1+6RS2+6RS3	500
Higher Secondary-2	T0-HS2	630	12	16	6RS1+5RS2+5RS3	650

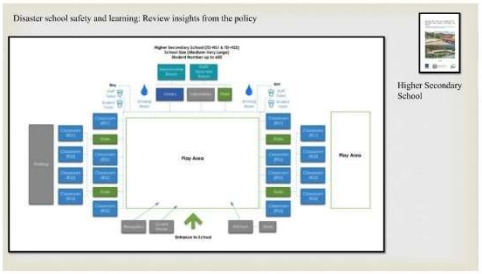

Disaster school safety and learning: Review insights from the policy
2.Architectural and Space Plan Table 3-1Classroom Standards
Space allocation
• classroom sizing
• Access
• Multi-stories
• Classroom Size and space
Library
Laboratory
School administration
Teacher/staff Room
Sanitary Facilities
Circulation and social space
Classroom Standards (Size and Number)

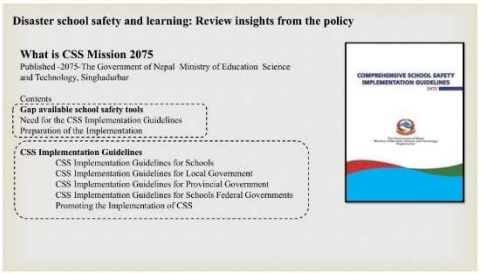

Disaster school safety and learning: Review insights from the policy
3. Integrated DR and ES Considerations
Disaster Resilience

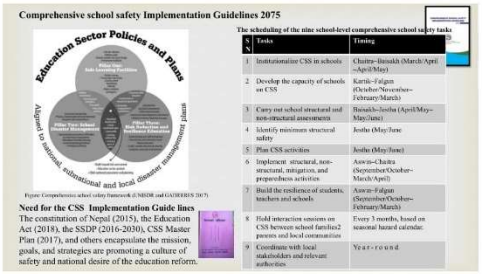

Disaster school safety and learning: Review insights from the policy
5. Material and Construction Technology Considerations
6. Structural Design Considerations
All school building should follow NBC
7. Site Infrastructure Design Considerations
Site Infrastructure Guidelines
• school size and location
• Assessment of topographical risk
• Hygiene, Sanitation & Water
• External Circulation and the School Entrance
• Early Childcare facilities
• Emergency Situation

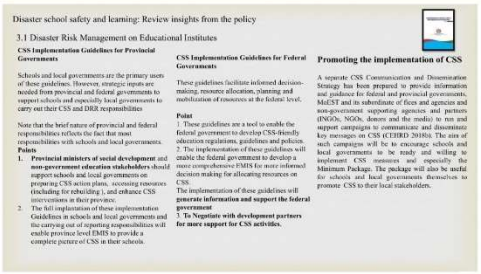

Disaster school safety and learning: Review insights from the policy
Primary School (TD-PS1)
School Size (Very Small-Medium)
Student Number up to 100
Primary School

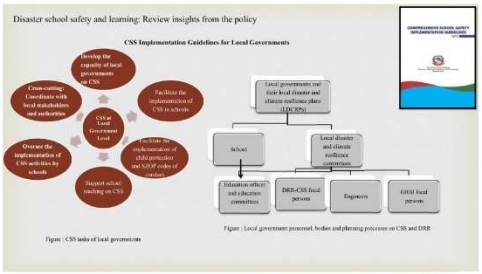

Disaster school safety and learning: Review insights from the policy
Lower Secondary and Secondary School


Disaster school safety and learning: Review insights from the policy
Higher Secondary School

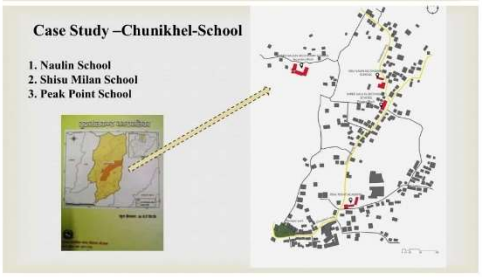

Disaster school safety and learning: Review insights from the policy
What is CSS Mission 2075
Published -2075- The Government of Nepal Ministry of Education Science and Technology, Singhadurbar
Contents
Gap available school safety tools
Need for the CSS Implementation Guidelines
Preparation of the Implementation
CSS Implementation Guidelines
CSS Implementation Guidelines for Schools
CSS Implementation Guidelines for Local Government
CSS Implementation Guidelines for Provincial Government
CSS Implementation Guidelines for Schools Federal Governments
Promoting the Implementation of CSS

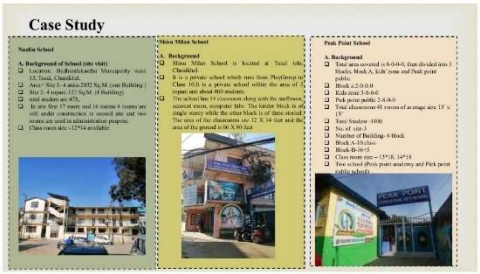

Comprehensive school safety Implementation Guidelines 2075
Education Sector Policies and Plans
The scheduling of the nine school-level comprehensive school safety tasks
Need for the CSS Implementation Guide lines

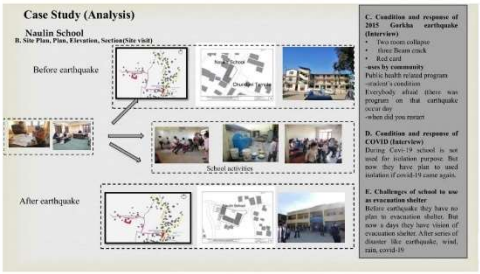

Disaster school safety and learning: Review insights from the policy
3.1 Disaster Risk Management on Educational Institutes
CSS Implementation Guidelines for Provincial Governments
CSS Implementation Guidelines for Federal Governments
Promoting the implementation of CSS

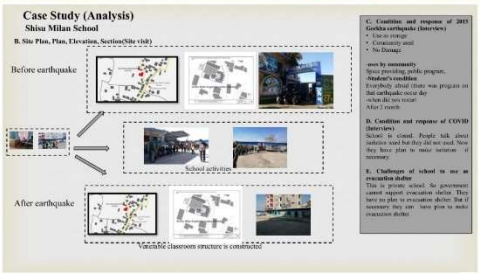

Disaster school safety and learning: Review insights from the policy
CSS Implementation Guidelines for Local Governments
Figure : CSS tasks of local governments
Figure : Local government personnel, bodies and planning processes on CSS and DRR

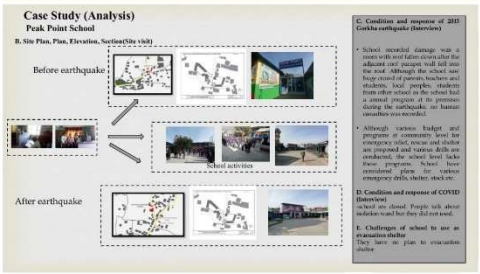

Case Study
Nepal map
Municipality ward boundary map
Ward No. 13 Map
Chunikhel Google map


Case Study –Chunikhel-School
1. Naulin School
2. Shisu Milan School
3. Peak Point School

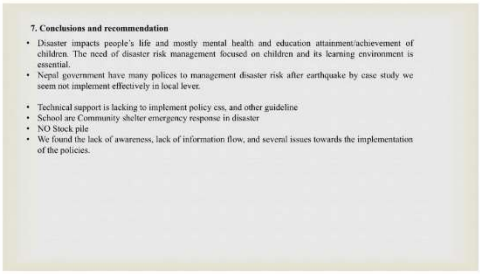








SN	Indicator	Comparison Chart		
		School		
		Naulin School	Shisu Milan School	Peak Point
	School Site	Two Sites	one sites	three sites
	Government Private	Government	Private	Private
	Student	671	401	1002
	Building Type	RCC	RCC+ Tahara	RCC+ Tahara
	Damage Building	three crack in beam, stair case crack, red card after earthquake	No crack(rent Building)	No crack
	After Earthquake	No used	store used	storage
	Disaster earthquake plan	No documented plan only if necessary they will plan	No documented plan only if necessary they will plan	No documented plan only if necessary they will plan
	DRR awareness	No	No	No
	National DRR policy awareness	Not sufficient	Not sufficient	Not sufficient
	Challenges of school to use as Evacuation shelter	Before earthquake they have no plan to evacuation shelter. (old,/new building) But now a days they have vision of evacuation shelter. After series of disaster like earthquake, wind, rain, covid-19.	no plan. They have if need plan to evacuation shelter.	They have if need plan to evacuation shelter
	Covid-19	school are closed. People talk about isolation ward but they did not used	school are closed. People talk about isolation ward but they did not used	school are closed. People talk about isolation ward but they did not used
	Closed of school	only used school building for health camp purpose	only used school building for public program	only used school building for public program
	Shift, day	No	No	No
	Close off school	-	-	-
	a. normal time	school running	school running	school running
	b. after earthquake 2015	use as shelter	Use as shelter	Use as shelter
	c. during covid-19 pandemic	concern about isolation but not use	concern about isolation but not use	concern about isolation but not use

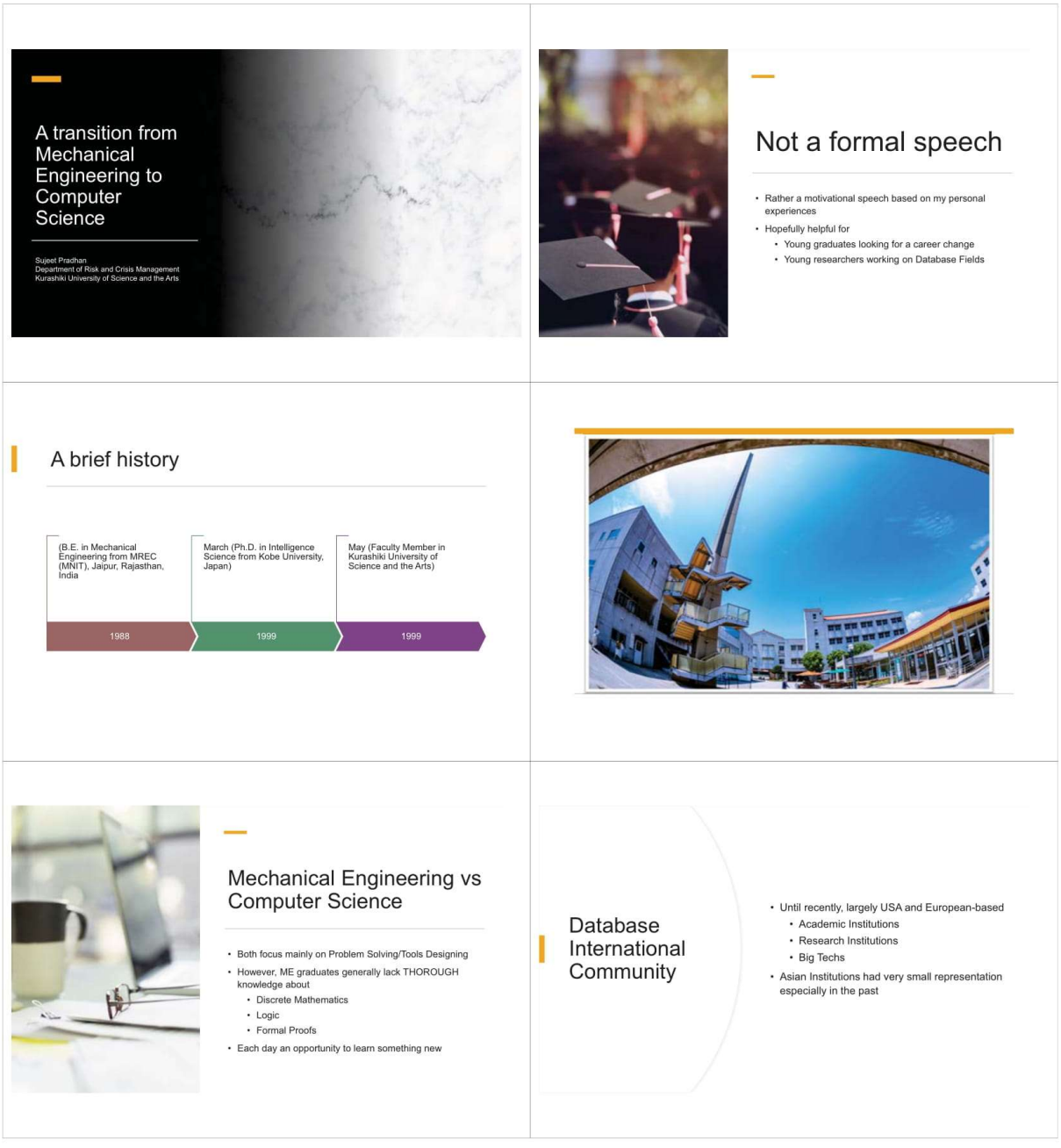


Panel Discussion on Bridging Academic and Research Activities Between Nepal and Japan

Keynote Speech 1:

A Transition from Mechanical Engineering to Computer Science

Prof. Dr. Sujeet Pradhan
Kurashiki University of Science and the Arts



One should not lose hope

- Keep submitting your papers on major conferences (1st tier)
- Papers published on major conferences are treated equally as ones published in major Journal papers
- One paper published in a major conference is equivalent to 30 in less renowned confrences.

Formal theories are always winners in the long run

Application based (trendy) research papers are important

However, papers based on strong mathematical concepts last long

Multi-disciplinary approach

- Getting out of your comfort zone
- Fresh outlook
- Curiosity
- Not easily accepted but worth trying

Major Database Conferences

VLDB (Very Large Database Systems)

ACM SIGMOD (Special Interest Group on Management of Data)

My research hobbies

Research Area

Non-traditional Data Models

Query Processing

Conceptual Framework

Research in Database Field

- Traditional
  - Focuses mainly on the foundations set by E.F.Codd's Relational Model
- Unorthodox
  - Conceptual (not necessarily implementable in the near future)

Data: Stored vs How they are Presented (Discrepancy)

- Non-traditional data
  - Not necessarily structured
  - Not necessarily in a single media
  - Not necessarily complete in itself
- Rather
  - Fragmentary
  - Distributed
  - Complementary

Research Issues

- Challenges
  - Continuous nature of underlying data
  - Answers are not necessarily strictly bounded
  - Scattered complementary information across data sources
- How do you retrieve non-traditional data the way we did traditional (relational) data?
  - An integrated framework based on a Probabilistic Retrieval Model?

Keynote Speech 2:

Research Gaps and Opportunities in Water Resources Sector of Nepal

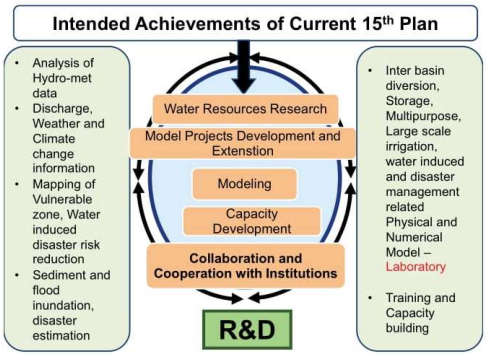
Dr. Maheswor Shrestha

Joint Secretary, Water Resources Division, Ministry of Energy, Water Resources and Irrigation, Government of Nepal

Research Gaps and Opportunities in Water Resources Sector of Nepal

Maheswor Shrestha, Ph.D.
Joint Secretary
Water Resources Division
Ministry of Energy, Water Resources and Irrigation

26 February, 2022



RESEARCH vs STUDY

Research works are treated as consulting service

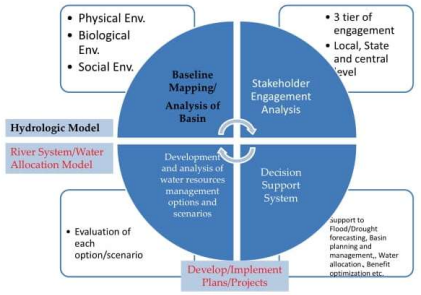
- Due to lack of orientation
- Lack of vision
- Lack of human resources

Financial Resource may not be a constraint

Research Gaps

How much water is flowing to Nepal ?
How much water is flowing out from Nepal ?

Optimal Integrated Water Resources Management Practice towards a Sustainable Society



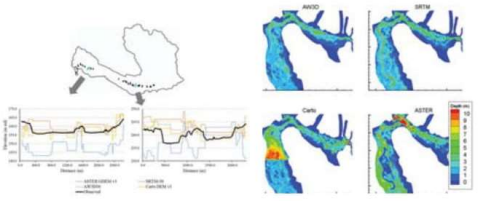
Digital Elevation Model (DEM)

A basic input to hydrologic analysis, modeling, hazard, risk mapping, flood inundation, transboundary issues

HYDRO1k Elevation Derivative Database (1000m DEM)
GTOPO30 (30-arc DEM : Almost 1000m DEM)
For ASTER (30m GDEM): ASTER GDEM Explorer
For SRTM (3-arc DEM): USGS EarthExplorer
Hydroshed-(3-arc DEM: about 90m DEM)
SRTM (1-arc DEM: about 30 m DEM)
JAXA's Global ALOS 3D World (30 m DSM)
AW3D DEM (Commercial)
TANDEM-X (30m, 90m)

Department of Survey, Topographic Data - NEPAL

Accuracy of DEM, a case study at West Rapti River

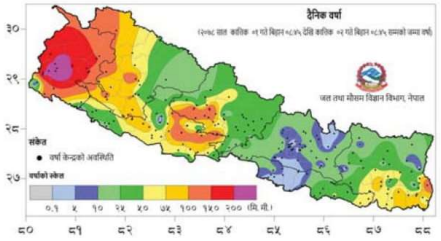


Talchabhadel et al., 2021: Assessment of vertical accuracy of open source 30m resolution space-borne digital elevation models

Gap: Hydrologically corrected DEM
Opportunity: Disaster/Risk Mapping and EWS

Spatial Distribution of Precipitation

A basic input to water resources assessment and management



Bias correction of Climate model projections

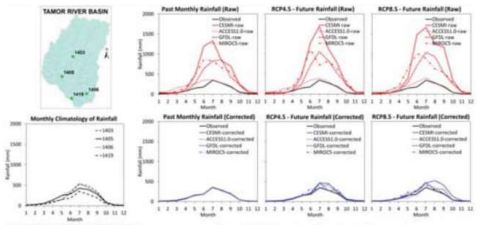


Figure 1: Studied Rainfall stations in Tamor River Basin

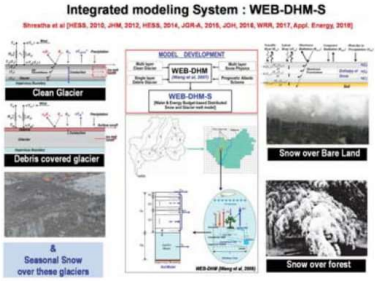
Figure 2: Monthly climatology for GCM raw and corrected rainfall for station 1419

Shrestha (2021) Bias correction of precipitation for selected GCMs in Tamor River Basin, Nepal, WRRDC Research Letter, Issue no: 14, November 2021, pp. 1-2

Numerical Modeling – Physics based distributed hydrologic model

A complete model to assess the contribution of snow and glacier-melt to total runoff

Integrated modeling System : WEB-DHM-S



Budhiganga Basin, Nepal

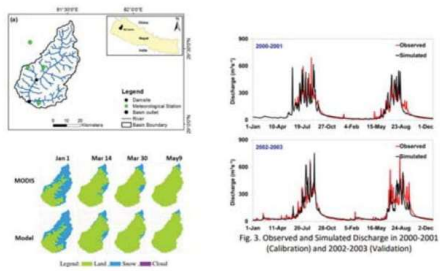


Fig. 3. Observed and Simulated Discharge in 2000-2001 (Calibration) and 2002-2003 (Validation)

Shrestha, M., 2021. Water and energy budget based distributed hydrologic modeling in Budhiganga River Basin of Nepal Himalaya, WRRDC Research Letter, Issue no: 12, September 2021, pp. 1-2

Physical Hydraulic models for inter-basin water transfer models/storage projects

Less Research and Effort in Physical modeling

WRRDC Hydraulic Laboratory, Godawari

Attentions shall be given to strengthen the Lab to prepare prototypes of inter-basin water transfer projects/storage projects

Central Water Resources Information System

Integration of Data related to thematic layers of water resources

- Water and Energy Commission Secretariat (WECS) is mandated to prepare WRIS as per National Water Plan
- Preliminary WRIS was prepared in 2010
- WECS is preparing River Basin Plan.
- WRIS will be prepared and updated in near future.

Hydropower Potential Mapping

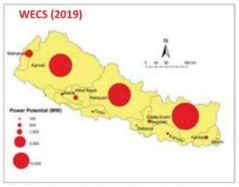


Table 7-1: Gross Hydropower Potential in different river basins of Nepal

SN	River basin	Empirical	HEC-HMS	Adopted
1	Koshi	21940	27805	27805
2	Gandaki	19385	19803	19803
3	Karnali	21306	20385	20385
4	Rapti	595	745	745
5	Bagmati	638	437	437
6	Babai	174	264	264
7	Kankai	463	394	394
8	Kamala	209	261	261
9	Tinau	101	184	184
10	Bakaiya	84		84
11	Mechi	62		62
12	Mahakali	2120		2120
			Total	72,544

https://wecs.gov.np/storage/listies/February2021/final-report-july-2019-on-hydropower-potential.pdf

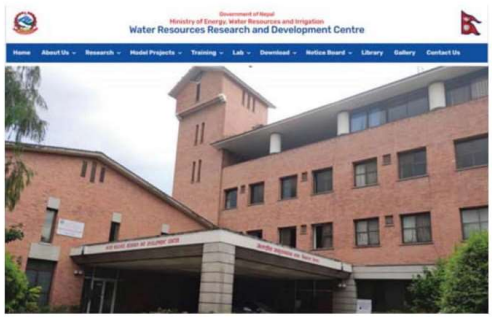
Link Science to Policy and Policy to Science

That's why research gaps and opportunities are always dependent on the policy interventions in water resources sector, if you want your research output is fruitful and serves the nation in someway.

Water management

- Water is taken as **concurrent subject** to Federal, State and Local government in Constitution of Nepal-2072 – opens opportunity to manage by the reform of legislation
- Demarcation of rights of each level of government, River management and regulation
- Transboundary Issues/Downstream Benefits.

Fostering R and D by GoN through WRRDC



Keynote Speech 3:

Protective Systems, Advanced Earthquake Engineering and Large Scale Experimentations

Associate Prof. Dr. Kshitij Charan Shrestha
IOE, Pulchowk Campus

Protective systems, advanced earthquake engineering and large scale experimentations

Kshitij C. Shrestha
26th February, 2022

About me

1. Masonry structure
2. Braced steel frame structure
3. Reinforced concrete structures
4. Composite masonry structures

3

1. Masonry structure
KYOTO UNIVERSITY, JAPAN

4

Residual deformation on typical RC structure

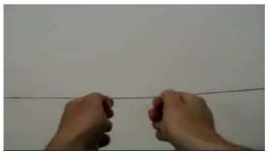
RC Structure (with conventional steel reinforcement) after earthquake excitation

Source:
- left photo by M. Bruneau, MCEER
- right photo by A. Whittaker, NISEE, EERC, UC Berkeley

5

Shape memory alloy (SMA) / Superelastic SMA bars

Shape memory alloy (SMA)

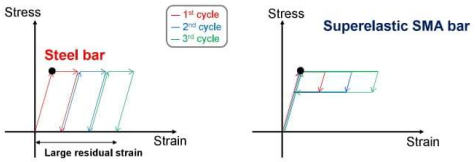


Super elastic shape memory alloy (SMA)

* Movie Clips

6

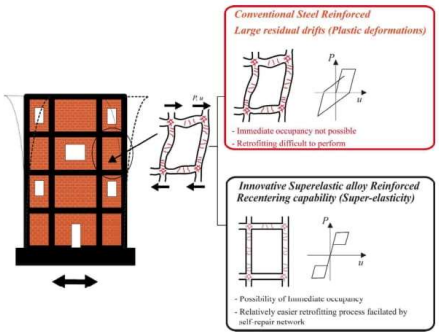
Steel bar versus superelastic shape memory alloy (SMA)



- Steel bars show *large residual strains* post yielding.
- SMA bars possess *unique deformation recovery property* even after yielding.

7

Structure with recentering capability



8

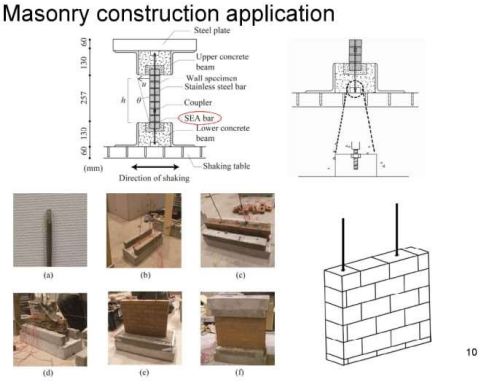
1. Masonry Construction Application

Selected journal publications:

1. ***K.C. Shrestha***, Y. Araki, T. Nagae, T. Omori, Y. Sutou, R. Kainuma, K. Ishida, Effectiveness of superelastic bars for seismic rehabilitation of clay-unit masonry walls, *Earthquake Engineering and Structural Dynamics*, Vol. 42, No. 5, pp. 725-741, April, 2013.
2. ***K.C. Shrestha***, Y. Araki, T. Nagae, T. Omori, Y. Sutou, R. Kainuma, K. Ishida, Applicability of Cu-Al-Mn shape memory alloy rods to retrofitting of historical masonry constructions, *Earthquakes and Structures, An International Journal*, Vol. 2, No. 3, pp. 233-256, September, 2011.

9

Masonry construction application

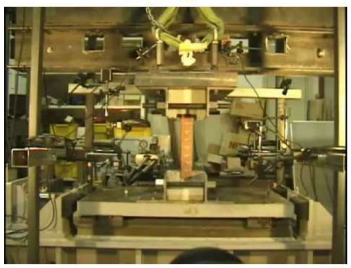


10

Masonry construction application

Unreinforced masonry

PGA 0.3*g*



11

* Movie Clip

Masonry construction application

Steel reinforced masonry

PGA 0.44*g*

12

* Movie Clip

Masonry construction application

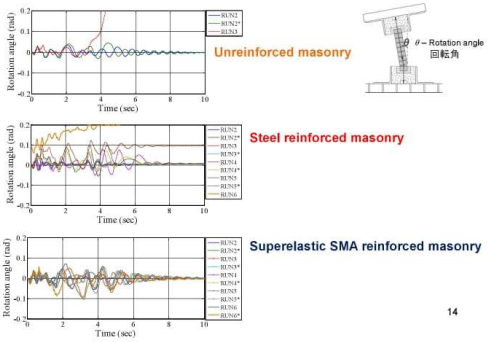
Superelastic SMA reinforced masonry

PGA 0.73*g*

13

* Movie Clip

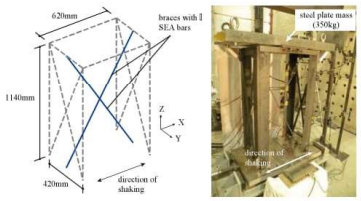
Deformation time-histories 変形時間履歴



14

2. Braced Frame Structure Application

2. Braced steel frame structure
KYOTO UNIVERSITY, JAPAN

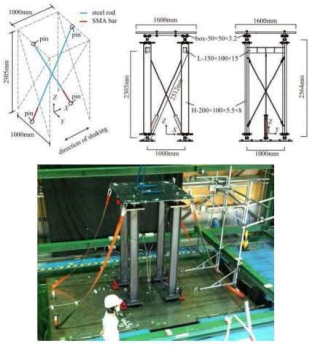


Selected journal publications:

1. Y. Araki, N. Maekawa, **K.C. Shrestha**, M. Yamakawa, Y. Koetaka, T. Omori, R. Kainuma, Feasibility of tension braces using Cu-Al-Mn superelastic alloy bars, *Structural Control and Health Monitoring*, Vol. 21, No. 10, pp. 1304-1315, 2014.
2. Y. Araki, **K.C. Shrestha**, N. Maekawa, Y. Koetaka, T. Omori, R. Kainuma, Shaking table tests of steel frame with superelastic Cu-Al-Mn SMA tension braces, *Earthquake Engineering and Structural Dynamics*, Vol. 45, No. 2, pp. 297-314, 2016.

15 16

Full-scale steel brace frame



17

3. Reinforced concrete structures
KYOTO UNIVERSITY, JAPAN
NIHON UNIVERSITY, JAPAN
UNIVERSITY OF NEVADA RENO, USA
QATAR UNIVERSITY, QATAR

18

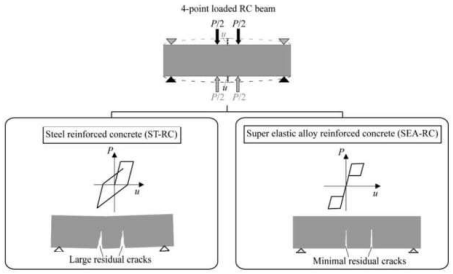
3. Reinforced concrete structure application

Selected journal publications:

1. **K.C. Shrestha**, M.S. Saidi, C.A. Cruz, Advanced materials for control of post-earthquake damage in bridges, *Smart Materials and Structures*, Vol. 24, No. 2, 025035, 16pp, January, 2015.
2. **K.C. Shrestha**, Y. Araki, T. Nagae, Y. Koetaka, Y. Suzuki, T. Omori, Y. Sutou, R. Kainuma, K. Ishida, Feasibility of Cu-Al-Mn superelastic alloy bars as reinforcement elements in concrete beams, *Smart Materials and Structures*, Vol. 22, No. 2, 025025, February, 2013.
3. S. Pareek, **K.C. Shrestha**, Y. Suzuki, T. Omori, R. Kainuma, Y. Araki, Feasibility of externally activated self-repairing concrete with epoxy injection network and Cu-Al-Mn superelastic alloy reinforcing bars, *Smart Materials and Structures*, Vol. 23, No. 10, pp. 105027, September, 2014.

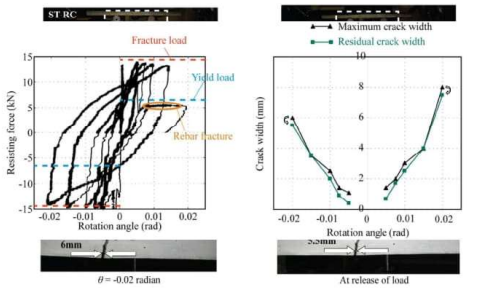
19

4-point loading beam test



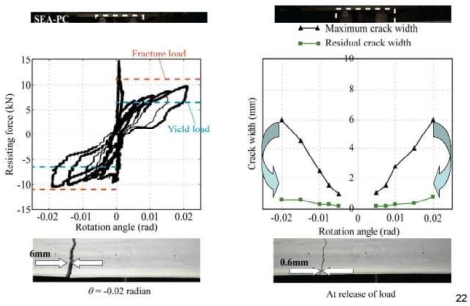
20

ST-RC specimen



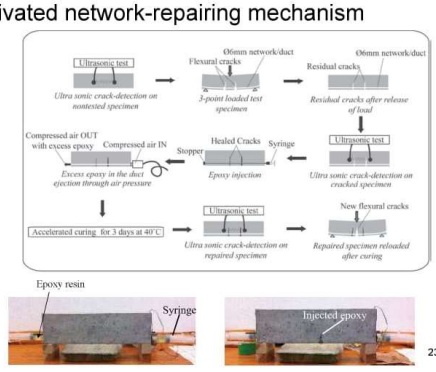
21

SMA-RC specimen



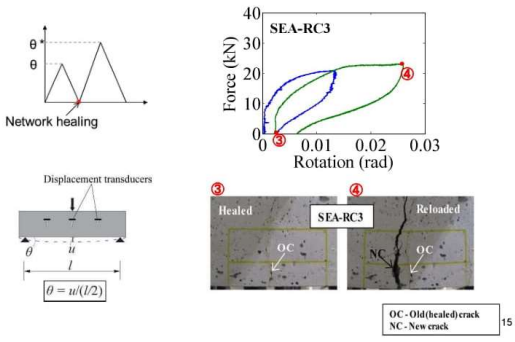
22

Activated network-repairing mechanism



23

SEA used network repaired specimen



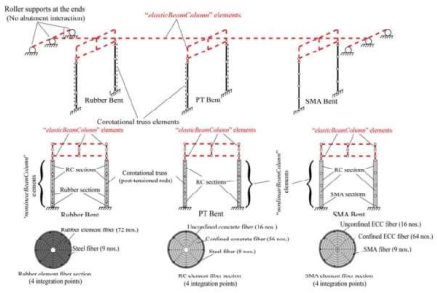
15

RC bridge application

¼ scaled 33 m long, 4-span bridge

25

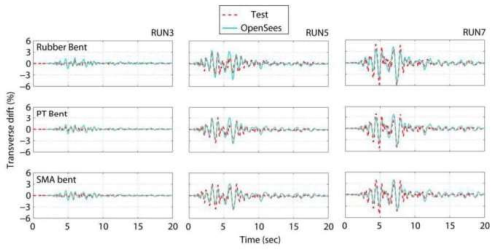
RC bridge application



¼ scaled 33 m long, 4-span bridge
Numerical modeling using OpenSees

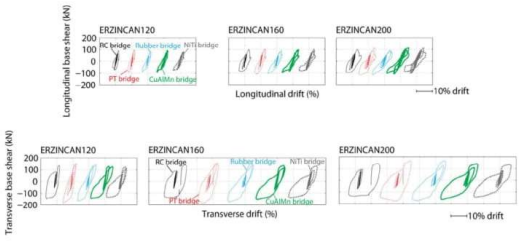
26

RC bridge application



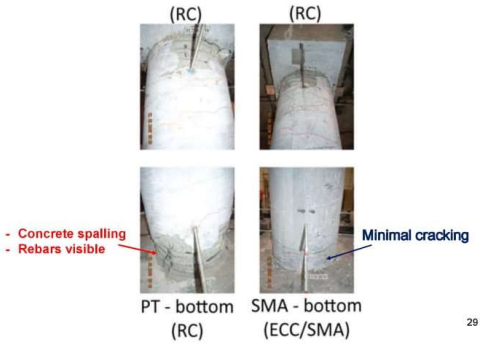
27

RC bridge application



28

RC bridge application

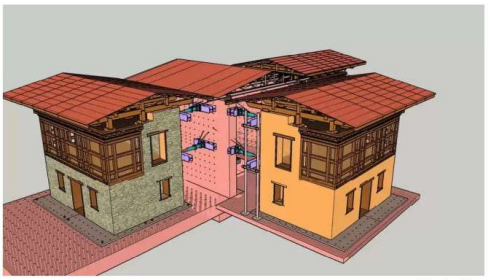


29

4. Composite masonry structures
NAGOYA CITY UNIVERSITY, JAPAN

30

Test facility overview



* Movie Clip

31

PILOT SHAKING TABLE TEST

* Movie Clip 32

Full-scale test

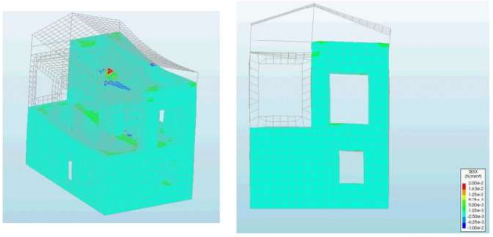
33

Full-scale test

* Movie Clip

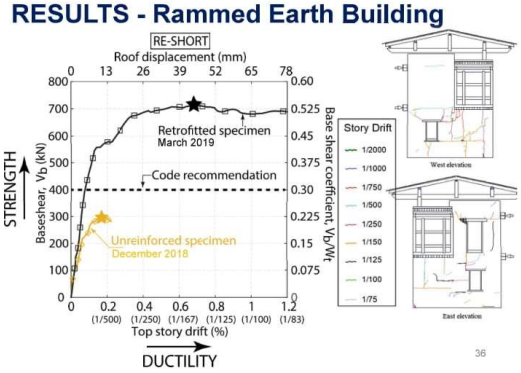
34

Full-scale test – Numerical modeling



* Movie Clip

RESULTS - Rammed Earth Building



36

Retrofitting method

Local Sustainable Effective

TOTAL COST WITHIN 15% OF NEW CONSTRUCTION

37

Thank you for your kind attention

38

Comments and Floor Discussion

The comments on the keynote speech has been given by Dr. Bhoj Raj Pantha and Dr. Jhabindra Prasad Ghimire. Following are the main keypoints of the commentators.

Comments of Dr. Bhoj Raj Pantha, *Katahira & Engineers International*

(Contents of this section will be updated soon.)

Comments of Dr. Jhabindra Prasad Ghimire, *Asha Consulting Group Pvt. Ltd.*

(Contents of this section will be updated soon.)

Closing Remarks and Kanpai (Virtual Nomikai)

Assoc. Prof. Dr. Lata Shakya
Ritsumeikan University

(Contents of this section will be updated soon.)

Photos

(Contents of this section will be updated soon.)