Attachment

Adopted projects related to the April 2015 Nepal earthquake

Title of the Project		Japan based Principal Investigator Nepal based Principal Investigator	Title Affiliation	Outline
1	Investigation of Ground-motion to Damage Relationship in the Kathmandu Valley from Aftershock and Microtremor Observations	Kazuki Koketsu	Professor, Earthquake Research Institute, The University of Tokyo	In this study, research teams carry out aftershock and microtremor surveys in the Kathmandu Valley together with building damage surveys for elucidating the relationship between ground motion and damage and the mechanism of ground motion damage. To put it concretely, we perform 1) the construction of the velocity structure in the Kathmandu Valley, 2) the recovery of mainshock ground motions there, 3) the establishment of ground motion to damage relationship, and 4) the examination of mechanism of ground motion damage. The outcomes of this study are expected to enhance the accuracy of seismic risk assessment in the Kathmandu Valley.
		Soma Nath Sapkota	Deputy Director General, Department of Mines and Geology, Ministry of Industry	

2	Damage Mapping of April 2015 Nepal Earthquake using Small UAV	Hiroshi Inoue	Principal Senior Researcher, National Research Institute for Earth Science and Disaster Prevention	We map the damage of buildings caused by the Nepal earthquake in Kathmandu Valley and surrounding mountain areas using a small fixed-wing UAV (Unmanned Aerial Vehicle), in systematic, extensive, and precise manner for the purposes of 1) damage assessment, and risk assessment for urban planning by the national and local governments towards recovery, 2) detailed study of the distribution of building damages, and 3) improvement of the methods of rapid damage mapping using satellite and UAV imageries. We carry out the survey as projects of national and local governments with UAV flight permission. The Japanese team provides UAV operation and mapping technology to the Nepali side. We provide data to the government and share the data for research. The project aims at 1) damage assessment by the governments and risk assessment for urban planning for recovery, 2) studying relationship between damage distribution and the terrain, soil and other conditions, 3) verification and improvement of rapid damage assessment by satellite imagery data, 4) improvement and transfer of UAV operation technology in built-up urban center and mountain areas, and 5) improvement of timeliness of damage assessment by introducing the UAV and 3D mapping technology.
		Ramesh Guragain	Deputy Executive Director, National Society for Earthquake Technology-Nepal	
3	Inventory Mapping of Landslides induced by the Nepal Earthquake and Hazard Mapping of Future Landslides for	Masahiro Chigira	Professor, Disaster Prevention Research Institute, Kyoto University	The purpose of this study is 1) to make an inventory mapping on landslides, cracks, and landslide dams induced by the Nepal earthquake and to investigate their formative mechanisms, and 2) to detect the areas and displacements of slope surfaces, of which susceptibility to landslides would be evaluated on the basis of geology, geomorphology, and groundwater

	Making the Plan of Better Reconstruction	Vishnu Dangol	Professor, Department of Geology, Tribhuvan University	conditions. The joint research has the following schemes. 1) Inventory mapping of landslides and related phenomena like cracks and landslide dams. 2) Identification and mapping of displaced slopes using the results of SAR image analyses and field survey. 3) Rainfall mapping before the earthquake using the rainfall database APHRODITE. 4) Analysis on major landslides, unstable slopes, and landslide dams from the viewpoints of geology, geomorphology, and antecedent rainfalls. 5) Semi quantitative slope stability analysis with geological and geomorphological features and quantitative seismic response analysis with FEM (Finite Element Method). This study will clarify the characteristics and the distribution of slope movements induced by the Nepal earthquake, and enables identification of future potential landslide sites, which results will be used to establish the methodology of predicting earthquake-induced landslides. We wish we can help the governmental organizations of Nepal to make decisions on where or how to relocate villages and how to maintain roads against natural disaster.
4	Investigation of Cryo-geohazards in Langtang Valley, Nepal	Koji Fujita	Associate Professor, Graduate School of Environmental Studies, Nagoya University	On 25 April 2015, Langtang village, which is located north of Kathmandu, was severely damaged by the Gorkha Earthquake triggering avalanches. To investigate the tragic destruction, we estimate debris quantity covering the village and its distribution, which may consist of ice and rock mixture, by comparing three sets of digital elevation models (DEMs) and 3D images for the pre-earthquake, post-earthquake and post-monsoon, which will be created by satellite imagery, footages and UAV photographs with a couple of advanced technologies

		Rijan Bhakta Kayastha	Associate Professor, School of Science, Kathmandu University	such as Leica Photogrammetry Suite (LPS) and Structure from Motion (SfM). Based on this information, we will validate and improve our avalanche model by taking into account different materials and entrainment process, and then create an avalanche hazard map using the newly developed method of polynomial chaos quadrature (PCQ), which allows us to describe avalanche flow as a probability distribution. We then plan to provide this hazard map to villagers rebuilding their lives in Langtang Valley. Through the observations and analyses in this proposal, our knowledge, technology and skill will be transferred and shared with Nepali researchers for their own research capability in the future.
5	Field Survey and Development of GIS Database on Rural Areas Affected by the Nepal Earthquake	Machito Mihara	Professor, Faculty of Regional Environment Science, Tokyo University of Agriculture	This research deals with the analysis of the facts and features of devastation and the evaluation of land use in rural areas that suffered from the Nepal Earthquake in April and May 2015 for building up the new GIS database. The purposes of the research are as follows. 1.Understand and analyze the damage of residential and other buildings as well as agricultural land and facilities 2.Classify suitable land use type taking into account consideration of disaster risks 3.Suggest to the Nepalese Government suitable resettlement areas with high resilience to natural disasters 4.Recommend to the government a sustainable land use plan for rural areas To accomplish these purposes, the research team collects existing GIS data, conducts field survey and develops new GIS data as well as a digital elevation model (DEM) through remote sensing. All of those data are reflected in the team's developing GIS database for land use evaluation. This land use evaluation aims to classify
		Bim Prasad Shrestha	Professor, School of Engineering, Kathmandu University	

				the types of suitable land use for resettlement, forestry, conservation area, wetland, and so on, as well as to identify the disaster-prone areas from landslides, flooding and so on. With the research outcomes, it is expected that the Nepalese Government could identify what aid and reconstruction plans are proper and needed in the project areas to make the rural societies more resilient to natural disasters and sustainable.
6	Emergency survey of the great earthquake impacting on water security in Kathmandu, Nepal	Futaba Kazama	Professor Graduate Faculty of Interdisciplinary Research University of Yamanashi	This project aims to research the impacts of the Great Earthquake on domestic water, water resources and water systems and propose/assess emergency actions for securing water-related hygiene conditions, quick and efficient water treatment methods and availability of alternate sources in Kathmandu and surrounding areas. In the short term, the project surveys damages of reservoirs and pipelines at household level, hygiene condition of water sources, change of natural water sources, water infrastructures in/before service, alternative water sources such as groundwater privately controlled, water use in evacuation area and QOL of local people. In the mid/long term, the outcomes contribute to dissemination of the Low-maintenance, Compact and Decentralised (LCD) water treatment system as well as establishment of Water Security Assessment Tool with consideration of resilience for disaster. Throughout this project, water security will be achieved in emergency situations after the Quake, and the Nepal Government will be supported in the long-term development plan for water resources and infrastructures.
		Shakya Narendra Man	Professor Institute of Engineering Tribhuvan University	

7	Field investigation research to improve seismic capacity of new and existing Nepalese buildings.	Koichi Kusunoki	Associate Professor, Earthquake Research Institute, The University of Tokyo	The objectives of this research are to organize the required research items to improve Nepalese seismic design method and seismic screening method, and to develop a technical road map to achieve the improvement of seismic performance evaluation method. To be more precise, 1) field investigation on the seismic performance of existing buildings, especially damaged buildings will be conducted prior to demolitions, 2) applicability of Japanese seismic screening methods will be investigated, and 3) possible improvement of Nepalese seismic design method will be pointed out. Administrative procedures of the seismic evaluation will be also discussed to introduce practical seismic evaluation technique and strengthen methods. According to the proposed research, improvement of seismic performance of new buildings and the accuracy of the seismic screening method of existing buildings can be expected. Moreover, the outcome of the proposed research may be applied for the buildings of other countries where similar structural systems are applied.
		Krishna Kumar Bhetwal	Assistant Professor, Institute of Engineering, Tribhuvan University	
8	Process of Recovery and Housing Reconstruction in Urban and Rural Areas After the Nepal Earthquake	Toshio Otsuki	Professor Dept. of Architecture , Graduate School of Engineering, The University of Tokyo	This research is to propose the process of recovery and housing construction in urban and rural areas after the Nepal Earthquake. The survey will be held in two urban areas (Patan and Bhaktapur) and one rural area (Charikot). These areas have different situation in damage, pattern of housings and life styles. Our research team will clarify the detail situation of current living condition (evacuation) and the future

		Umesh Bahadur Malla	Executive Member Shelter & Local Technology Development Centre (SLTDC)	plans for recovery and reconstruction of the housing. Through this survey, we can analyze the trend of the dwellers' plan and challenges for recovery and reconstruction of the housing in each of the areas. Then, we can propose the process of recovery and reconstruction of the housing both in engineering aspect and lifestyle aspect in each of the areas.
9	Investigation of foundation liquefaction susceptibility in the Kathmandu valley	Mitsu Okamura	Professor Civil and Environmental Department Ehime University	The peak accelerations of the 2015 Nepal earthquake observed at a few locations in Kathmandu valley were approximately 180 Gal. Although this acceleration was much smaller than that expected (i.e. 300 Gal), extensive soil liquefaction was observed at several locations in the vicinity of major rivers in Kathmandu city. This strongly indicates that soils in the city are quite prone to liquefaction and liquefaction assessment is of great importance to prepare for stronger earthquakes in the future. Because of the uniqueness of soils in Kathmandu, which are rich in Mica, liquefaction assessment methods established based on experiences in Japan and the US have to be verified. In order to refine or reestablish liquefaction assessment methods, identification of field evidence of liquefaction including sand volcanos and lateral spreading are necessary and the 2015 April earthquake provided us a valuable opportunity to do this. Our research team will conduct a field survey, in-situ tests as well as laboratory tests described below and establish a liquefaction assessment method which is suitable for Kathmandu. □Extensive field survey to identify locations of soil liquefaction all over the valley and summarize in a map. □In-situ tests at several liquefied sites including boring, standard penetration tests, undisturbed soil
		Surya Narayan Shrestha	Deputy Executive Director National Society for Earthquake Technology-Nepal (NSET)	

				sampling and PS logging. Based on test results we will be able to prepare relationship between N value or S wave velocity and threshold acceleration which separates liquefied and non-liquefied sites. □Laboratory tests on samples including physical test, cyclic triaxial test to measure liquefaction strength and X-ray deflection test. It is expected from these tests that liquefaction strength characteristics of Kathmandu soils, which may exhibit strong influences of Mica contents, are revealed. □Extensive microtremor measurements will be conducted all over the valley which is expected to reveal local amplification characteristics.
10	Reevaluation of seismic vulnerability on historic structures based on damage investigation of the 2015 Nepal earthquake and of retrofitting methods	Junji Kiyono	Professor, Graduate School of Global Environmental Studies, Kyoto University	The objectives of this research are; 1) to conduct joint field investigations in damaged areas with Tribhuban University and compare the results with our past field survey already conducted at Patan, 2) to reexamine the seismic capacity of historic buildings and reevaluate the strength of the materials of the building, and 3) to propose the strengthening and retrofitting methods to prevent the historic structures from future destructive earthquakes. In order to do this, we examine the outline of damage by using satellite images and check the design ground motion by comparing with the observed records. Material tests of damaged masonry structures are carried out to evaluate the seismic capacity of existing historic structures. Complete enumeration is also conducted to estimate the vulnerability of the area of Lalitpur, Patan Durbar Square. Through these cooperative research activities, effective information collection by grasping the outline of earthquake damage becomes possible and significance of design ground motion becomes clear. New findings and techniques developed for preventing damage
		Prem Nath Maskey	Professor, Institute of Engineering Tribhuvan University	

				to vulnerable historic structures are expected to contribute strongly to the preservation of heritage structures in not only Nepal but also other countries.
11	Vulnerability assessment of Kathmandu valley and surrounding areas based on comprehensive damage investigation of the 2915 Gurkha, Nepal earthquake	Kimiro Meguro	Professor Institute of Industrial Science The University of Tokyo	The research aims at providing practical solutions for supporting efficient rehabilitation and reconstruction of the areas affected by the 2015 Gurkha, Nepal earthquake and also making proper prioritization of seismic strengthening of buildings in the areas with potential risk of future earthquakes. Firstly, a distribution of building damage in affected areas by the Gurkha, Nepal earthquake will be analyzed using both remote sensing data obtained from multiple satellite sensors and existing data from unmanned aerial vehicles (UAV). Then, high-precision fragility curves for Nepalese buildings with different material and structural types will be created by statistically processing the survey results and fragility curves developed by Dr. Ramesh Guragain using numerical approach. With the newly created high-precision fragility curves, ground conditions and expected ground motion distribution in the future, the research will be able to indicate micro-zoning for efficient recovery and reconstruction of affected area and support efficient seismic strengthening by region and building type in unaffected areas with potential earthquake risk. There are six expected outcomes of the research: (1) Acquisition of spatial information data of buildings in widespread area, (2) Acquisition of extensive building damage data and understanding of actual condition, (3)
		Ramesh Guragain	Deputy Executive Director National Society for Earthquake Technology-Nepal (NSET)	

				Development of high-precision fragility curve for Nepalese buildings, (4) Micro-zoning for efficient recovery and reconstruction of affected areas, (5) Clarification of areas and buildings to be strengthened preferentially against high-risk future earthquakes, (6) Proposal of proper seismic retrofit method for building clarified by item (5).
12	Identification of temporary evacuation sites and relocation of dangerous settlements in the Dolakha District: an approach by hazard mapping	Teiji Watanabe	Professor Environmental Earth Science Hokkaido University	This research, focusing in the Dolakha District with the devastating damages by the earthquake in 2015, aims to (1) identify the damaged sties and clarify geological and geomorphological characteristics of the sites, (2) identify potentially dangerous sites in the case of future earthquake and other hazards, (3) propose temporal evacuation sites in the case of future hazards (household level), and (4) examine the necessity of relocation of dangerous settlements in the district. This research prepares a detailed hazard map with combined approaches of an analysis of photographs taken by UAV, remote sensing, and field survey. The map includes paths to temporal evacuation sites from dangerous sites. Moreover, interview surveys and questionnaire surveys will be conducted to identify the settlements that need relocation. The results will be delivered to the governmental and administrative organizations for future actions. The detailed hazard map involving the state-of-art knowledge and technology, which will be the main product of this research, will be helpful to insure safety for the local residents as well as porters and guides who help international trekkers because such porters and guides use the road and settlements in the district between Kathmandu and Jiri. Further, transferring the methodology of the hazard mapping to Nepal will be
		Lalu Paudel	Professor and Head Central Department of Geology Tribhuvan University	

				included in this research.
13	Monitoring for ensured communicable disease control on evacuation site	Sakiko Kanbara	Associate Professor Graduate School of Nursing University of Kochi	To prevent unnecessary deaths through early detection of cases of diseases that have outbreak potential, this project aims to visualize and summarize prevention of communicable diseases through communicating in real time with Nepali nurses who will be conducting the surveillance in order to protect and promote health and safety of people and communities during disasters. The tool kit is established for the health coordination mechanism/development by incorporating the following WHO guideline and application. The most critical challenge is data collection to generate reasonable information that can be used in predicting whether something is likely to occur. Our interest lies in collecting information on the items from the view of public health and nursing including culture, lifestyle and perception. It is developed as an open tool kit that can easily provide APIs (application programming interface) for integration with others as well as provide APIs for data integration and data sharing with other health sectors, MoHP and WHO. As a result, it enables communication in real time and supplies relevant information into central and actionable one for community leaders. It will be one of model on large-scale disaster which hit another country.
		Tara Pokhrel	President, Nursing Association of Nepal	