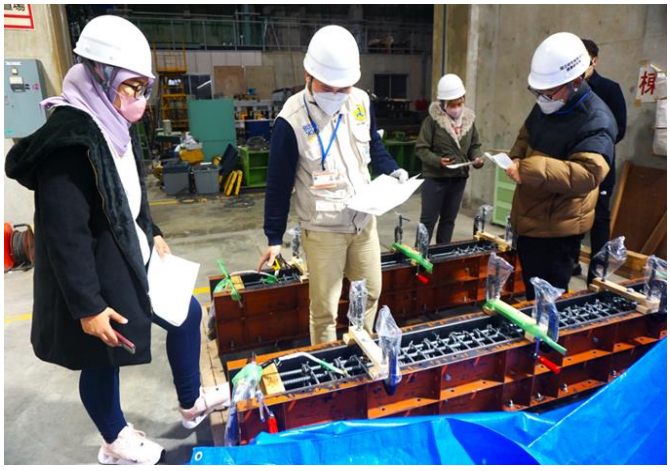
IISEE International Institute of Seismology and Earthquake Engineering

Building Research Institute B R I

Selected Abstracts of 2022-2023 Training Course



IISEE Newsletter Special Edition
November 2023

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 2022-2023 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/jp/information/syndb/

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

We hope this booklet will help you.

Hiroto Nakagawa (E Course leader)
Tatsuhiko Hara (S Course leader)
Yushiro Fujii (T Course leader)

International Institute of Seismology and Earthquake Engineering,
Building Research Institute
1 Tachihara, Tsukuba, Ibaraki 305-0802, JAPAN.
E-mail: iisee@kenken.go.jp

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Seismology Course

Engineering Course

Tsunami Course

Citation: Adam, H. A., T. Hayashida (2023), Estimation of crustal structure in northern Egypt using broadband seismic Ambient noise (5-50 s), Abstract of OOSEE-GRIPS Master's Thesis.

ESTIMATION OF CRUSTAL STRUCTURE IN NORTHERN EGYPT USING BROADBAND SEISMIC AMBIENT NOISE (5-50 s)

Hany ADAM
National Research Institute of Astronomy and Geophysics (NRIAG), EGYPT
E-mail : hany.adam@nriag.sci.eg
Takumi HAYASHIDA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Used seismic ambient noise to calculate shear wave velocity models at Northern Egypt

This study presents a comprehensive group velocity map for the crustal structure estimation in Northern Egypt using ambient noise tomography (ANT) focusing on periods from 5 to 50 s. The study area covers Northern Egypt and surrounding regions bounded by the Red Sea to the east and the Mediterranean Sea. We collected seismic ambient noise data from 24 broadband seismic stations in the North part of Egypt (Fig. 1) from July 2021 to June 2022, with an interstation spacing ranging from 50 to 1000 km. Green's Functions were derived from the cross-correlation of the recorded data, resulting in 276 station pairs for analysis. Accordingly, 100 to 250 reliable measurements were selected based on the signal-to-noise ratio and the standard deviation of seasonal dispersion curves. Utilizing the dense coverage of the ray paths enabled the generation of group velocity maps with 5 to 30 s periods (example in Fig. 2), offering spatial resolutions between 50 and 400 km. The derived map revealed two distinct structural zones in the upper crust: a high-velocity zone in the eastern part and a low-seismic velocity zone in the western part (Fig. 2). To further validate the results, we obtained one-dimensional shear wave velocity profiles were inverted from the observed group velocities (example in Fig. 3). We found that the estimated Moho depths range from 35 km in the north and eastern parts to 40 km in the southwestern region, which are comparable with those obtained from receiver function results. Our results show that ANT is a powerful and advantageous tool, particularly in nonactive seismic areas, effectively overcoming the challenges encountered in conventional approaches based on seismic recordings.

Graphical abstract

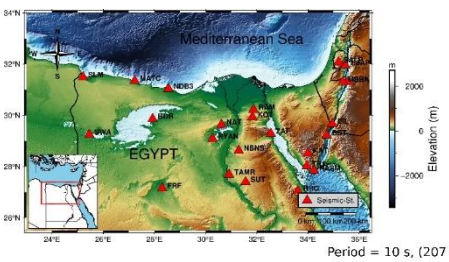


Fig. 1. Tomographic map of the study area. Red triangles refer to 24 broadband seismic stations used in this study.

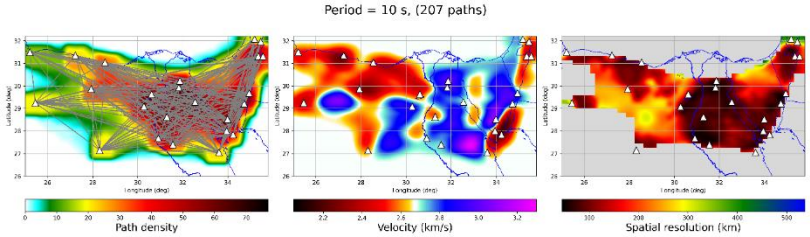


Fig. 2. Example of Rayleigh wave group velocity map at periods 10 s. (Left) path densities for each grid node from 207 station pairs. (Middle) group velocity distribution. (Right) spatial resolution map from 50 to 500 km.

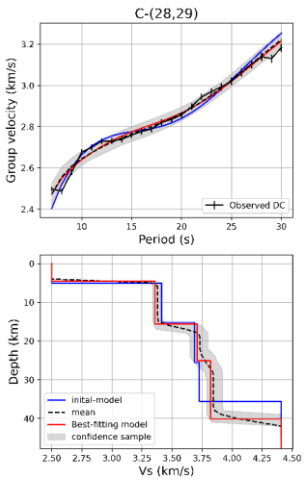


Fig. 3. Example of derived group velocity dispersion curves at point C(Latitude: 28º, Longitude: 29º) in the Northwestern Desert (top panel) The red line indicates the theoretical group velocities derived from the best-fitting 1D structure model (red trace in the bottom panel).

National Research Institute of Astronomy and Geophysics (NRIAG)

National Research Institute of Astronomy and Geophysics (NRIAG), is an organization established in 1903 in Helwan city, Egypt. It was established at the beginning for astronomical observation, then expanded to include earthquake observation. Now NRIAG includes four main department: Seismology, Astronomy, Geodynamics, and Electric and Magnetic.

Citation: Shalaby, I., T. Hayashida (2023), Ground motion simulation of a significant earthquake in Egypt, Abstract of IISEE-GRIPS Master's Thesis.

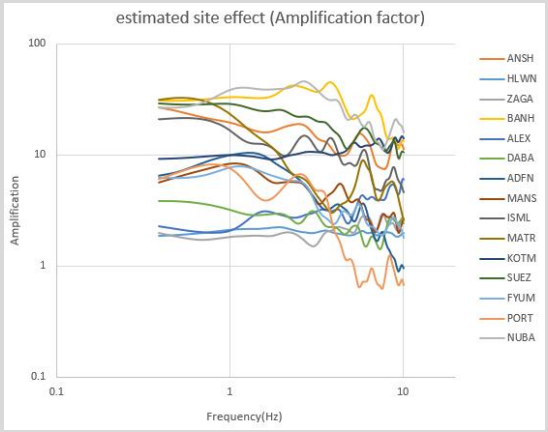
Ground Motion Simulation Of A Significant Earthquake In Egypt

Ibrahim SHALABY
National Research Institute of Astronomy and Geophysics, Helwan, Cairo, EGYPT
E-mail : geoyousef2010@gmail.com
Takumi HAYASHIDA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

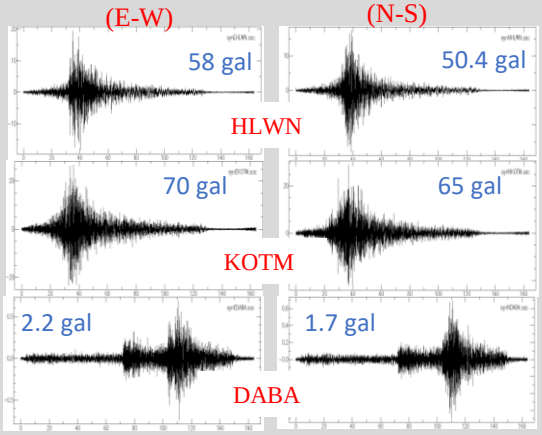
Abstract

Physics-based information was obtained for the simulation of strong ground motions for potential earthquakes in Egypt.).
Destructive and significant earthquakes, such as the 1992 Dahshur Earthquake in Egypt (Mb5.8), may recur with varying magnitudes and intensities. Earthquake simulation necessitates three essential pieces of information: the characteristics of the seismic source, the path through which seismic waves propagate, and the amplification factors specific to the site. The objective of this study is to disentangle the effects of the source, site, and propagation path for earthquakes recorded by the Egyptian Strong-Motion Network (ESMN), aiming to simulate ground motions that might be associated with a significant earthquake recurrence in Egypt. We employed the spectral inversion method (generalized spectral inversion technique: GIT), utilizing ground motion data collected from 20 stations across 52 earthquakes ranging from magnitude 3.0 to 7.8. Station HLWN was designated as a reference station representing a rock site, while station ANSH served as a divisor site due to its record of the maximum number of seismic events in the GIT based on Moya and Irikura (2003). Subsequently, we utilized the information derived from GIT, in conjunction with phase data from a minor earthquake in Cairo, to simulate ground motions anticipated during a potential earthquake scenario in Cairo, assuming a moment magnitude (Mw) of 7.0. The simulated waveforms indicate peak ground accelerations of 58 cm/s^2 at station HLWN, located approximately 35 kilometers from the epicenter. This finding implies the potential for significant ground motions extending into densely populated areas. Ultimately, this study underscores the effectiveness of GIT in providing physics-based estimations of ground motion in Egypt.

Graphical abstract



Estimated site amplification factors at each frequency at each station. Almost all the station site amplifications decreased when the frequency increased. This was mainly observed in frequencies higher than 1.0 Hz.



Simulated waveform and PGA values for an Mw7.0 earthquake at the E–W and N–S components at stations HLWN, KOTM and DABA.

National Research Institute of Astronomy and Geophysics (NRIAG)-Helwan-Cairo-Egypt

The National Research Institute of Astronomy and Geophysics (NRIAG)- first modern observatory operated at Bulaq in western Cairo from 1840 to 1860 (Boulac Observatory). In 1865 an astronomical and geophysical observatory was established at Abbasya , east of Cairo. In 1903 the observatory was moved to Helwan. The most important roles of NRIAG to study Earth's crust movements and subsurface study. Also, to study the space and solar studies.

Citation: Sawi, P., S. Kita (2023), Machine-learning-based phase picker: Analyzing the temporal and spatial changes of the October 2019 Cotabato and December 2019 Davao Del Sur earthquakes, Abstract of IISEE-GRIPS Master's Thesis.

Machine-learning-based phase picker: Analyzing the temporal and spatial changes of the October 2019 Cotabato and December 2019 Davao Del Sur Earthquakes

Paulo Pangan SAWI
Department of Science and Technology – Philippine Institute of Volcanology and Seismology (DOST-PHIVOLCS) , PHILIPPINES
E-mail : paulo.sawi@phivolcs.dost.gov.ph
Saeko KITA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Hypocenter determination using a machine-learning-based phase picker, unlocks a fault system pattern in the Philippines.

A deep-neural-network-based phase picker, PhaseNet, was used to pick the arrival times of the P and S waves during the earthquake sequence in Cotabato and Davao del Sur, Philippines, which occurred from October to December 2019, involving five M~6 inland earthquakes with magnitudes MW 6.4, 6.6, 5.9, 6.5 and 6.7. In this study, we utilized 80 days of seismic data from stations located within 200 km of the event area and input them into PhaseNet for analysis. The phase picks, the output of PhaseNet, were first associated and initially located using Rapid Earthquake Association and Location (REAL). Subsequently, the earthquakes were relocated using VELEST. The hypocenters were further refined using the relative location method called HypoDD. Using these methods, we successfully created an earthquake catalog comprising 5,017 earthquakes, which is more than those on the list by the Department of Science and Technology – Philippine Institute of Volcanology and Seismology (DOST-PHIVOLCS) on their website. This catalog reveals the spatial and temporal changes in seismicity following each significant event. It also uncovers detailed patterns in aftershock clustering, which are likely linked to complex fault system structures that may have contributed to the seismic activity.

Graphical abstract

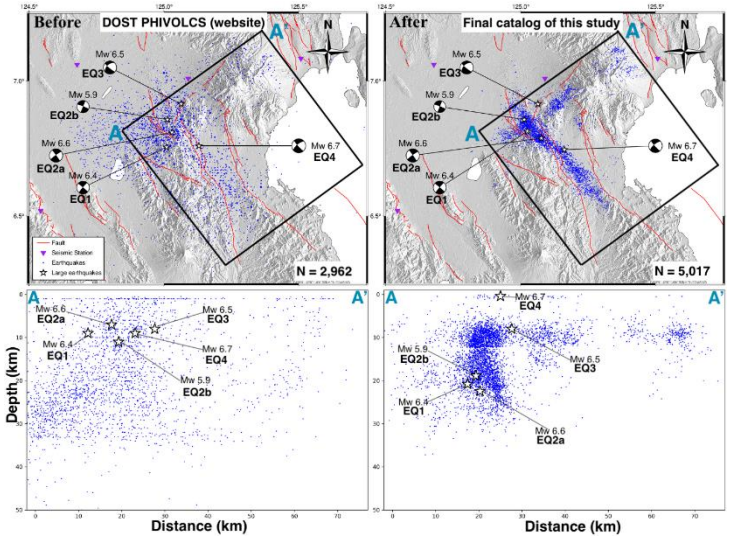


Fig. 1. Distribution of hypocenters. Routine catalog by DOST-PHIVOLCS (website) versus the final catalog of this study after applying HypoDD.

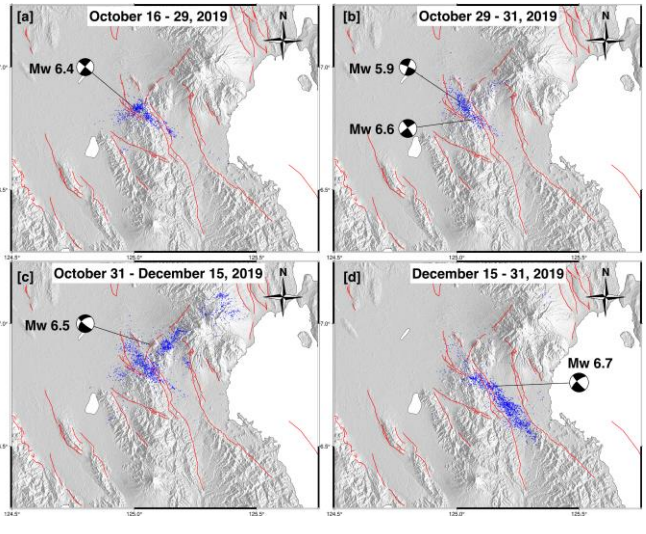


Fig. 2. The spatial and temporal changes following the occurrence of a significant large earthquake. The beach ball represents the location of a large earthquake, while the blue circles indicate the hypocenters of aftershocks.

Department of Science and Technology – Philippine Institute of Volcanology and Seismology (DOST-PHIVOLCS)

The DOST-PHIVOLCS is a mandated agency responsible for mitigating disasters that may arise from volcanic eruptions, earthquakes, tsunami, and other related geotectonic phenomena in the Philippines. Its mission is to provide timely, high-quality, and socially inclusive information and services for warning, disaster preparedness, and mitigation.

Citation: Sulthan, F., M. Seki, H. Nakagawa, Y. Otsuka (2023), Seismic fragility analysis of fixed and isolated base reinforced concrete building structures in Indonesia, Abstract of IISEE-GRIPS Master's Thesis.

Seismic Fragility Analysis of Fixed and Isolated Base Reinforced Concrete Building Structures in Indonesia

Faiz SULTHAN
Implementation Unit for Building Materials and Structures, Directorate General of Human Settlements, Ministry of Public Works and Housing, INDONESIA
E-mail : faiz.sulthan@pu.go.id
Matsutaro SEKI, Hiroto NAKAGAWA, and Yuri OTSUKA (Supervisors)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

The comparison of fragility analysis on seismic isolation systems and conventional reinforced concrete building structures in Indonesia

Indonesia has had seismic codes for earthquake-resistant structure designs since 1970 and has been updated five times to the latest in 2019. In updating the Indonesian seismic codes, seismic hazard maps for design also update, and there are changes to the Peak Ground Acceleration (PGA). The Indonesian seismic design uses the concept of building performance levels consisting of Immediate Occupancy (IO), Life Safety (LS), and Collapse Prevention (CP). In relation to these performance levels, some cases have shown that buildings suffer from huge damage compared to their performance targets after an earthquake. Considering this issue, the current study aims to analyze the performance of the seismic isolation system design (isolated) on existing target buildings (fixed) and analyze seismic fragility with the PGA intensity according to Indonesia's seismic hazard maps of 0.1–1.5 g. The target building used in this study is a prototype design eight-story medium-rise residential building that uses the reinforced concrete moment frame structure. The analysis uses Nonlinear Time History Analysis (NLTHA) for the design and Incremental Dynamic Analysis (IDA) for seismic fragility. Both analyses use 11 selected ground motions based on soil classification, magnitude, fault distance, and earthquake source mechanism. The NLTHA results reveal that using a seismic isolation system can increase the target building's performance level from LS to IO. A comparison of the IDA results depicts a trend of significant performance improvement. That is, with the same performance level target and risk category, the isolated base structure can be used at 1.46–3.20 times higher PGA than the fixed base structure. The fragility analysis results show that the fixed base structure has a 30% safety margin and a 62.5% isolated base structure from the PGA design. The obtained results are useful for assessing existing buildings or considering a new building's performance.

Figure

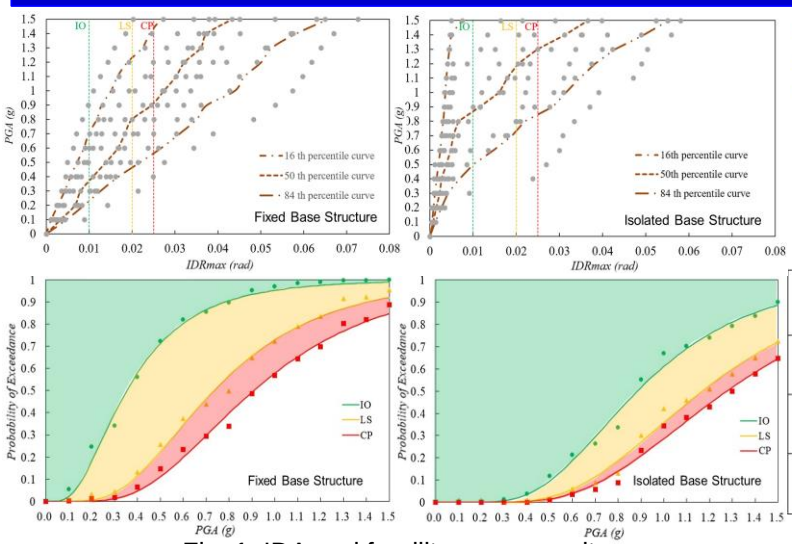


Fig. 1. IDA and fragility curve result

Fig. 2. Performance levels criteria (ASCE 41-17)

Risk Category	POE (ASCE 7-16)	PGA limit					
		Fixed structure			Isolated structure		
		IO	LS	CP	IO	LS	CP
I-II	25 %	≤0.23 g	>0.23 g ≤0.52 g	>0.52 g ≤0.65 g	≤0.65 g	>0.65 g ≤0.87 g	>0.87 g ≤0.95 g
III	15 %	≤0.18 g	>0.18 g ≤0.43 g	>0.43 g ≤0.54 g	≤0.56 g	>0.56 g ≤0.75 g	>0.75 g ≤0.81 g
IV	9 %	≤0.15 g	>0.15 g ≤0.37 g	>0.37 g ≤0.47 g	≤0.48 g	>0.48 g ≤0.65 g	>0.65 g ≤0.70 g

Fig. 3. PGA values range of performance levels at target reliability

Indonesia Ministry of Public Works and Housing

Implementation Unit for Building Materials and Structures, Directorate General of Human Settlements, formerly widely known as Materials and Structures Laboratory in Research Institute for Human Settlements (RIHS or PUSKIM in Indonesian). This institution is under the Indonesia Ministry of Public Works and Housing and is tasked to conduct materials and building structures testing, earthquake engineering studies, post-earthquake structure buildings assessment, and provide technical advice on the existing building or the impact buildings after the earthquakes.

Citation: Iqbal N.S., S. Nakai (2023), Soil type dependency on the seismic performance of the RC precast government residential building, Abstract of IISEE-GRIPS Master's Thesis,

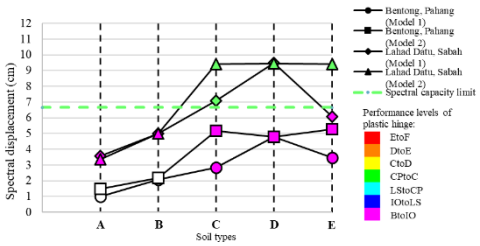
Soil type dependency on the seismic performance of the RC precast government residential building

Nur Shajihan Binti MOHAMED IQBAL
Public Works Department of Malaysia (PWD), Kuala Lumpur, MALAYSIA
E-mail : shajihan@jkr.gov.my; shajihan91@gmail.com
Shoichi NAKAI (Supervisor)
Professor Emeritus, Chiba University, and Visiting Research Fellow, International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

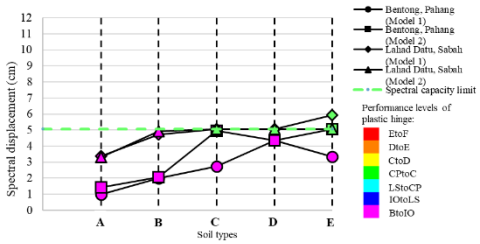
Malaysia's capability against earthquakes: navigating the soil variations

The latest occurrence of earthquake in Ranau on June, 5 2015 that had caused casualties and damages to properties, triggered Malaysia to take immediate actions to deal with all the issues. Following that, the national seismic code and National Annex were introduced in 2015 and 2017 respectively. However, buildings constructed before both documents were established do not consider seismic requirements. This study is conducted to evaluate the seismic performance of the target building and improves it with suitable seismic retrofit methods. A 5-story RC precast government residential building is selected to be evaluated based on the seismic hazard level at Bentong, Pahang with $a_g = 0.106$ g and Lahad Datu, Sabah with $a_g = 0.192$ g considering soil profile models available in Malaysia. Capacity spectrum method is carried out to estimate the performance points based on specific seismic hazard levels with different soil profile models. The seismic performance of the building is then evaluated based on the performance level of plastic hinges formation observed at the performance points. Finding indicates that the target building can survive based on the seismic hazard level at Bentong, Pahang with soil profile model 1 without requiring any seismic retrofitting. Nonetheless, it cannot survive concerning the soil type E of soil profile model 2. For the seismic hazard level at Lahad Datu, Sabah, the target building cannot survive concerning the soil types C, D and E of soil profile model 1 and 2. Seismic retrofit plan is applied to the target building, and the seismic performance of the retrofitted building is re-evaluated. The finding shows that the retrofitted building can survive based on both seismic hazard levels with soil profile models 1 and 2.

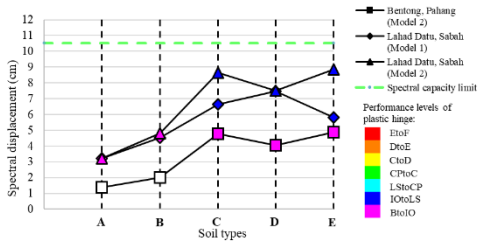
Figures



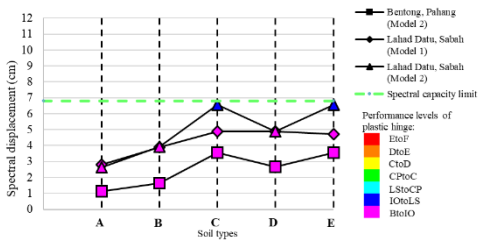
(a) Existing building in X-direction



(b) Existing building in Y-direction



(c) Retrofitted building in X-direction



(d) Retrofitted building in Y-direction

Figures (a) and (b) show the maximum inelastic displacement of the existing building in X and Y directions respectively, meanwhile figures (c) and (d) show the maximum inelastic displacement of the retrofitted building in X and Y directions respectively, based on the seismic hazard level at Bentong, Pahang and Lahad Datu, Sabah with different soil profile models.

Public Works Department (PWD) of Malaysia

PWD of Malaysia has been established since 1872 and is the largest government technical department in Malaysia which serves under the Ministry of Works (MOW). It plays a role in implementing infrastructure development and maintenance projects to various ministries, departments, statutory bodies and state governments such as roads, buildings, airports, ports and jetties.

Citation: Nasuha, M. Z., T. Azuhata (2023), Seismic performance evaluation of a hybrid RC frame – precast wall building in Malaysia, Abstract of IISEE-GRIPS Master's Thesis.

Seismic Performance Evaluation of A Hybrid RC Frame – Precast Wall Building In Malaysia

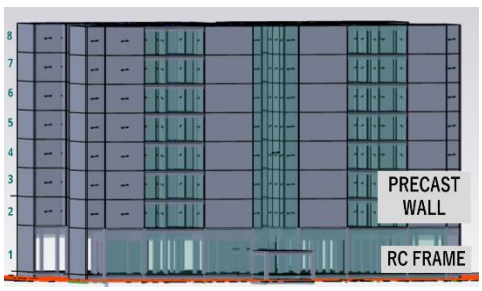
Nurul Nasuha binti MD ZIN
Civil and Structural Engineering Branch, Public Works Department, MALAYSIA
E-mail : nasuhamdzin@gmail.com

Dr. Tatsuya AZUHATA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

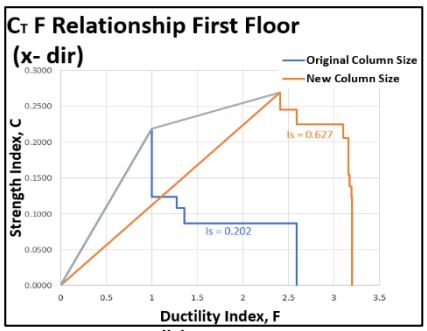
By identifying vulnerabilities and proposing strategies for improvement, the research contributes to the safety of both existing and future buildings in Malaysia

This study evaluates the seismic performance of a hybrid reinforced concrete (RC) frame–precast wall building in Malaysia to assess the building's response to seismic forces, identify potential vulnerabilities, and propose strategies to enhance its seismic resilience. To do this, various methodologies, including modal analysis, first and second screening methods based on the Japan Building Disaster Prevention Association (JBDPA) guidelines, and response history analysis (RSA) are employed. The building's behavior under different seismic scenarios is investigated through comprehensive evaluations. The findings illuminate essential perspectives on the structural seismic resilience of the building. The original architectural and engineering design of the structure does indeed display a series of notable inadequacies and limitations, most conspicuously in its capacity to effectively endure and withstand the considerably elevated levels of peak ground acceleration that may be imposed upon it during seismic events of greater magnitude and intensity. However, the building's seismic performance can significantly be enhanced with the careful consideration and implementation of specific design improvements. This work highlights the importance of incorporating the best practices in structural design to better withstand the potential seismic events in Malaysia. The findings from this research enrich the body of knowledge in seismic engineering, offering practical implications that can be applied to enhance construction techniques and safety regulations for hybrid RC frame–precast wall buildings situated in areas prone to seismic events. These insights serve as a valuable resource for improving structural integrity and disaster preparedness in regions susceptible to earthquakes.

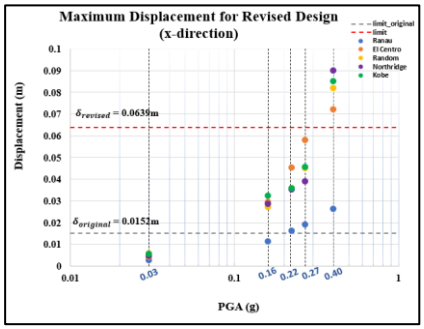
Figure



(a)



(b)



(c)

Fig. (a). Illustrates the target building's hybrid structure, featuring precast walls on its upper levels and a reinforced concrete frame on its ground floor.
Fig. (b). This graph illustrates the relationship highlighting the substantial enhancement in the seismic index (Is) for x-direction for original and new column size
Fig. (c). illustrates the maximum displacement values in both the x direction for the original and proposed designs under various PGA sets.

Civil and Structural Engineering Branch, Public Works Department, Malaysia

Civil and Structural Engineering Branch, Public Works of Department, Malaysia engaging in cutting-edge research and offering design proficiency in civil and structural engineering to various JKR branches, including JKR Headquarters, State/Federal Territories, and specialized units. This support aids in the development of government infrastructure projects aligned with the National Development Policy.

Citation: Hamidon, N.Z., T. Kabeyasawa (2023), Seismic performance of precast reinforced concrete Beam-to-column connection, Abstract of IISEE-GRIPS Master's Thesis.

Seismic Performance of Precast Reinforced Concrete Beam-to-Column Connection

Nurul Zawani binti Hamidon
Structural Engineer, Public Work Department (PWD) of Malaysia
E-mail : nurulzawanihamidon@gmail.com

Toshikazu KABEYASAWA (Supervisor)
Associate Professor, Tokyo Metropolitan University

Model and study the seismic performance of precast frame connections in Malaysia by introducing the beam-line method (BLM)

This research aims to analyze the behavior of precast structures in Malaysia when subjected to seismic activity, specifically focusing on the connection between beams and columns. To achieve this, a new method called the Beam-Line Method (BLM) has been developed and utilized to model and analyze the seismic performance of these connections in precast frames to compare with the Japanese method (AIJ). The study employs non-linear static pushover analysis and non-linear dynamic time history analysis (THA) to comprehensively evaluate the structural response under seismic loads. Additionally, the seismic performance of the building is assessed by combining the seismic capacity curve obtained through pushover analysis with the elastic response spectrum curve of the earthquake. Furthermore, the study investigates the significance of connections in the overall structural performance by calculating moment rotations in the beam-to-column connection. These are then utilized in the seismic analysis of the entire frame. The outcomes of this research provide valuable insights into the seismic behavior of precast reinforced concrete beam-to-column connections, thus informing future design and construction practices to enhance the seismic resilience of such structures.

Figure

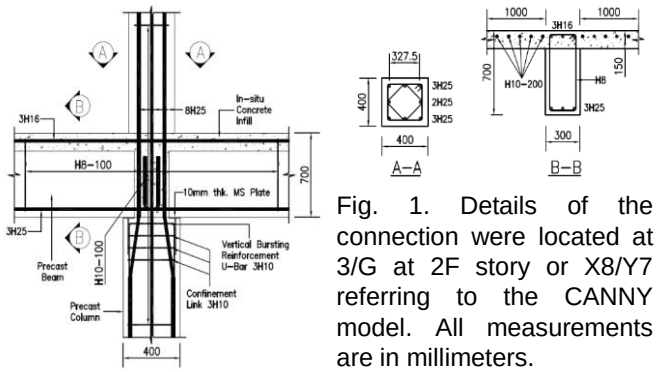


Fig. 1. Details of the connection were located at 3/G at 2F story or X8/Y7 referring to the CANNY model. All measurements are in millimeters.

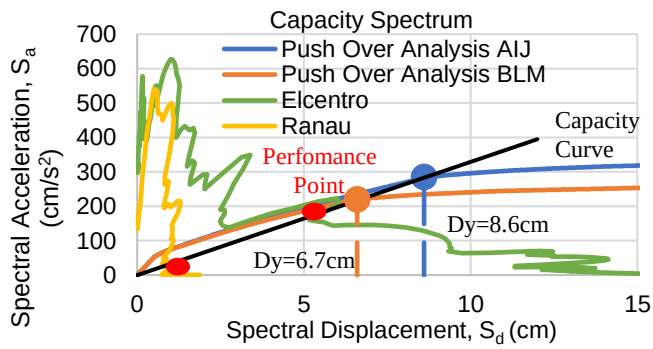


Fig. 2. Comparison of the capacity spectra of the AIJ and BLM models (earthquake).

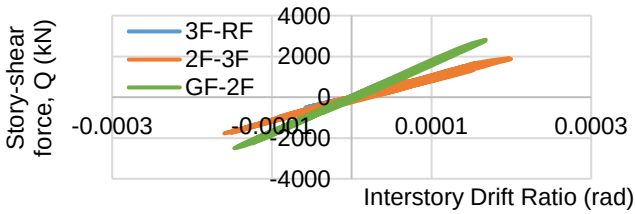


Fig. 3. Load–deformation curve for the BLM model under the Ranau ground motion. From THA.

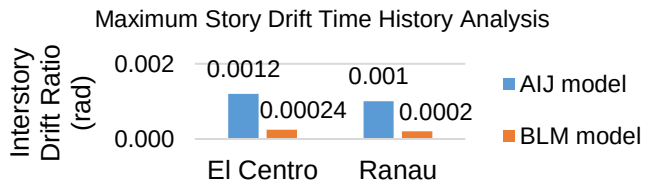


Fig. 4. Comparison of the maximum story drifts for the AIJ and BLM models with the THA

Public Works Department (PWD) of Malaysia

Malaysia's Public Works Department (PWD) oversees the nation's infrastructure development. Integral to its responsibilities, PWD ensures the adoption of seismic design principles, especially in earthquake-prone regions. Besides that, the department also promotes the use of precast structures for their efficiency, uniformity, and swift construction, ensuring resilience and sustainability in Malaysian infrastructure. These measures aim to create a sustainable and secure built environment across Malaysia

Citation: Dendup, T., T. Saito (2023), Comparative study on the seismic performances of typical RC residential buildings designed with old and new Indian codes in Bhutan, Abstract of IISEE-GRIPS Master's Thesis,

COMPARATIVE STUDY ON THE SEISMIC PERFORMANCES OF TYPICAL RC RESIDENTIAL BUILDINGS DESIGNED WITH OLD AND NEW INDIAN CODES IN BHUTAN

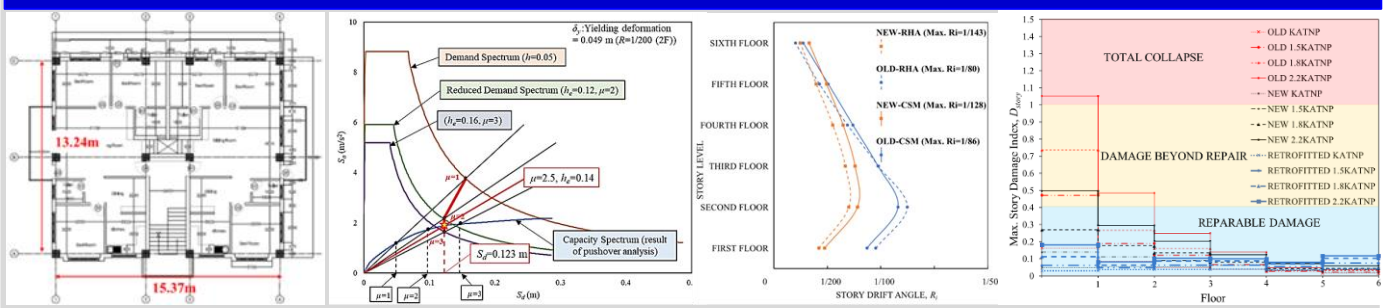
Tshering DENDUP
Department of Infrastructure Development, Ministry of Infrastructure and Transport, Bhutan.
E-mail : tsheringdendup2@gmail.com
Taiki SAITO(Supervisor)
Toyohashi University of Technology, Japan.

Findings

In Bhutan, the Indian seismic codes are referred for the design of reinforced concrete (RC) buildings. These seismic codes were revised in 2016 as a result of earthquakes that took place after their publication. The frequent and recent earthquakes in and around the Himalayan region have caused substantial damage to RC buildings necessitating for study of seismic performance. This paper presents a comparative study on the seismic performances of typical five-story RC residential buildings designed with old and new Indian codes. Accordingly, two three-dimensional models of a building designed with the old and new Indian codes are developed using STERA_3D software. The seismic performances are evaluated using the Capacity Spectrum Method (CSM) and non-linear Response History Analysis (RHA) for three input ground motions (Simulated-1 (Random Phase), Simulated-2 (Kobe_TOT90 Phase) and KATNP_360). In addition, the structural damage estimates given by damage indices are compared under scaled ground motions. The basic damage index model developed by Park et al., (1984) representing the structural damage on the RC element and further modification of model to the story-level damage index and its calibration into the categories of physical structural damage is adopted. $D_{story} < 0.4$ is considered to be Reparable, whereas $D_{story} > 0.4$ represents Damage Beyond Repair, and $D_{story} > 1.0$ represents Total Collapse.

Results show that the building designed with the new Indian codes provide reduced structural responses when compared to that designed with old Indian codes. The CSM also proved to give good results when compared to the RHA results. Furthermore, the assessment of the damage indices for the building designed using the new codes shows that the building has more even damage dispersion over the floors and prevents collapse-level structural damage under the considered maximum scaled ground motion. Whereas for the building designed with old Indian codes the damage indices indicated collapse of structure under same intensity of ground motion. Thus, three shear walls are proposed, two in weaker direction and one in stronger direction for the building designed with old Indian codes as a retrofitting measure. The results show that under the considered input ground motions the Retrofitted Model will demonstrate improved performance by limiting responses by large. In addition, the maximum story-level damage indices for all the models plotted indicated that the Retrofitted model will exhibit only repairable damage over all floors even under maximum considered intensity.

Graphical abstract



(1) (2) (3) (4)

(1) Target Building; (2) CSM Performance Point; (3) CSM Results and Comparison with RHA Results; (4) Damage Indices Results.

Department of Infrastructure Development, MoIT, Bhutan

The Ministry of Infrastructure and Transport was established on December 30, 2022 by merging the Ministry of Works and Human Settlement and Ministry of Information and Communications.

The Ministry's vision is to be a dynamic organization for building quality and sustainable infrastructure, efficient transportation services, and built environment for socio-economic well-being and happiness

Citation: Chodavarapu, P., Y. Ohta, B. Shibazaki, Rapid determination of tsunamigenic source parameters and real time inundation modelling for Tews, Abstract of IISEE-GRIPS Master's Thesis.

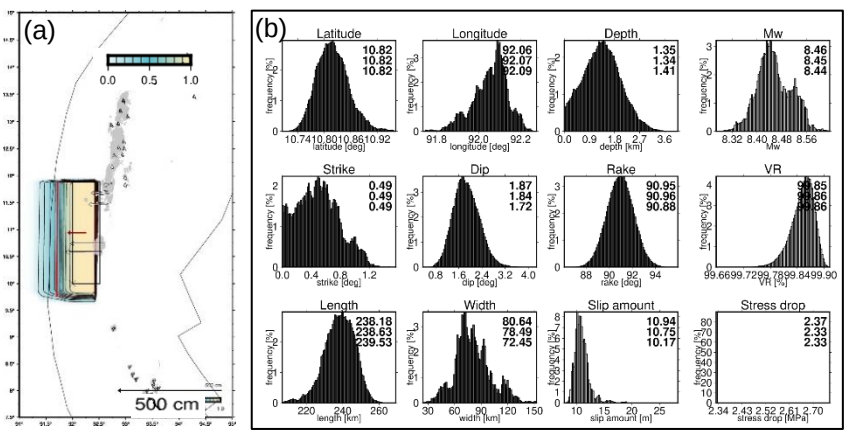
Rapid determination of tsunamigenic source parameters and real time inundation modelling for TEWS

Patanjali Kumar CHODAVARAPU
Indian Tsunami Early Warning Center (ITEWC), INCOIS, MoES, Govt. of India, INDIA
E-mail : patanjali@incois.gov.in
Dr. Yusaku OHTA (Supervisor)
Associate Professor, Graduate School of Science, Tohoku University, JAPAN
Dr. Bunichiro SHIBAZAKI (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Estimation of uncertainty in coseismic fault model and Realtime tsunami inundation modelling for Andaman and Nicobar Archipelago

INCOIS-MoES established the Global Navigation Satellite System (GNSS) - Strong Motion Accelerometer (SMA) network of 35 stations in the Andaman and Nicobar Islands to monitor the coseismic displacements caused by tsunamigenic earthquake occurrences. This study adopts a robust methodology for estimating the uncertainties in coseismic fault models with the GNSS data using the Markov Chain Monte Carlo (MCMC) method and conducts a real-time tsunami inundation modeling using TUNAMI simulation code and ADCIRC for the assumed earthquake scenarios in the vicinity of the Andaman and Nicobar archipelago. The results of the probability density functions for a range of source parameters estimated by the MCMC method for a rectangular fault model, including stress drop and the Variance Reduction (VR) Index for the various assumed earthquake scenarios and tsunami inundation results for the Port Blair and Car Nicobar regions. Our findings emphasize the critical roles that the station density and the spatial configuration play in accurately determining certain fault parameters. While the fault length, strike angle, and slip amounts are reliably recovered through the existing GNSS station network, the dip angle, depth, and fault width estimation warrants further improvement. Our study demonstrates the efficient computation of the tsunami inundation, achieving results within a mere 5 min computational time for a 12 h simulation of tsunami propagation and inundation modeling. Finally, this study recommends that implementing the MCMC single rectangular fault model inversion with the real-time tsunami inundation modeling at the ITEWC will significantly enhance the capability of the operational tsunami services.

Figure



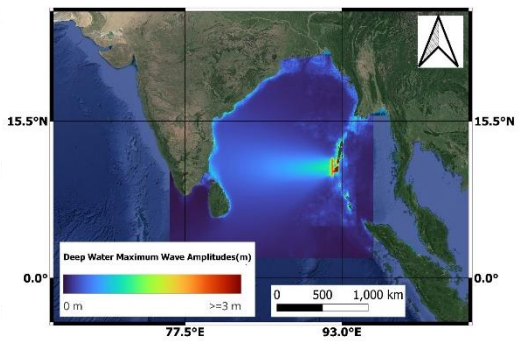


Fig 2. Maximum wave amplitudes and inundation computed for the study area.

Fig 1. Results from MCMC method for the scenario of Mw 8.2 magnitude earthquake near the Andaman and Nicobar Islands: (a). estimated coseismic fault models with varying color gradient from light blue to yellow (0.1 to 1.0) indicate the range of solutions, with yellow representing the most probable fault model and (b). posterior PDFs of source parameters along with Mw, VR and Stress drop. Inserted values in the upper right-hand corner denote the mean, median and mode in the top, middle and bottom positions respectively.

Indian National Center for Ocean Information Services , MoES, Govt of India

Indian National Center for Ocean Information Services (INCOIS) is an ESSO organization under Ministry of Earth Sciences (MoES) with the mission stating, "Provide Ocean Information and Advisory Services to Society, Industry, Government Agencies and Scientific Community through Sustained Ocean Observations and Constant improvements through Systematic and Focused Research". The ITEWC at INCOIS operates 24/7, providing timely tsunami information by effectively preventing false alarms.

Citation: Hani, S. E., T. Hara, Y. Fujii (2023), Rapid determination of earthquake source parameters for tsunami early warning system for Egypt, Abstract of IISEE-GRIPS Master's Thesis.

Rapid Determination of Earthquake Source Parameters for Tsunami Early Warning System for Egypt

Hani Saber ELBEHIRI
National Research Institute of Astronomy and Geophysics (NRIAG), Egyptian National Data Center (ENDC), EGYPT
E-mail: hanysaber369@gmail.com
Tatsuhiko HARA, Yushiro FUJII (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Mwp is the suitable magnitude for issuing tsunami early warning for Egypt

This study used SeisComP3 (SC3) to determine different magnitudes for 32 significant earthquakes in the Mediterranean Sea. Different magnitudes (i.e., mb, Mwp, and mB) under different computational times are compared with the Mww determined by the United States Geological Survey (USGS) for evaluation. The Tsunami Travel Time (TTT) Software Package by ITIC was used to calculate the tsunami wave arrival times on Egypt's coasts. The results obtained for mb confirmed the magnitude saturation, especially for large earthquakes. We determined the relationship between Mww and Mwp and Mww and mB. We obtained Mw estimates from Mwp using the formula implemented in SC3 and those using the relation of this study. Then, we evaluated the tsunami messages following the Standard Operational Procedures at different times and compared those for Mww from USGS (Fig.1). The messages did not change much for the estimates from SC3 and those from the formula of this study. At 11 minutes after the origin times, for 28 events, the messages are accurate, and for 4 events, they are under-estimates for both cases. For mB results at 11 minutes after the origin times, for 22 events, the messages are accurate, and for 10 events, they are false when the estimates from SC3 were used. The number of false messages decreased to 6 when we applied the formula obtained by this study. These results suggest that Mwp is more stable and accurate than mB. It takes over 65 minutes for tsunamis from the Hellenic and Cyprian arcs to reach the Egyptian coasts (Fig.2). Therefore, tsunami warnings around 11 minutes after the origin times are expected to be effective for tsunami countermeasures in Egypt.

Graphical abstract

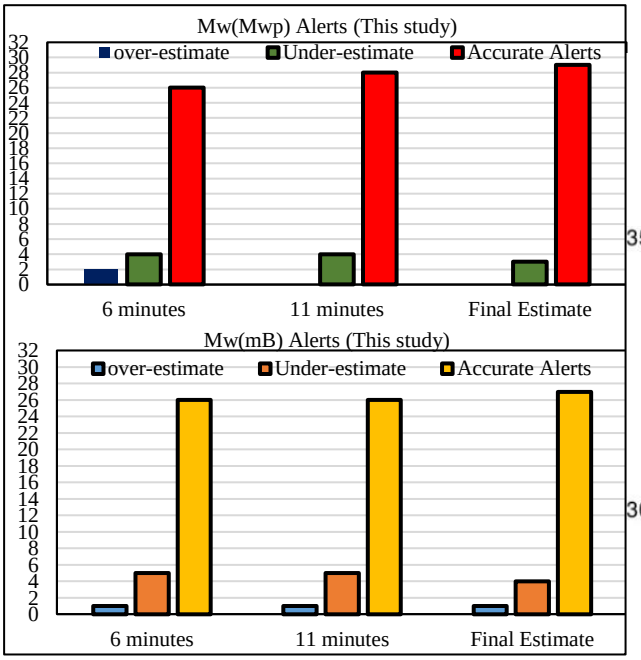


Fig.1.The alerts produced for Mw(Mwp) and Mw(mB).

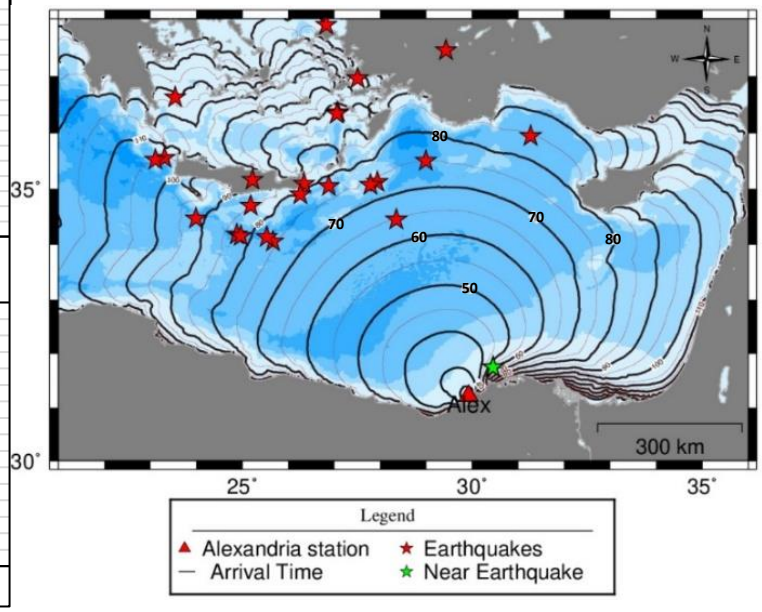


Fig.2. Tsunami travel time for the 32 earthquakes.

National Research Institute of Astronomy and Geophysics (NRIAG)

The National Research Institute of Astronomy and Geophysics (NRIAG) is a vital scientific institution in Egypt, contributing significantly to astronomy, space science, and geophysics research. Its work enhances our understanding of the universe and planet and supports national development and disaster preparedness efforts.

Citation: Lesikikabara, K., Y. Fujii, B. Shibazaki(2023), Enhancing tsunami early warning system in Fiji using tsunami database, Abstract of IISEE-GRIPS Master's Thesis.

Enhancing tsunami early warning system in Fiji using tsunami database

Koroi LESIKIKABARA
Mineral Resources Department, Fiji
E-mail: koroi.seniroqa@gmail.com
Yushiro FUJII (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, Japan
Bunichiro SHIBAZAKI (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, Japan

A tsunami database was constructed for a coastal block around Suva and five methods were adopted for retrieving tsunami height from the database to make tsunami warning messages.

This study aims to enhance Fiji's tsunami early warning system by employing a tsunami database, which includes 64 (four magnitudes and depths at four source points) precomputed simulation results stored in a MySQL database. The current warning system predominantly relies on manual input of forecasting messages, making it time-consuming and error-prone. Five methods for retrieving tsunami height from the database were assessed, revealing significant variations in the estimated tsunami heights. The most simple approach was defined as Method 2, which selects the maximum tsunami height among the four source points selecting the larger magnitude and shallower depth based on the searched magnitude and depth. This method was used for its simplicity and ease of implementation, primarily due to its avoidance of complex interpolation techniques. Compared to the existing system, which takes 10 to 15 minutes to generate and dispatch tsunami warnings, the enhanced system can produce forecasting messages in seconds using Method 2 after earthquake parameters are obtained.

Figures

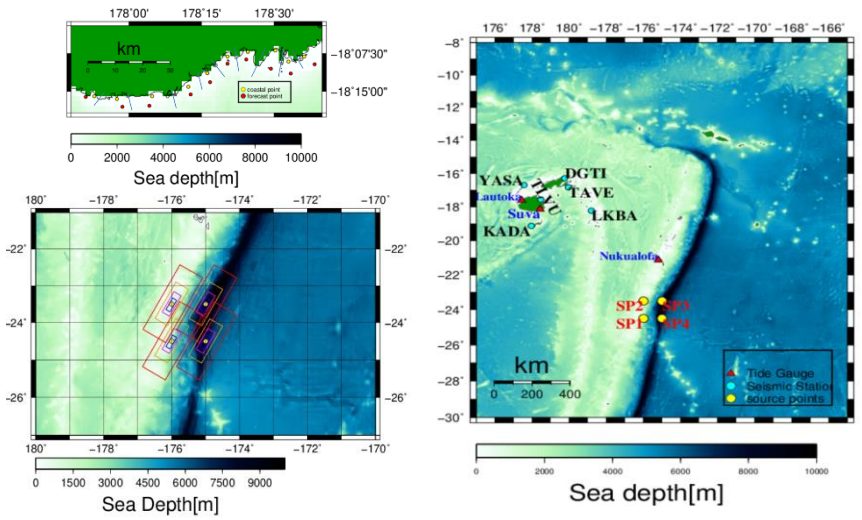


Figure 1. (top left) Distribution of Coastal Points (CPs) and Forecast Points (FPs). The blue lines divide the coastal block G around Suva into smaller regions for FP (red circles) and CP (yellow circles) pairs. (bottom left) Fault models for each Source Point (SP). The red, orange, purple and blue rectangles denote M8.5, M8.0, M7.5 and M7.0 fault models, respectively. (right) Locations of SPs, tige gauges (red triangles) and broadband seismic stations (cyan circles).

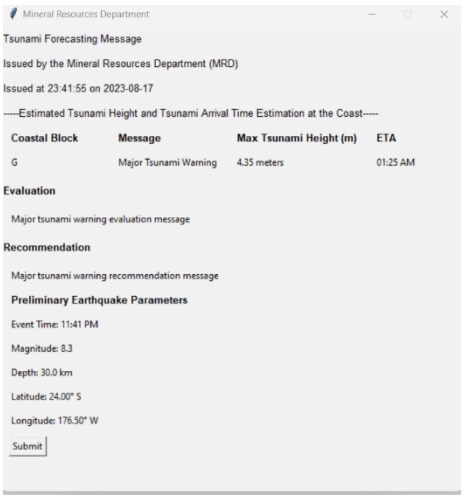


Figure 2. Sample of "Major Tsunami Warning" message. The preprepared message is also stored in the tsunami database.

Mineral Resources Department (MRD)

The Mineral Resources Department (MRD) of Fiji oversees the country's mineral, groundwater resources, and monitors earthquakes and tsunamis. They grant exploration and mining licenses, conduct geological surveys, manage groundwater, ensure environmental compliance, and contribute to Fiji's economic development through resource management.

Citation: Malodali, J. S., B. Shibazaki, Y. Fujii (2023), Tsunami propagation and inundation simulations in Fiji based on scenario earthquakes, Abstract of IISEE-GRIPS Master's Thesis.

Tsunami Propagation and Inundation Simulations in Fiji Based on Scenario Earthquakes

Malodali Joji Sakaraia
Fiji Seismology Unit, Mineral Resources Department, Fiji
E-mail : jmalodali@gmail.com
Bunichiro SHIBAZAKI (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, Japan
Yushiro FUJII (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, Japan

Tsunami propagation simulations using global bathymetry data and inundation simulations for two target areas in Fiji were performed.

In this study, tsunami simulations were conducted by assuming an M8.5 earthquake generated along the Tonga Trench, including horizontal deformation effect, and using a depth of five kilometers aligned to the buried faults. We performed numerical tsunami simulations using the Tohoku University's Numerical Analysis Model for Investigation (TUNAMI) code for the linear or non-linear wave equations in a spherical coordinate system. We tested two bathymetry data of GEBCO_2023 and ETOPO_2022 for single grid computations. We used the GEBCO for bathymetry data and the SRTM data for the topography for the tsunami inundation simulations. We adopted the nesting grid system with four layers including the finer grid merging the GEBCO and SRTM data on the tsunami inundation area. We selected two study areas to focus on the inundation: Suva and Ono-i-Lau.

We placed four output points along the Suva coastlines in FDB foreshore, Walu bay, Lami, and Draunibota. The computational result in the Suva study area shows that the maximum inundation height recorded was at Walu Bay, with a height of 3.06 meters, and the earliest wave recorded was at FDB foreshore, with a time of 103.8 minutes. For the second study area in Ono-i-Lau, the four output points are Nukuni, South Nukuni, North Matokana, and Doi. The results show that the maximum inundation height recorded was at South Nukuni, with a height of 1.61 meters, and the earliest wave recorded was also at South Nukuni, with a time of 62.5 minutes.

Figure

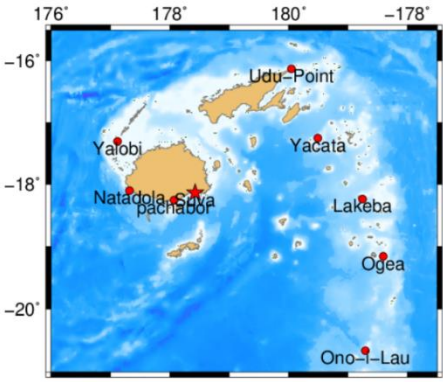


Figure 1. Close-up map of the locations of the nine selected output points in the study region.

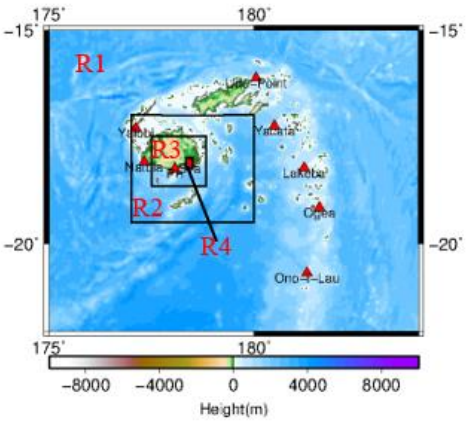


Figure 2. Nesting grids with four layers (R1 – R4) for the Suva study area.

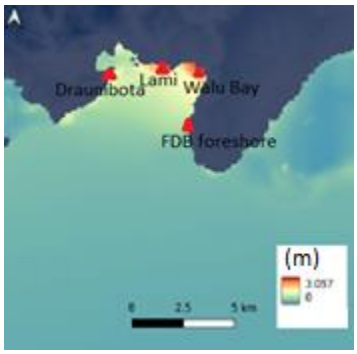


Figure 3. Inundated area (R4 in Figure 2) with the maximum inundation height.

Mineral Resources Department

The Mineral Resources Department provides geoscientific information about Fiji. It develops policies on mining and provides information and assistance to investors on mining sectors, facilitates exploration, and provides information on the non-living resources of the country. The Seismology unit's primary role is to provide information on geohazards assessment and timely dissemination of information during any local or felt regional seismic event.

Citation: Harvan, M., Y. Tanioka (2023), Real-time tsunami inundation forecasting for Mentawai Islands, Indonesia, Abstract of IISEE-GRIPS Master's Thesis.

Real-time Tsunami Inundation Forecasting for Mentawai Islands, Indonesia

Muhammad HARVAN
Agency for Meteorology Climatology and Geophysics (BMKG), Indonesia
E-mail : muhammad.harvan@bmkg.go.id
Yuichiro TANIOKA (Supervisor)
Institute of Seismology and Volcanology (ISV), Faculty of Science, Hokkaido University, Japan

The Near-field Tsunami Inundation Forecasting (NearTIF) method is reliable and practical for real-time tsunami early warning system in Mentawai Islands.

We conducted an implementation study of Near-field Tsunami Inundation Forecasting (NearTIF) method to enhance the operational capability of the tsunami early warning system in Mentawai Islands, Indonesia. This study focused on testing the method's reliability by conducting a retrospective test in forecasting the tsunami inundation during the 2010 Mentawai tsunami event.

The NearTIF method utilizes: (1) a pre-computed database containing pairs of inundation model and offshore tsunami waveforms, (2) input fault models, and (3) a NearTIF search engine. The pre-computed database was constructed using 462 unique fault scenarios. The linear and non-linear tsunami simulations were done to simulate tsunami propagation and inundation model, respectively. This study also utilized W-phase inversion to generate input fault models for the NearTIF method. The NearTIF search engine was applied to choose the best inundation model from the pre-computed database for a specific site.

The NearTIF method's reliability was analysed by comparing the simulated tsunami height from the forecasting result and the direct numerical forward modelling results (NFM) using the input fault parameter, with field observation data collected from another study. Computation speeds to obtain inundation models were also compared. Analysis results in this study demonstrated that the NearTIF method is reliable and practical to be implemented in real-time tsunami early warning systems.

Graphical abstract

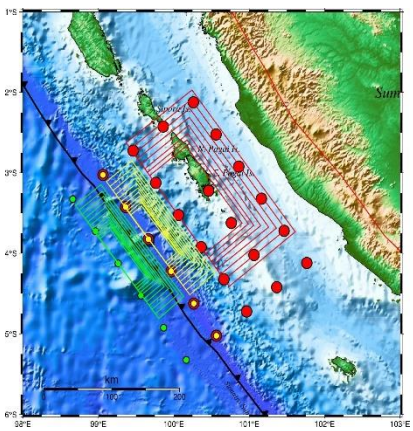


Fig 1. Fault model scenarios. The colored dots are the top center positions of interplate (red), tsunami earthquake (yellow) and outer rise (green) fault models.

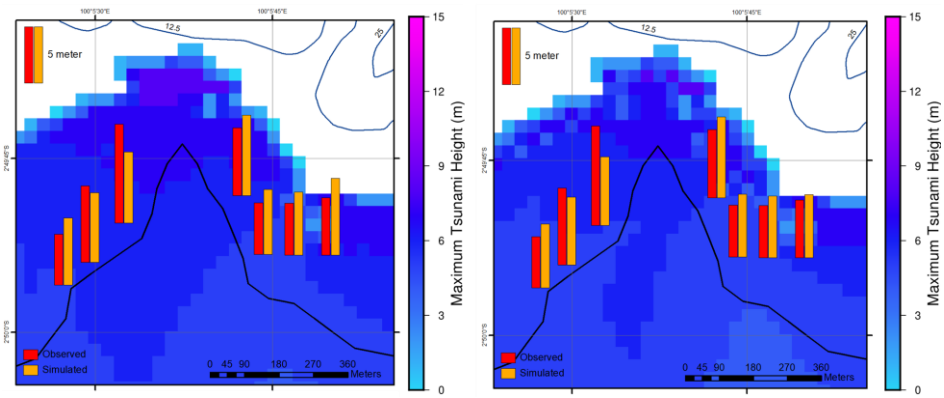


Fig 2. Comparisons between the observed tsunami heights (red bars) by Satake et al. (2012) and the simulated ones (orange bars) from the NFM result (left) generated 54 minutes after the earthquake and the forecasted model using the NearTIF method (right) obtained within 11 minutes after the earthquake. Both have similar inundation extent and tsunami height distribution.

Agency for Meteorology Climatology and Geophysics (BMKG), Indonesia

BMKG is a non-department governmental agency of Republic Indonesia which has been tasked to carry out observation, analysis, and dissemination duty regarding Meteorology, Climatology, and Geophysics phenomena occurring around the country. The agency has been monitoring and providing information regarding weather, climate, air quality, earthquake, and tsunami since its establishment in 1947.