IISEE Newsletter

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In This Issue

IISEE Net and Training

2020 Meeting of International Platform for Reducing Earthquake Disasters (IPRED)

By Dr. Toshiaki Yokoi, Senior Fellow, IISEE

We held the IPRED meeting (On-line) at 16th and 23rd of Oct. 2020 (Japan Standard Time). IPRED is a UNESCO's project being implemented by IISEE and the leading organization of 10 countries, which keep a firm connection with IISEE through ODA based JICA projects and IISEE's international training program.

The meeting was directed by Mr. M. Sasaki, Natural Science Sector, UNESCO who in 16th at the beginning reported about the 11th meeting at Bucharest, Romania 10th to 13th of June 2019 and its resolution. Next, he introduced the current UNESCO activities based on its general direction "Disaster Risk Reduction (DRR) by the appropriate planning of Built Environment (BE)". Namely, Built Environment in LAC 5 countries (Mexico, Guatemala, Cuba, Dominican Republic and Peru), and PRERADE in Mexico. There, the following DRR tools are expected to be improved and implemented: Technical Regulation (Building Code, Standards for Building Materials, Regulation of Construction etc.) and Social System (Building Control, Land Use Control, Retrofitting Policy, Training and Education for Engineers etc.). Then, he listed the current progress of IPRED action plan and proposed the next step of IPRED: dissemination of the knowledge and experiences of IPRED members to the developing countries through developing policy recommendation and technical guidelines.

In the 16th presentations on the current activities were given by the representatives of Egypt, Japan and Kazakhstan, whereas in the 23rd by those of Mexico, El Salvador, Peru, Turkey and Romania. The titles of the presentation are shown in Table 1 below.
We have scheduled the 12th (next) annual meeting in Sendai together with the 17th World Conference on Earthquake Engineering (17WCEE) in that two sessions are prepared in relation with IPRED activities: Special Session " Contribution to Sendai Framework" and

Earthquakes

The 2011 off the Pacific coast of Tohoku Earthquake

Reports of Recent Earthquakes

Utsu Catalog

Earthquake Catalog

Call for Papers

IISEE Bulletin is now accepting submissions of papers for the seismology, earthquake engineering, and tsunami. Developing countries are targeted, but are not limited.

Your original papers will be reviewed by the editorial members and some experts.

NO submission fee is needed.

Try to challenge!

Mini Symposium "Comparison of Seismic Code". We will distribute more information on the IISEE NEWS LETTER and IISEE HP.

In the difficult situation of global infection of the new coronavirus, we had an online opening ceremony of the training courses in Seismology, Earthquake Engineering, and Tsunami Disaster Mitigation for young researchers and engineers on Oct 12th, and the course has started.

Table 1 Titles of Presentation in IPRED Meeting 2020

Egypt	Progress, Challenges and the Way Forward on Action VI
	Cultural Heritage Preservation, and Documentation: Case Studies in Egypt
	Ambient Vibration Tests for the Cairo Citadel s Minarets: First Insight
Japan	Report on Recent Activities Including the Progress for the Action Plan
Kazakhstan	Ground Motion Parameters and Intensities: Early Warning System for Almaty
Mexico	Promotion of Techniques for Pre-earthquake Vulnerability Assessment and Post-earthquake Structural Evaluation
El Salvador	Promotion of Seismic Evaluation for Strengthening and Retrofit as well as the Guideline and Training for Professionals and Non-Professionals and the strategy for dissemination
	Promotion of Technical Assistance for School Safety Assessment Project of UNESCO (VISUS)
Peru	Progress, Challenges and the Way Forward on Action Plan VIII: Promotion of Structural Hearth Monitoring
Turkey	Promotion of the Information Sharing on Updating and Implementation of Building Codes
Romania	Progress, Challenges and Way Forward on Actions VII and XIII

Ex-participants' papers published in the proceedings of 17WCEE

By Dr. Tatsuya AZUHATA, Director of IISEE

The 17th World Conference of Earthquake Engineering (17WCEE) secretariat published the proceedings in September on the homepage. The IISEE encouraged the 2018-2019 training course participants to submit the paper about their research results while still staying in Japan. As a result, four participants, 1) - 4), plus one ex-participant of the 2017-2018 course, 5), submitted their reports

Contact Us

The IISEE Newsletter is intended to act as a go-between for IISEE and ex-participants.

We encourage you to contribute a report and an article to this news-letter. Please let us know your current activities in your countries.

We also welcome your co-workers and friends to register our mailing list.

iiseenews@kenken.go.jp

Back Numbers

http://iisee.kenken.go.jp/nldb/

below, and the editors accepted them to the proceedings. You can know the authors, the titles, and the papers' ID numbers in the following. This newsletter shows only participants' names, but IISEE staff contribute as co-authors to all reports. And two 2019-2020 course participants join as co-authors in the documents of 3) and 4).

1) J. Lamsal, et al.: SEISMIC RETROFIT OF AN EXISTING RESIDENTIAL BUILDING IN NEPAL TO FUNCTIONALIZE AS A HOSPITAL USING FERROCEMENT, 3b-0060.

2) A. Soto, et al.: EVALUATION AND RETROFITTING OF AN EXISTING HOSPITAL BUILDING IN PERU CONSIDERING FUNCIONATILY AFTER SEVERE EARTHQUAKES, 3g-0031.

3) P. Adhikari, A. Varma, et al.: FRAGILITY EVALUATION OF RC BUILDING DESIGNED BY NEPAL BUILDING CODE CONSIDERING DEFORMATION CAPACITY, 2b-0112.

4) R. Panaligan, J. Oropel, et al.: EARTHQUAKE PERFORMANCE EVALUATION OF A TYPICAL BRIDGE STRUCTURE DESIGNED BY FORCE-BASED DESIGN METHOD IN PHILIPPINES, 2b-0110.

5) Md. Kamruzzaman, et al.: SEISMIC VULNERABILITY AND RETROFIT OF SOFT FIRST STORY RC BUILDINGS DESIGNED BY BARE FRAME ANALYSIS IN BANGLADESH, 3b-0057.

Furthermore, the IISEE recommended the 2019-2020 course participants to submit a paper about the research results they had conducted in their country before they participated in the training course. As a result, three participants submitted the following documents, and the editors accepted them.

6) Pema, et al.: TEST FACILITY TO STUDY TRADITIONAL COMPOSITE MASONRY STRUCTURES IN BHUTAN - AN OUTCOME OF SATREPS, 10c-0001.

7) V. Díaz, et al.: THE 2010 EARTHQUAKE IN CHILE - LESSONS AND ROAD MANUAL UPGRADE, 2d-0039

8) C. Delgado, et al.: APPLICATIONS OF SEISMIC DISSIPATION AND SEISMIC ISOLATION IN MEXICO, 9e-0013.

The IISEE had planned for 2019-2020 course trainees to attend the 17wcee. But, the secretariat postponed it due to the pandemic COVID-19. However, they will still have a chance to participate in the video meeting of the 17WCEE even if it is difficult for them to come to Japan next year. We hope that we discuss earthquake engineering topics again using this chance.
We also want more information from readers of this newsletter. Please let us know about your submitted paper and your presentation at 17WCEE next year if you like.

IISEE International Institute of Seismology and Earthquake Engineering

Building Research Institute B R I

Selected Abstracts of 2019-2020 Training Course




IISEE Newsletter Special Edition
November 2020

Foreword

Our institution, International Institute of Seismology and Earthquake Engineering (IISEE), mainly conducts three following one-year training courses named (S) Seismology Course, (E) Earthquake Engineering Course and (T) Tsunami Disaster Mitigation Course.

This booklet is a collection of abstracts of individual study reports from the trainees of the 2019-2020 course. Regarding the trainees from S course and T course, only trainees who have volunteered wrote their abstracts. Therefore, please kindly note that not all the abstracts are posted in this booklet.

Their further detailed synopsis can be found on the following website.
https://iisee.kenken.go.jp/syndb/

Also, the final presentation from six trainees will be released on IISEE E-learning website. (Coming soon)
https://iisee.kenken.go.jp/el/

We hope this booklet will help you.

Tatsuya Azuhata (E Course leader)
Tatsuhiko Hara (S Course leader)
Bunichiro Shibazaki (T Course leader)

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Seismology Course

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Tsunami Course

Estimation of Surface Wave Dispersion Characteristics Using Ambient Noise Records in Ulaanbaatar Region

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Seismic interferometry is a technique for extracting Green's function from ambient noise cross-correlations between two receivers is now an effective tool to illuminate subsurface structures such as crust and uppermost mantle of the Earth from the regional to global scale. Our study obtained Rayleigh and Love wave dispersion characteristics between 5 s and 20 s from yearly-stacked cross-correlation functions (CCFs) of ambient seismic noise data (between January 1, 2018 and January 1, 2019), using the dense seismic broadband network consisting of 17 stations in the Ulaanbaatar region, Mongolia. The extracted empirical Green's functions of Rayleigh and Love waves between 136 pairs of stations showed substantially large signal-to-noise ratios (> 17) in the target periodic range, indicating clear trends of wave propagation up to ~270 km. We used transverse-transverse (TT) component for the estimation of Love wave dispersions. As for Rayleigh wave. we removed P-wave contamination, which exists as precursors, from the stacked CCFs using vertical-to-radial (ZR) and radial-to-vertical (RZ) components and succeeded in obtaining dominant Rayleigh-wave signals. The estimated Rayleigh and Love-wave phase velocities using the matched-filter frequency-time analysis (Fig. 1) showed little variation over the period between 6 s and 10 s, indicating small subsurface heterogeneity in the Ulaanbaatar region. The estimated Rayleigh wave phase velocity map for 8 s indicated small (~0.05–0.1 km/s) velocity contrasts between the western and eastern parts, suggesting the possibility of local-scale seismic velocity heterogeneity in the study area. The resulting velocity trend corresponds well with the estimations derived with a sparse seismic array. We also found a significant feature which could extend our Rayleigh wave phase velocity dispersion to a much longer period, and shorter spacing stations, (which are typically excluded in seismic interferometry) could be included using the spatial autocorrelation (SPAC) method (Fig. 2). The combined use of the two methods makes it possible to conduct a tomographic study in the Ulaanbaatar region.

Figure

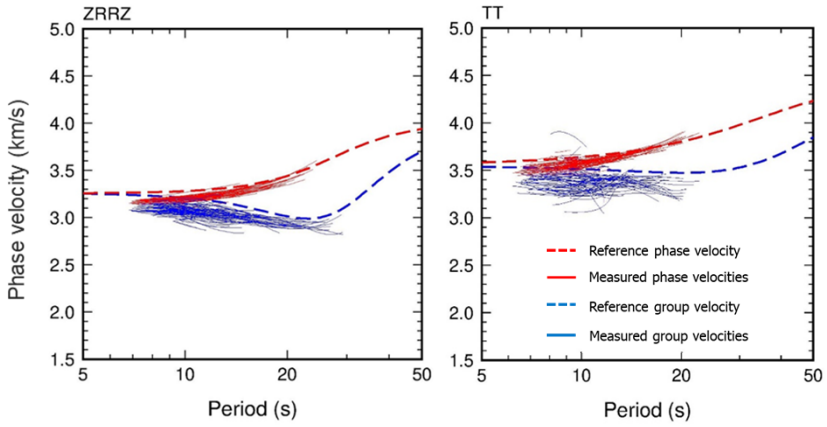

Fig. 1. Measured Rayleigh and Love wave phase and group velocities for all station pairs, (a) Rayleigh wave, (b) Love wave.

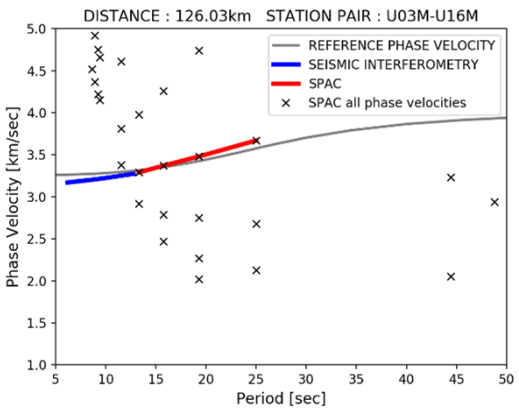

Fig. 2. The comparison between the SPAC results and seismic interferometry results .

Institute of Astronomy and Geophysics of Mongolian Academy of Science

The Institute of Astronomy and Geophysics (IAG) of the Mongolian Academy of Science (MAS) was established in 1957. The IAG is the only organization that conducts geomagnetic and seismological studies under the government budget. It also closely collaborates with the National Emergency Management Agency and National Security Council with its main duty that provides emergency information about earthquake occurrence.

Strong Motion Estimation in Costa Rica at Specific Sites Using Spectral Inversion Method

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Determination of site effect at different stations as a way to secure lifeline facilities

The complex tectonic setting of Costa Rica implies the necessity of a real seismic hazard scenario characterization for lifeline facilities and the country. In this paper, one of the conventional spectral inversion techniques is applied to strong ground motion records obtained at important facilities including powerhouses distributed over the country, with the purpose of separate the site effect, the source spectra, and the path effect.
To assure the quality of the results, the broadband station JTS of IRIS/IDA is also incorporated. A first consistency check was established to assure the appropriateness of the input data using the individual site effects. Once inversion was performed using the reference events and a depurated database, the frequency-dependent quality factor $Q = 179f^{0.5598}$ was obtained for the northern and central part of Costa Rica, along with the source spectra and the individual site effect (Fig. 1). A second consistency check was performed to assure the results using synthetic acceleration spectra in comparison with the real observed ones.
Based on the results of the inversion, synthetic acceleration amplitude spectra for the 2012 Sámara earthquake of Mw 7.6 at specific sites were calculated and could be consistent with the intensity anomaly observed during this earthquake (Fig. 2). This method of reproduction may allow us to estimate acceleration spectra of major earthquakes, and to develop a proper seismic hazard analysis of the country. Recommendations are given based on the lessons obtained during the analysis to better and reinforce the strong motion observation of the Costa Rican Electricity Institute (ICE).

Figure

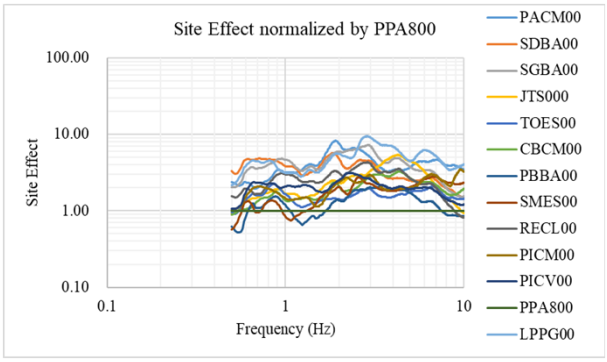


Fig. 1. Site effect of the strong motion stations, normalized by PPA8 (rock site station).

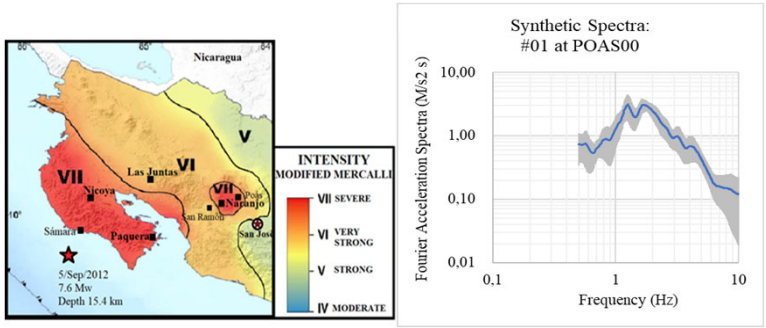
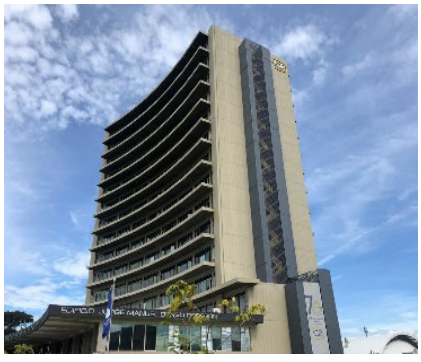


Fig. 2. (left) Anomalous intensity distribution (modified from RSN, 2012) and (right) synthetic spectra at Poás station for the 7.6 Mw 2012 Sámara earthquake .

Costa Rican Electricity Institute



The Costa Rican Electricity Institute (ICE) is a public institution created in 1949 to provide electricity to the entire country. ICE uses hydroelectric, geothermal, wind, and solar sources to produce energy. Today, ICE provides electricity to 99% of Costa Rica's territory, obtained from 100% renewable energy most days of the year. To secure the inversion given by ICE, in 1973 the Seismology and Volcanic Auscultation and threats department was created, and from 1975 became a member of the National Seismological Network of Costa Rica (RSN UCR-ICE).

Strong Ground Motion Simulation of the 2019 Java, Indonesia, Earthquake (*Mw* 6.9) Using Empirical Green's Function Method

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Through the adjustment of the scaling parameters, adequate synthetized waveform of the large intraslab earthquake can be achieved using plate boundary earthquake records

This study estimated strong motion generation area parameters and simulated the strong ground motion of the 2 August 2019 (Mw 6.9) intraslab earthquake and a hypothetical plate boundary earthquake (Mw 8.7) using the strong motion records of the 11 August 2019 (Mw 5.1) plate boundary earthquake with the empirical Green's function method. We first estimated the strong motion generation area that reproduced the strong ground motion during the Mw 6.9 intraslab earthquake and conducted a rough estimation of the scaling parameters to see the impact of these parameters on the performance of the synthetic waveform reproduction. We also adjusted the stress drop ratio parameter (C) for some station records, which is sensitive to waveform amplitude. Adequate synthetized waveform for the estimated strong motion generation area can be achieved for acceleration, velocity, and displacement pulses (Fig. 1).

We then modeled the strong motion generation area of the Mw 8.7 hypothetical plate boundary earthquake using the Mw 5.1 plate boundary earthquake and the Mw 6.9 intraslab earthquake as the element events (Fig. 2). The estimated peak ground acceleration values from the empirical Green's function simulation were compared with the conventional ground motion prediction equation. The comparison provided a simulated acceleration level excited by a hypothetical Mw 8.7 that may occur in the future. The variability of simulated ground motion in terms of methods, source type as the element event, and rupture directivity effect was confirmed.

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Figures

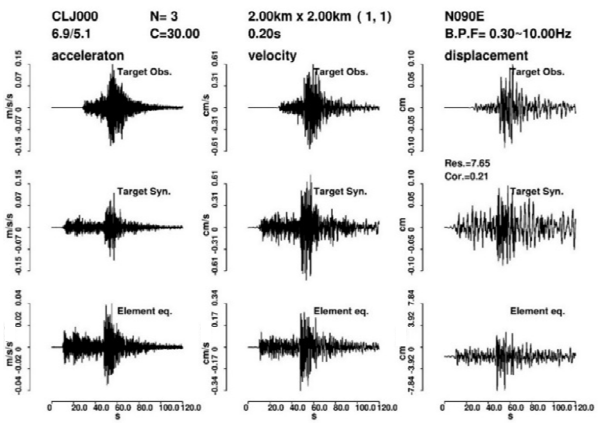

Fig. 1. Ground motion simulation results of the Mw 6.9 intraslab earthquake using the Mw 5.1 plate boundary earthquake at CLJO station (EW component).

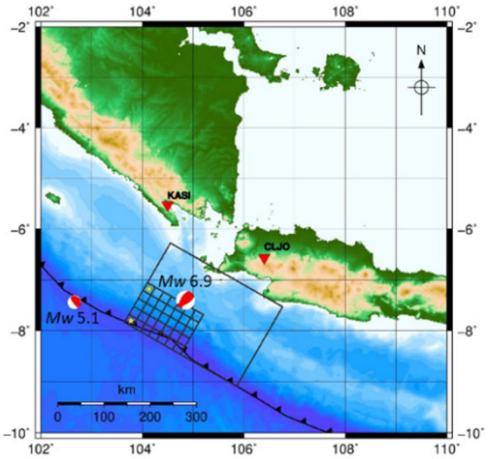

Fig. 2. Strong motion generation area estimated to simulate the Mw 8.7 hypothetical plate boundary earthquake using the Mw 5.1 plate boundary earthquake and the Mw 6.9 intraslab earthquake as the element events.

Agency for Meteorology, Climatology and Geophysics (BMKG)

The Agency for Meteorology, Climatology and Geophysics is a government institution that carries out government tasks in the fields of Meteorology, Climatology, Air Quality and Geophysics in accordance with the provisions of the applicable laws.

Detail Seismic Performance Evaluation of a Twelve (12) Storied Official Building in Dhaka and Suitable Retrofitting Technique

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The detail seismic evaluation is a more rational and practical one to evaluate the seismic performance of the building.

The main purpose of this study is the evaluation of the seismic performance of the existing RC building situated in Dhaka and constructed before the establishment of the National building code, 1993. Currently, Bangladesh National Building Code (BNBC) is being updated. Significance changes in seismic provisions have been brought. Therefore, it is necessary to evaluate seismic performance and the strengthening of old buildings to keep compatibility with the requirement of updated building code. This study compares the seismic evaluation results of building by the 2nd level screening method of Japan Building Disaster Prevention Association (JBDPA), 2001, and detail seismic evaluation method and suggests a suitable retrofit technique. The JBDPA, 2001 standard mainly targets weak-column and applies for low to mid-rise buildings. Therefore, it provides inaccurate results for weak-beam building. On the other hand, the concept of detail seismic evaluation method is based on both the Japanese and the American seismic evaluation method. This method can evaluate the actual behaviors of weak-beam buildings during earthquake events. To evaluate the seismic performance of the building by detail seismic evaluation method, non-linear static pushover analysis was performed according to ATC 40, 1996 / FEMA 273, 1997 /356, 2000 /440, 2005 and ASCE 41, 2013. The damage distribution and sequence of the collapse of the building were observed. It was found that detail seismic evaluation method provided most rational and practical results rather than 2nd level screening method of JBDPA, 2001 from the viewpoint of seismic evaluation of the building due to the target building was found to be weak-beam and high-rise building. Furthermore, the required strength for retrofit was easily estimated by this method. The new shear wall for retrofit proved to be effective in increasing the necessary seismic capacity of the building.

Figure

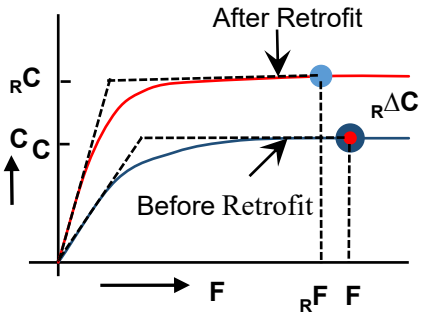

Fig. 1. The calculation procedure of required strength for retrofit. $_RI_{S0}$ is Newly defined based on structural type after retrofit. $_RF$, new ductility index is considered which will be less than the existing F value.

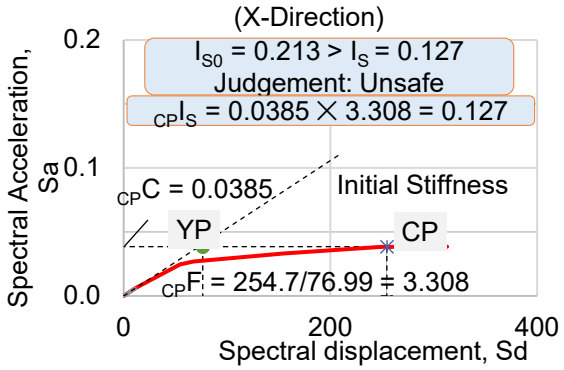

Fig. 2. Evaluation by detail seismic evaluation (X-direction). The seismic index of the structure is found to be 0.127, which is less than seismic demand (0.213). Therefore, it is judged that this building does not have the adequate seismic capacity.

Public Works Department (PWD), Bangladesh

Public Works Department (PWD), under the Ministry of Housing and Public Works, is the pioneer government organization for designing, construction & regulating buildings in Bangladesh. Over about two centuries, PWD could successfully keep up the country's infrastructure development trend and standard. Currently, PWD involves various projects related to earthquake disaster management, especially in retrofit buildings.

Seismic Evaluation and Retrofitting of Traditional Bhutanese Residential House

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The first of its kind conventional fragility curves are developed based on capacity curves derived experimentally for traditional Bhutanese houses.

Traditional stone masonry houses form an integral part of the unique landscape of Bhutan. Unfortunately, these structures are highly vulnerable to seismic activities, but only limited research works for the vernacular masonry constructions. Thus, this paper explicitly deals with the development of seismic technology to strengthen such random rubble masonry structures in mud and cement mortars. This study's basis is the full-scale quasi-static test conducted on two-storied residential houses designed based on a representative sampling of traditional houses for unreinforced and retrofitted types. The proposed seismic intervention is the mesh-wrap retrofitting technique. There are three components in this research study: (i) Three phases of seismic evaluation of random rubble masonry, i.e., specification code, allowable unit stress calculation, and horizontal load-carrying capacity; (ii) Experimental campaigns and FE-based numerical simulations and (iii) Seismic fragility assessment with development of experimental based fragility curves based on capacity spectrum method. Firstly, the seismic evaluation helps in easy assessment and judgment of the seismic capacity, employing simple hand calculations without using a sophisticated analysis tool. Secondly, the full-scale quasi-static test reveals that the proposed mesh-wrap retrofitting technique effectively increases the seismic capacity of such structures, i.e., 1.58 times the base shear of conventional (unreinforced) structures. We developed a Finite Element based numerical models and conducted non-linear pushover analyses. The FE-numerical model was capable of simulating the structural response similar to the experimental campaign. Thirdly, the developed fragility curves are first of its kind for stone masonry houses of Bhutan, with a clear definition of limits states.

Figures

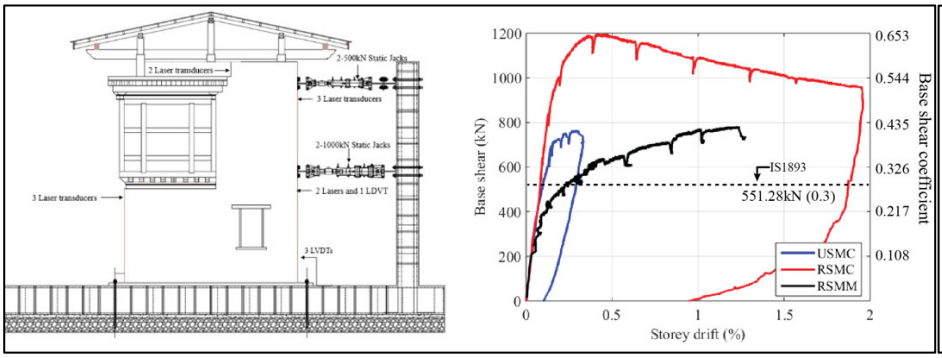

Fig. 1. Schematic full-scale quasi-static test setup (left) and Experimental capacity curves in terms of base shear (kN) and top storey drift (%) for Unreinforced rubble Stone Masonry in Cement mortar (USMC),Retrofitted rubble Stone Masonry in Cement mortar (RSMC) and Retrofitted rubble Stone Masonry in Mud mortar (RSMM) in blue, red and black lines respectively (right).

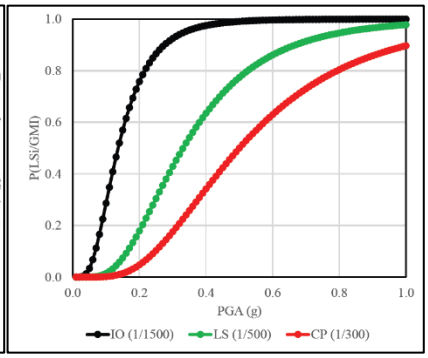

Fig. 2. Fragility curve of USMC house. Each dotted lines corresponds to limit states: Immediate Occupancy (IO), Life Safety (LS) and Collapse prevention (CP). Similar curves are also developed for RSMC and RSMM structures.

Department of Culture, Ministry of Home and Cultural Affairs

The Department of Culture is a government entity responsible for the sustenance of cultural heritage and Bhutan's cultural landscape for the present and future generations, amongst other mandates. It places importance on integrating cultural heritage into all areas of national development. *"A nation stays alive when its culture stays alive"*. Please refer to http://www.departmentofculture.gov.bt for more details.

Proposal of Ground Motion Prediction Equation (GMPE) for Chilean Ground Motion Records and Its Application

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Shojiro KATAOKA (Supervisor)
National Institute for Land and Infrastructure Management, JAPAN

A Japanese Ground Motion Prediction Equation modified by Chilean records, has a correct correlation with Chilean Earthquakes.

After the 2010 Chilean Earthquake, buildings design code was upgraded in topics related to spectrum design and soil classification. However, the bridge's design code keeps the same spectrum design and the same soil classification. Therefore, it is necessary to analyze it. The main target of this research is to propose a Ground Motion Prediction Equation (GMPE), to predict seismic intensity in different locations in Chile, and analyze current spectrum design for bridges. Due to a short time of research, I use an existing GMPE given by Dr. KATAOKA Shojiro from NILIM. This equation was developed in Japan; therefore, it is based on Japanese soil classification and its natural period. The current soil classification in Chile inside the bridges' code, is not depending on the natural period of the soil. Therefore, it is necessary to create a database with this modification or correlation to be able to use this GMPE in Chile. The essential information will be obtained from the national seismic network supervised by the University of Chile. The activities in this research are: (a) Create a database with a natural period of soil for each seismic station in Chile. For this, I will obtain acceleration records from the seismic station in Chile. In addition, I will get all the input information to use GMPE (the type of soil, the depth of hypocenter, and the shortest distance from the seismic station to the rupture area). (b) Find the modification factor for the equation using the geometric mean value of the spectrum ratio (acceleration spectrum over the predicted acceleration spectrum). The geometric mean value must trend to 1. (c) Validate GMPE Modified with Chilean accelerometers records for earthquakes with seismic intensity between 5.0 Mw and 8.8 Mw. (d) Use this modified equation in some study cases, and (e) Analyze the current spectrum design of the Road Manual in Chile. The results show that the GMPE Modified geometric mean value trend to one and develop a correct correlation with Chilean Acceleration Records.

Figure

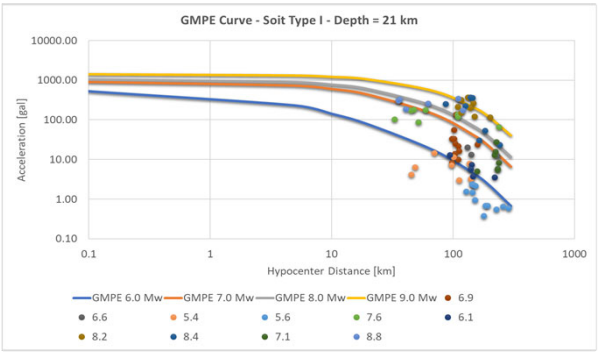

Fig. 1. GMPE Modified curve for soil type I and depth equal to 21 km magnitude 6 Mw, 7 Mw, 8 Mw and 9 Mw. Dots are Chilean acceleration records in Mw.

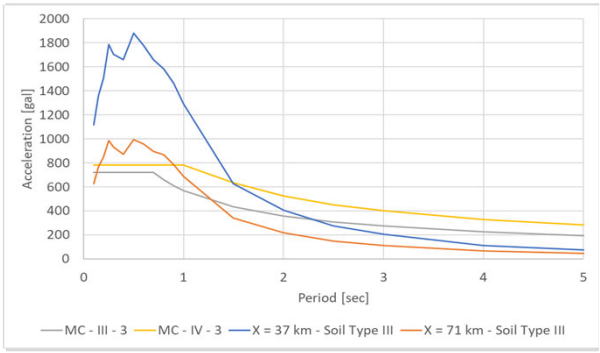

Fig. 2. GMPE Modified Acceleration Response Spectrum comparing with Road Manual (MC). X is the hypocenter distance. The current spectrum design must be upgrade and increase the acceleration peak.

Ministry of Publics Works

The Ministry of Public Works (MOP) is the cabinet-level administrative office in charge of planning, studying, designing and constructing as well as repairing, maintaining and operating public infrastructure in Chile.
Its work embraces roads, highways, bridges, tunnels, airports and airfields. It is also responsible for the management, distribution, use and conservation of all water resources within the country.

Evaluation and Retrofitting of a Historic Adobe Masonry Building

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Overlay walls, a technique widely used in Japan to retrofit RC structures, can improve the seismic capacity of a real Adobe Masonry Building.

Most old buildings in El Salvador are made out of adobe, a type of earth masonry that is built using traditional techniques. Their architectural beauty and their ancient origins are why they are considered Cultural Heritage. But there is a problem: They are extremely weak against earthquakes. After several devastating earthquakes, people understood the importance of seismic retrofitting. However, adobe is a non-engineered material, and thus, there are too few studies of its seismic behavior and almost no studies regarding its retrofitting. This study was conducted to find the best retrofitting solution for adobe buildings. A 150-years-old historic adobe building was evaluated, and three retrofitting alternatives were selected: Polypropylene band wrapping, Reinforced Concrete (RC) wall affixing, and RC frame affixing. Three analysis methods were used to determine the seismic performance of each alternative: Seismic Index (Is), capacity spectrum method, and response history analysis. Finally, two levels of seismic demand were used: A high level, taken from the Salvadorian Seismic Code, and a lower level, taken from a Probabilistic Seismic Hazard Analysis. Each retrofitting alternative was compared, by their seismic performance, the amount of material needed, and their impact on the historic value of the building. The Polypropylene band wrapping solution was not enough for a building which was very fragile and located at a site with high seismicity. The RC frame affixing solution worked, but it requires partial demolition works and causes extensive cracking on the walls. Finally, the Backside wall affixing technique provided the right balance between its impact on the historic value of the building and seismic performance, while presenting a failure mode that protects the walls from damage. Therefore, this is the best solution to retrofit the target building.

Figure

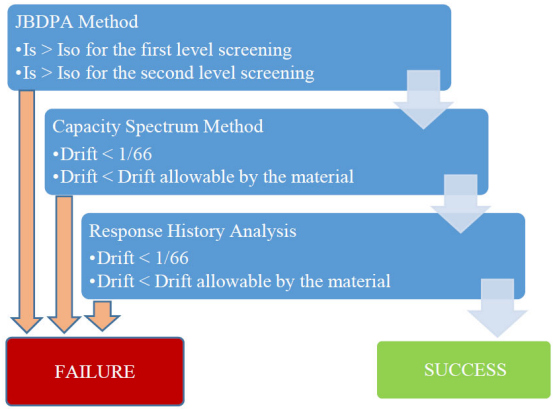

Fig. 1. Flowchart with the evaluation process for each retrofitting solution.

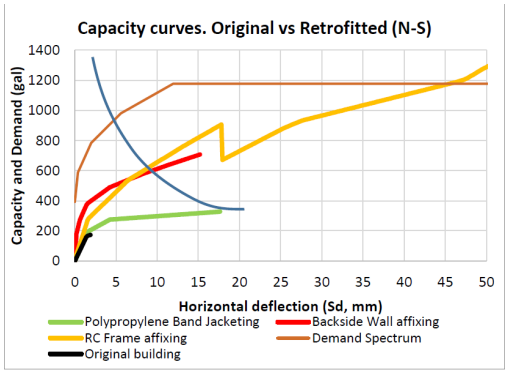

Fig. 2. Capacity curves of all the retrofitting techniques and the original building in the N-S direction. The high demand spectrum and the demand line are shown.

Ministry of Culture, El Salvador

The Ministry of Culture (MICULTURA), established in 1991, is the institution that guarantees the conservation, promotion and dissemination of culture in El Salvador. It is the only institution in the national government in charge of the conservation of Historic Buildings, through its Department of Built Heritage (DPCE).

Seismic Evaluation and Retrofitting of Existing Reinforced Concrete Buildings in Myanmar

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Installing RC Shear Walls and RC Column Jacketing are appropriate retrofitting methods in Myanmar

Myanmar is an earthquake-prone country. In this study, hazard maps were initially used to implement an earthquake disaster mitigation strategy. Two cities, in particular, Mandalay and Yangon, were selected to investigate the hazard risk of buildings in the high and low seismic zones. A three-story reinforced concrete (RC) building with brick walls was evaluated by the Japan Building Disaster Prevention Association (JBDPA) standard and the Capacity Spectrum Method (CSM). The Standard Japanese guide has three seismic screening levels: the first, second, and third. These three levels were used for the seismic evaluation and verification of seismic retrofitting of existing low-rise and medium-rise RC buildings. The CSM is used to analyze the maximum response of a structure under an earthquake ground motion. In this study, the first and second screening levels were used to check the building's seismic capacity. The building was analyzed again by the CSM using the STERA 3D program. After evaluating the target building with the JBDPA standard and the CSM, the target building did not meet requirements. Two simple retrofitting methods, RC column jacketing and RC shear wall, were applied in order to retrofit the target building. After construction of a small number of RC shear walls and increasing the size of selected columns on the 1st story, the building could be designated safe, even in a very high seismic zone. The results showed that we could obtain satisfactory earthquake-resistant buildings. Therefore, the Japanese seismic evaluation and retrofitting methods can be adopted in Myanmar to evaluate and upgrade the seismic performance of the existing RC building.

Figure

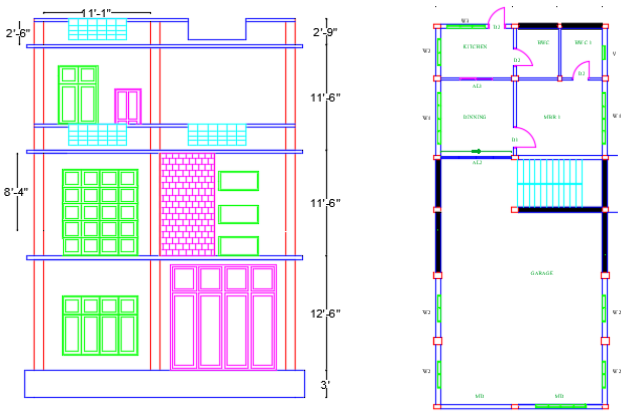

Fig.1. Front elevation and the first floor's plan of the target building. The blue lines in the plan show shear walls for retrofit.

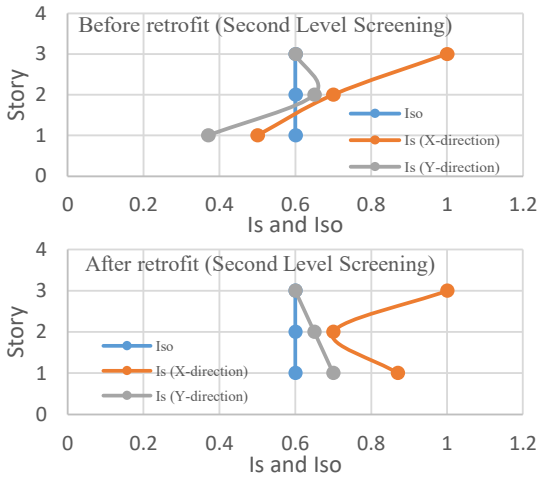

Fig.2. Comparison of Is (capacity) with Iso (demand) before and after retrofit

Department of Meteorology and Hydrology (DMH)

The Department of Meteorology and Hydrology (DMH) is under the Ministry of Transport and Communications. The DMH aims to take precautionary measures against and diminish the effect of natural disasters, to promote safety, comfort, and efficiency of air, land, sea, and water transportations, to promote agriculture and food production, to ensure efficient operation, development of activities in defense, health, social welfare and all sectors of the national economy, and to bring sustainable development of natural resources.

Seismic Performance Evaluation for Continuous Use of an Existing Bridge in Nepal

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For the continuous use of an existing bridge designed under the old IRC codes, the structure should be retrofitted with steel jacketing.

Road network is still the primary transportation system in Nepal, and bridges are the most sensitive part of that system. Most of the bridges were constructed about 40-50 years ago based on the design life of 50 years and traffic forecast for 30 years. The design was based on an allowable stress method as per Indian Road Congress (IRC) guidelines. In those codes, a small value of seismic design force was considered, and also there was no provision for shear design of a compression member. The effective design life of these structures is coming to an end. After the 2015 earthquake, there is an earnest need for seismic evaluation to propose some retrofitting techniques for the continuous use of existing bridge structures in Nepal.

The structure was evaluated separately for the allowable stress method and ultimate capacity method as per the revised code. The seismic performance of the bridge was then estimated with the Capacity Spectrum Method and the Response History Analysis. These analyses imply that the structure has enough capacity to meet the seismic demand as per the revised code or when the double lane standard deck replaces the existing one. Though the pier had a high capacity, the pounding occurred in the longitudinal direction. As the abutment restricted the movement, the damage is concentrated on the superstructure rather than the pier. The shear failure occurred in the transverse direction, which is not accepted for safety purposes. Therefore, the structure should be retrofitted to increase its shear capacity. For this purpose, steel jacketing was proposed for the continuous use of an existing structure as it is a very suitable method for developing countries such as Nepal.

Figure

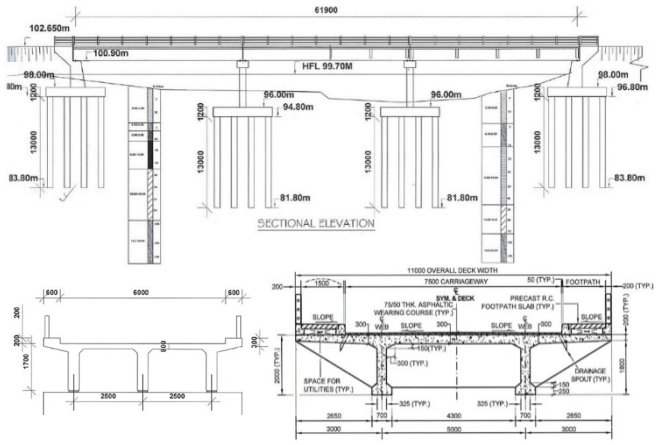

Fig. 1. The target bridge structure with the existing and newly proposed superstructure.

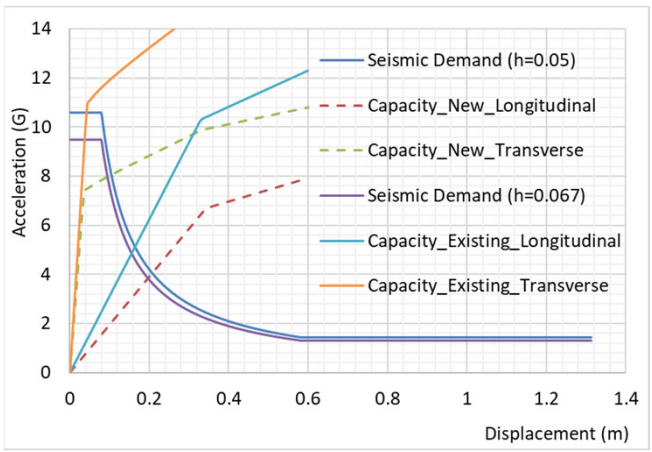

Fig. 2. Capacity curve versus demand spectrum for the existing and new superstructure.

Road Division, Palpa, Department of Roads (DoR), Kathmandu, Nepal

Road Division, Palpa is one of the divisional office under the DoR. The main objective is to develop, expand, and strengthen the road network in a sustainable way for enhancing the overall socio-economic development. The major responsibilities are planning, designing, procurement, construction, maintenance and supervision of national highways and bridges.

Earthquake Performance Evaluation of Typical Bridge Structures with Seismic Isolation and Soil Structure Interaction in the Philippines

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Lead rubber bearing (LRB) exclusively functioned towards rigid structures with either fixed supports or pile foundations.

The current seismic code for bridges in the Philippines, Bridge Seismic Design Specifications (BSDS), adopts concepts from the American Association of State Highway and Transportation Officials' (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 2012. It utilizes the Force-Based Design (FBD) approach, which has been applied in bridge seismic design since the 1990 Luzon Earthquake. However, AASHTO recently recommends the use of Displacement-Based Design (DBD) as an alternative approach in defining seismic performance levels. This approach utilizes displacement as the main parameter to establish seismic performance, predicting damage states more accurately. The study attempts to adopt the DBD method concept to investigate the effects of seismic isolation and soil-structure interaction (SSI) towards typical bridge structures in the Philippines. The approach for evaluating the structure's limit state and seismic performance was conducted following the provisions of the Japan Road Association Specifications for Highway Bridges (JRASHB), 2012. The application of isolation bearings on structures with distinctive natural periods was evaluated based on its effectivity and applicability. The seismic isolation bearing, lead rubber bearing (LRB), exclusively functioned when applied to rigid structures incorporating either fixed support or pile foundation conditions. Moreover, earthquake response analysis was also performed to analyze its influence on the structure to develop a more accurate representation of its seismic response. Furthermore, the effects of the individual and combined contribution from the parameters were evaluated on its significance in affecting seismic performance.

Figures

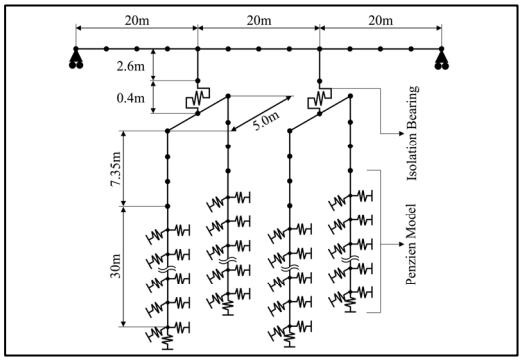

Fig. 1. Multi degree of freedom system of the bridge considering soil-structure interaction and seismic isolation.

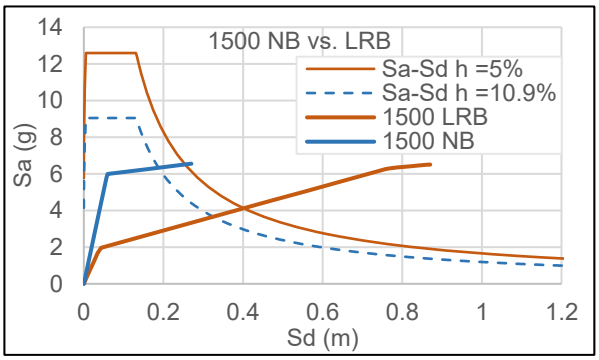

Fig. 2. Capacity Curve vs Demand Spectrum of the 1500-F-NB and 1500-F-LRB models along the longitudinal direction.

Department of Public Works and Highways

The Department of Public Works and Highways functions as the engineering and construction arm of the Government to continuously develop its technology for the purpose of ensuring the safety of all infrastructure facilities and securing for all public works at the highest efficiency and quality in construction. DPWH is currently responsible for the planning, design, construction and maintenance of infrastructure, especially the national highways, flood control and water resources development system, and other public works in accordance with national development objectives.

Tsunami Modeling of the Anak Krakatau Volcano for Development of Tsunami Warning System in the Sunda Strait

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Sea level sensors evaluation is expected to provide important consideration for a development of the tsunami warning system for non-tectonic tsunami sources.

A tsunami caused by the Anak Krakatau volcano on 22 December 2018 resulted in significant casualties and property losses. Using the simplified landslide source models, we validated tsunami modellings by comparing the observed tsunami waveforms at four tide gauges and measured tsunami heights from field surveys with the calculated ones. We also conducted sensitivity tests changing the source parameters and tsunami simulation settings. For the 2018 tsunami event, observed waveforms at tide gauges were almost reproduced in terms of initial wave arrival times and its amplitudes, although those at the tide gauges in Sumatra were not so well reproduced in terms of the wave period. We calculated correlation indexes to quantitatively evaluate the simulation results, and found that the calculated tsunami heights are almost half of the observed ones (Fig. 1).

In addition to the 2018 event, we assumed two future scenarios of landslide to the directions of north and southeast from the geological activities of Anak Krakatau. Tsunami height simulations for the three events were conducted to evaluate the potential tsunami hazard. Then, we identified that Labuhan and Carita beaches in Banten, and the Kalianda beach area, southern Lampung have the most significant potential to be hit by tsunamis with the heights of 2.5 - 6 m.

We also calculated the first-wave arrival time differences between the ocean bottom pressure gauge (OBPG) near Anak Krakatau and nine tide gauges at the coast along the Sunda Strait. The results show that there are the leading times of 15 - 20 min for evacuation after the tsunami warning issued according to the detection of the first wave at OBPG (Fig. 2). The evaluation of these sensors is expected to provide important consideration for a development of the tsunami warning system for non-tectonic tsunami sources.

Figure

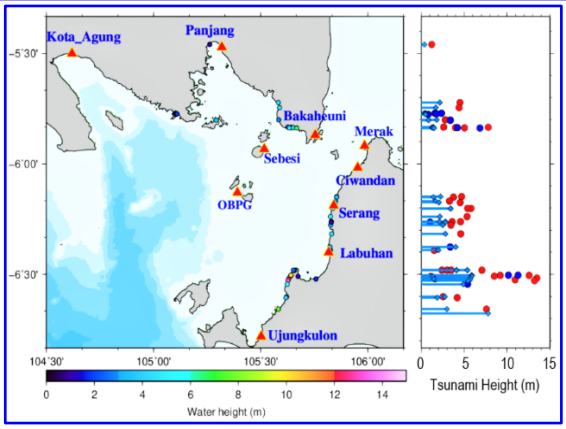

Fig. 1. Locations of sensors and comparison of measured tsunami heights (red and blue circles) and calculated ones (blue bars) for the 2018 tsunami.

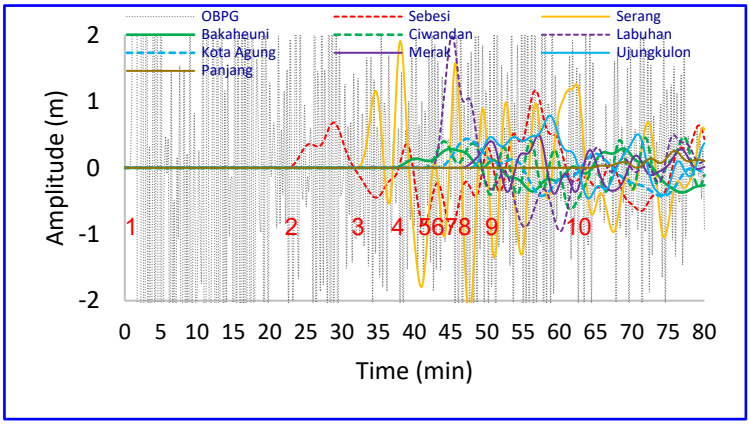

Fig. 2. Tsunami waveforms calculated at OBPG and tide gauges for the 2018 event. The numbers in red show the first arrival times of initial waves.

Indonesian Agency for Meteorology Climatology and Geophysics (BMKG)

BMKG is a non-departmental government agency that carries out government tasks in the fields of Meteorology, Climatology, Air Quality and Geophysics in order to support public safety and the success of national development, and plays an active role at the international level. Indonesia Tsunami Early Warning System at BMKG is tasked with providing earthquake information and tsunami early warnings on a national scale, ASEAN and to countries around the Indian Ocean.