IISEE International Institute of Seismology and Earthquake Engineering

Building Research Institute B R I

Selected Abstracts of 2017-2018 Training Course

IISEE Newsletter Special Edition
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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 2017-2018 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, you can watch the final presentation from five trainees on IISEE E-learning website.
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)

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

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Magnitude Estimation for Earthquake Early Warning (EEW) for Eastern Cairo and the South of Sinai

Ibrahim ZAHRA
National Research Institute of Astronomy and Geophysics (NRIAG), EGYPT
E-mail : eng.ibrahim.gamal@gmail.com
Bunichiro SHIBAZAKI (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Initial peak displacement P_d is the most accurate rapid-estimator of magnitude for EEW

Rapid and accurate magnitude estimation is a critical task for any earthquake early warning (EEW) system. Among related tasks, such as onset picking or hypocenter locating, estimating earthquake magnitude precisely using only the first 2 or 3 s of data from the beginning of the P-wave arrival is exceptionally important. In this study, we examined 3 techniques of magnitude estimation for earthquake early warning (EEW): corner period τ_c, peak predominant period τ_{max}^{p} and initial peak displacement P_d. We established the best fit relation between each of these parameters and magnitude. We also examined real-time parameters like the filter cut-off frequency and the time-window of estimation in order to find the values that give the best fit relation in each technique. We chose Eastern Cairo and the South of Sinai, in Fig. 1, because of its high importance in Egypt's economy and future urbanization as well as the moderate to high seismic activity in this region. We used a dataset of 20 earthquakes between 1999 and 2015, from the Egyptian National Seismic Network (ENSN) catalog, in the target region. All of the selected events, except for one, have local magnitude over 4.0. The results of τ_c and τ_{max}^{p} show that the error in magnitude estimation could reach up to 1.0, in this dataset. The results also indicate that P_d is the best parameter for magnitude estimation in EEW, in terms of the least estimation error and scaling with magnitude and epicentral distance (R), as shown in Fig. 2. Based on results, we made recommendations that could be extended into an action plan that is required to achieve an EEW system in Egypt.

Figures

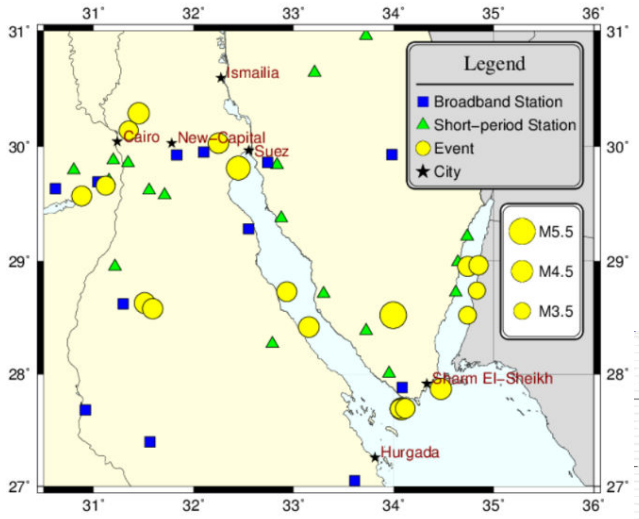
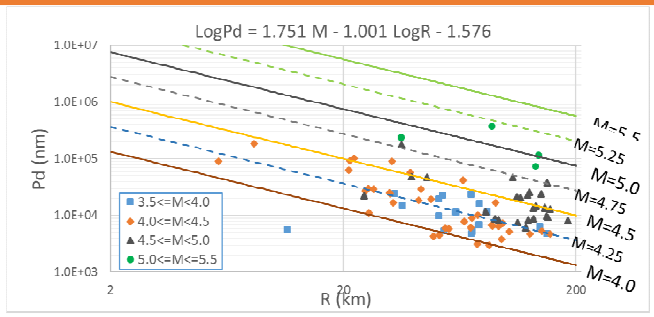


Fig. 1. The selected study region, events and ENSN stations.



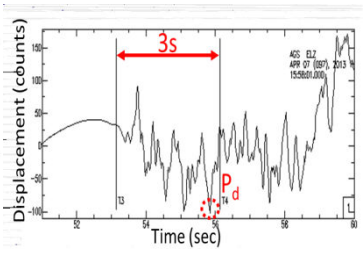


Fig. 2. Bottom: Pd is the maximum displacement in the first 3 s after the P-wave onset. Top: scaling between P_d (nm) and R (km) for different magnitude ranges with different colors. Straight lines are the best fit relationship at different M.

National Research Institute of Astronomy and Geophysics

The National Research Institute of Astronomy and Geophysics NRIAG was established, in Helwan, Egypt, in 1903 as an astronomical and geophysical (geomagnetic and seismic) observatory. The seismic station in Helwan at the same location have even been constructed, in 1899, even before the establishment of the observatory. Now, NRIAG has more than 350 of research staff, working on variety of topics in astronomy and geophysics.

Investigation of Site Response in Kathmandu Valley Using Aftershock Data of the 2015 Gorkha Earthquake, Nepal

Naresh MAHARJAN
Department of Mines and Geology, Kathmandu, NEPAL
E-mail : nrshmhrjn72@gmail.com, nrshmhrjn72@yahoo.com
Toshiaki YOKOI(Supervisor)
Takumi HAYASHIDA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Site amplification in sedimentary basin

We used 16 aftershock recordings of the 2015 Gorkha earthquake (Mw 7.8) at three temporary stations (NAKRM, NABKT and NANST) inside the Kathmandu Valley to derive earthquake H/V spectral ratios (EHVSRs) and compare those with microtremor H/V spectral ratios (MHVSRs) at same stations. The predominant frequency peaks of EHVSRs and MHVSRs are comparable at three continuous observation stations with three-component accelerometers; NAKRM shows 0.6 Hz, NANST shows 0.32 Hz and NABKT shows 2.2 Hz suggesting that accelerometers can sometimes be used to investigate response of the deep sedimentary basin. We also derived MHVSRs using microtremor data at 11 temporary sites inside the Kathmandu Valley to obtain dominant frequencies. Next we estimated the thickness of sedimentary layer by calculating theoretical H/V ratio with simplified four-layered velocity model and compared them with the derived MHVSRs. The estimations indicate that the thickness of sedimentary layer ranges from 42 to 700 m (Fig. 1). We also investigated amplification and attenuation property of S-waves inside Kathmandu using three earthquakes; one teleseismic event and two aftershocks of the 2015 Gorkha earthquake. Observed data clearly showed that the basin amplifies ground motion in the low frequency range (0.1 – 1.0 Hz), while high-frequency ground motion (>1 Hz) do not rapidly decay in the Kathmandu Valley (Fig. 2).

Figures

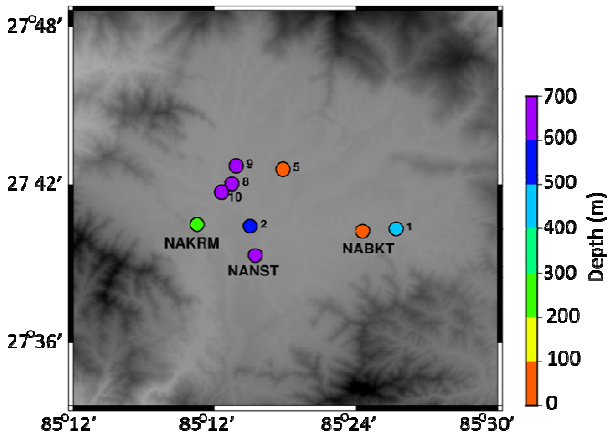


Fig. 1. Map showing the depth at each station using simplified model of Bhattarai et al., (2017)

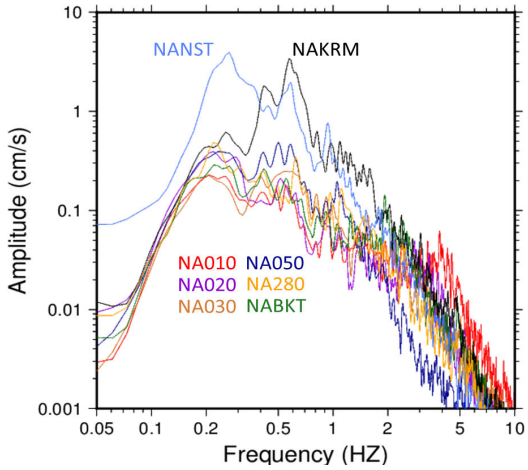


Fig. 2. Velocity spectrum of the Hindu Kush event (Mw 7.5) recorded in the stations along the propagation direction. NANST and NAKRM stations shows high amplification but other stations have similar amplitude trend.

Department of Mines and Geology

In 1977, the Bureau of Mines and the Nepal Geological Survey were united and named as the Department of Mines and Geology (DMG), Lainchour, Kathmandu, Nepal. It is the sole government organization which is responsible for all types of seismological research, geological survey, mineral exploration and administration of Mining Rules and Regulations in Nepal.

Effects of Soft First Story on Seismic Performance of RC Buildings and Sustainable Approach to Retrofit

MD. KAMRUZZAMAN
Sub-divisional Engineer, Public Works Department, BANGLADESH
E-mail : kamruzzaman.buet@gmail.com
Matsutaro SEKI (Supervisor)
Visiting Research Fellow, International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

The structural configuration with a soft first story proved to be very vulnerable and performed poorly during the past earthquakes. Like other many countries, brick infill masonry is used in Bangladesh as a nonstructural element. Its usages in upper stories and keeping building's ground floor open result in lateral stiffness difference and cause soft first story state. The scarcity of land in Bangladesh has compelled to construct multi storied RC buildings with an open ground to be used as vehicle parking, stores or other facilities. This research committed to assess the seismic vulnerabilities of RC buildings with a soft first story, causes behind the collapse of soft first story during earthquakes, seismic performance difference with bare frames and sustainable approach to retrofit them. Seismic performance and vulnerabilities of the soft first story were assessed by the JBDPA guidelines of seismic evaluation, FEMA-356, BNBC-2015 and nonlinear static pushover analysis. Flexural moment magnification at the soft first story columns during earthquakes was determined. Sustainable retrofitting approaches to upgrade seismic performance and prevent catastrophe during earthquakes were proposed with cost analysis. This research found that, seismic behavior, ductility demand, inter story drift pattern and damage distribution of RC buildings with a soft first story were totally different than the RC buildings designed by only bare frame analysis. The soft first story suffered huge ductility demand, extreme inter story drift change and concentrated in severe damage. Magnification of flexural moment at soft story columns was detected as a variable entity. Retrofitting of soft first story was found different from conventional RC buildings. A combination of RC column jacketing and adding steel bracing proved to be effective to eliminate stiffness difference and control the excessive inelastic lateral drift.

Figures

Fig. 1. Soft first story collapse in Golcuk, Turkey during the 1999 Turkey earthquake (source: Ahmet Topcu).

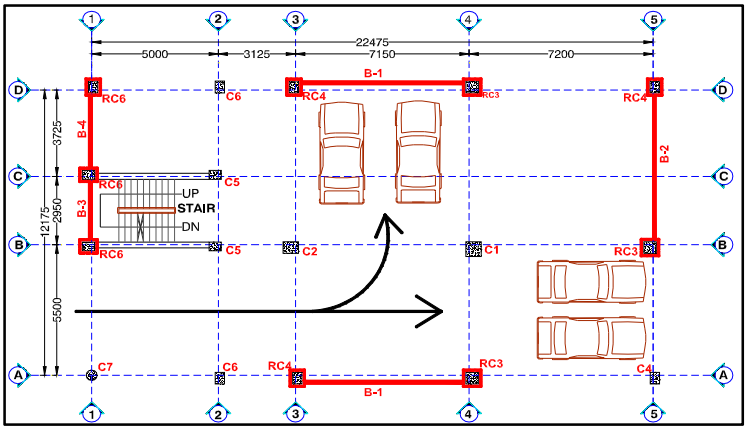


Fig. 2. Retrofit plan for the soft first story of the target building. A combination of column jacketing and adding steel bracing is sustainable and cost effective to retrofit soft first story and proposed by this research.

Public Works Department, Ministry of Housing and Public Works, Bangladesh

Public Works Department (PWD) is the pioneer in construction arena of Bangladesh. Over about two centuries, PWD could successfully set the trend and standard in the country's infrastructure development. It plays a pivotal role in the implementation of government construction projects. It also undertakes projects for autonomous bodies as deposit works. It has highly qualified and experienced professionals forming a multi-disciplinary team of civil, electrical and mechanical engineers.

Seismic Response Evaluation and Retrofit of a Five-Storied RC Building Damaged Due to the 2017 Tripura Earthquake

SK Toufiqur RAHMAN
Public Works Department, BANGLADESH
E-mail : toufiq_buet04@yahoo.com
Matsutaro SEKI (Supervisor)
Visiting Research Fellow, International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Seismic Response Simulation of a Damaged Building to Study the Dynamic Behavior for Devising Seismic Disaster Mitigation Plan in Bangladesh

The 2017 Tripura earthquake caused wide spread structural and nonstructural damage to some buildings in the North-Eastern part of Bangladesh. Dynamic behavior of a damaged building was investigated to make countermeasures for seismic disaster mitigation in Bangladesh, seismic response simulation was carried out. For time history analysis, synthetic ground motions were used since no ground motion was available for the Tripura earthquake. Attenuation relationships (Kanno et al., 2006) for ground motion data is proved to be useful to generate synthetic ground motion when parameters such as magnitude, focal depth and source distance are only available. When actual damage was compared with the analytical result from the nonlinear time history analysis, reasonable correlation was obtained. It was found that low strength concrete, bare frames in the ground floor, insufficient shear reinforcement, inadequate column sizes and weak beam-column joints were mainly responsible for the damage due to this earthquake.

Both strength oriented and ductility oriented retrofitting approach were considered for rehabilitation. From the nonlinear analysis, it can be concluded that strength oriented retrofitting is the best option for strengthening for local design and construction conditions in Bangladesh. RC column jacketing and steel framed braces have reduced large, concentrated deformation (due to soft story) in the ground floor. FRP wrapping alone in the ground floor is not enough to control deformation due to soft story (Piloti). Ductility dominant retrofitting can be opted, if some damage is allowed in the structure.

Figures

Fig. 1. Severely damaged column in ground floor. One column in the ground floor damaged severely. Big shear cracks and concrete spalling were found at the top of the column.

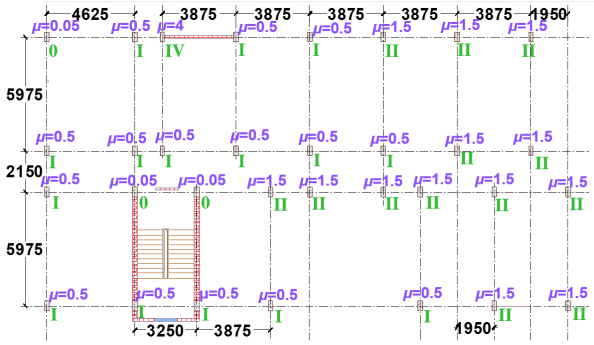


Fig. 2. Damage distribution in the ground floor and associated average ductility factors. These ductility factors were compared with ductility factors obtained from time history analysis for seismic simulation.

Public Works Department

Public Works Department (PWD), under the Ministry of Housing and Public Works is responsible for the implementation of government construction projects. It also undertakes projects for autonomous bodies as deposit works. Besides, it performs regulatory function in setting the pace and managing projects for the country's construction industry

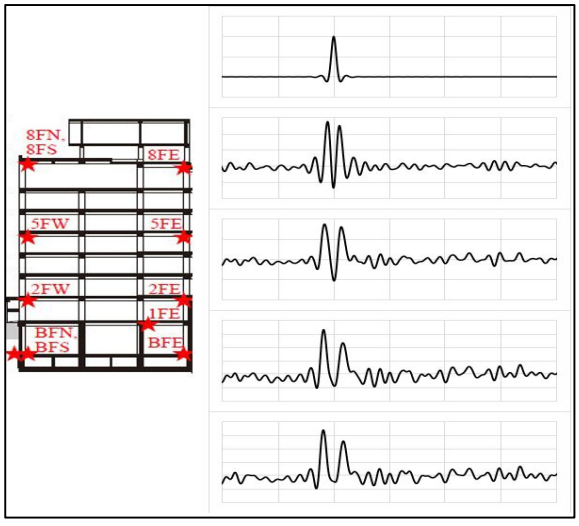
Health Monitoring of Building Using Seismic Interferometry

Ronald Stephan ALVAREZ REYES
Universidad de Santiago de Chile, CHILE
E-mail : ronald.alvarez@usach.cl
Toshihide KASHIMA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Study of the wave's patterns travel through the structures can provide interesting information to assess their dynamics properties.

The significant issue after earthquake is knows the status of the buildings quickly to assess the option to evacuate it. To reduce the possible causalities due to the aftershocks. Therefore, early detection and identification of the damages in the structures are the critical tasks that the engineering must cope with. Thus, owing to the expose risk a rapid methodological implementation for health monitoring of buildings and infrastructures are needed. Health monitoring of building using seismic interferometry is a tool for system identification that to recognize and to identify damages in building through the study of wave patterns that traveling inside the building, using strong motion or ambient vibrations. Seismic interferometry based on deconvolution is a method to unravel the building response, in others words, it extracts the soil-structural interaction and later estimate the shear wave velocity which travels through the building. In this study, we considered three building cases to show the reliability and effectiveness of this technique to detect damages, and to use this methodology not only as instrument for risk assessment and to generate rehabilitation or retrofitting strategies, but also to implement it as early warning system. Our evaluations indicated that the method has high sensibility to identify damages and this increment with the width of cracks, becoming it in a most suitable technique. Moreover, it procedure has powerful depend from numbers of sensors, if the stiffness designed present huge variations. On the other hand, using this approach is possible to estimate the shear stiffness per floor, study the sloshing water effect, and can be applied to the soil survey. Transforming it in the a versatile technique.

Figures



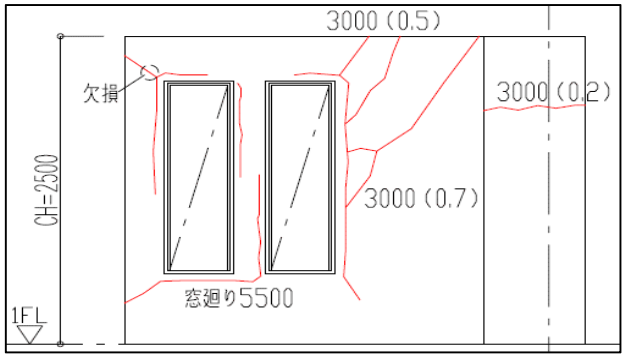


Fig. 1. Left side illustrates wave patterns traveling through the building after Great East Japan Earthquake on March 11th, 2011.
Fig. 2. Right side shows the damages caused on building due to the same quake.

University of Santiago of Chile

The Universidad de Santiago de Chile (USACH) is a public state established in 1849. It´s responsibility is to create, preserve, disseminate and apply knowledge for the welfare of society through teaching, research and extension. Also it has the task of forming quality professionals within its 66 undergraduate programs, providing all the necessary tools so that its students can develop as professionals of excellence and contribute to the development of the community.

Seismic Performance Assessment of Reinforced Concrete Buildings with Masonry Infill Walls in El Salvador

Jorge FLORES
Planning Office of the San Salvador Metropolitan Area, EL SALVADOR
E-mail : jostflo23@gmail.com
Shunsuke SUGANO (Supervisor)
Professor Emeritus, Hiroshima University, and Visiting Research Fellow, International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Seismic Performance Assessment of RC Buildings with Hybrid Masonry Infill Walls in El Salvador

The need for a method of seismic evaluation of the buildings of El Salvador is becoming increasingly necessary, due to the damage caused by previous earthquakes, which left very important economic losses, and at the same time, human losses. Although there have been field surveys of visual inspections of buildings damaged by past earthquakes, these remain only in the stage of rapid inspection, but there is no methodology to follow in the national code to rehabilitate these structures. Two buildings of 3-story with masonry walls are evaluated, which belong to school typologies, following the methodology proposed by the JBDPA standard. The increase of concrete frames with reinforced masonry walls has become very popular, and it is very important to understand the behavior of the infill walls.

It should be noted that the JBDPA does not include provisions to assess buildings of concrete frames with reinforced masonry infill walls, therefore, this study proposes a methodology to consider the masonry infill walls. A comparative analysis is done to consider only the bare frame and frame with reinforced infill walls. An approach of how to estimate the strength of reinforced masonry infill walls is proposed. It also shows the effect of the openings to the strength of the walls and how these effects reduce the capacity of the structure. As a last part, the rehabilitation of the two buildings is proposed.

Figures

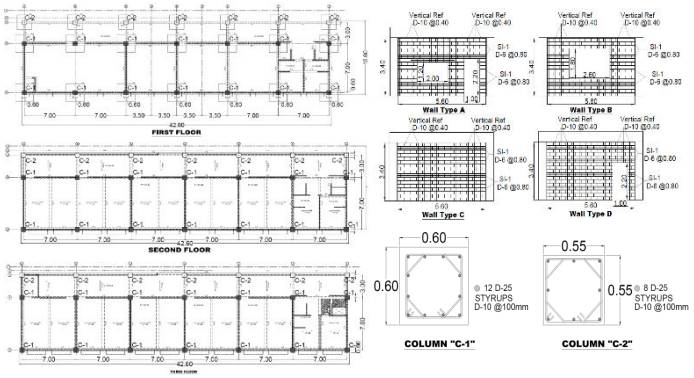


Fig. 1. Comparison of First and second level screening in Building 2.

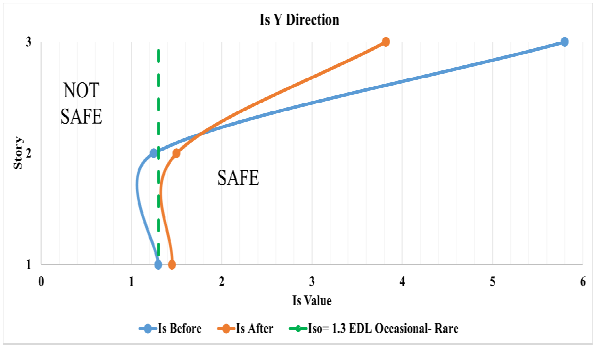


Fig. 2. Results of Seismic index of the structure before and after retrofit with infill wall in Building 2.

Planning Office of the San Salvador Metropolitan Area, OPAMSS, El Salvador

OPAMSS is responsible for the planning and control of the territory of the 14 municipalities that make up the Metropolitan Area of San Salvador.

It gives legal course to the necessary procedures so that the subdivision and construction projects that are developed in the AMSS. It plans and generates the instruments to exercise the function of the ordering and control of urban development and proposes to COAMSS, the specific technical standards required for the execution of construction and urbanization projects.

Development of Resilient Reinforced Concrete Public Apartment Buildings by Using Wall Elements Including Non-Structural Walls for Damage Reduction in El Salvador

William Roberto GUZMAN CALDERON
DACGER, Ministry of Public Works, Transport, Housing and Urban Development, EL SALVADOR
E-mail : william.guzman@mop.gob.sv
Koichi KUSUNOKI (Supervisor)
Earthquake Research Institute (ERI), University of Tokyo, JAPAN

Improvement of seismic performance of public apartment buildings by considering the effect of non-structural walls through numerical models based on experimental data

In El Salvador, public apartment buildings have been designed using structural systems based on reinforced concrete block masonry wall or reinforced concrete moment-resisting frames that usually have non-structural walls. However, no design methodology has been proposed to date to consider the effect of non-structural walls. It is still a common practice not to treat walls with large openings as structural walls, and their capacity is usually discarded in the design of the building. Past earthquakes have revealed that the structural systems mentioned above had a high level of damage to their components. Therefore, to obtain practical and economic resilient buildings, this study proposes to use a new construction method recently developed in Japan that has not been used yet in El Salvador. For the implementation of the new construction method, first a methodology of design and numerical model was proposed, then, the accuracy of the model used was verified through the comparison with experimental data obtained from a full-scale static loading test on a five-story building, performed by the Building Research Institute (BRI) of Japan. Finally, with the appropriate numerical model, the seismic performance of the Target Building was improved by considering the effect of the non-structural walls. From these three aspects, the Target Building was designed in this study, which is planned for construction in 2019 in El Salvador.

Figures

Fig. 1. 3D view of the proposed six-story resilient public apartment building for El Salvador.

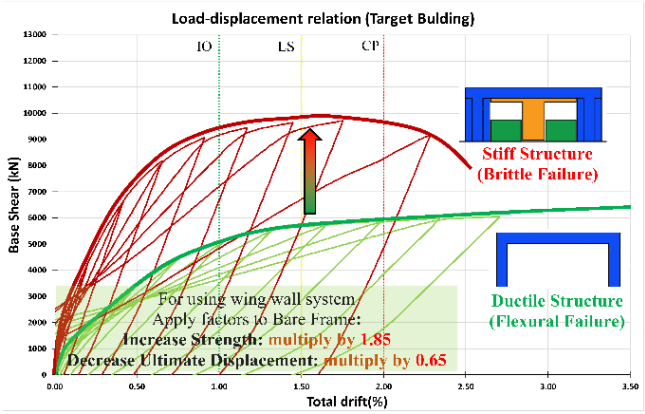


Fig. 2. The seismic performance of the Target Building as bare frame (green line) was improved by considering the effect of non-structural walls (red line).

Department of Adaptation to Climate Change and Strategic Risk Management (DACGER)

DACGER is an organization established in 2010 in the Ministry of Public Works (MOP) of El Salvador. It is the first specialized unit and totally focused on the adaptation of public infrastructure to climate change, and preventive risk management. The purpose of the unit is to prepare technical-scientific studies that allow adapting the country's social and productive infrastructure to climate change; as well as design and propose preventive measures to reduce vulnerability and the impact of natural hazards.

Probabilistic Performance Assessment for Masonry Structures of School Buildings in El Salvador

Luis MIXCO
Ministry of Environment and Natural Resources, EL SALVADOR
E-mail : lmixco@marn.gob.sv
Shunsuke SUGANO (Supervisor)
Professor Emeritus, Hiroshima University, and Visiting Research Fellow, International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN.

Conditional and unconditional failure probabilities for masonry structures of school buildings using real experimental data and seismic hazard of El Salvador

The seismic risk assessment in low-rise masonry buildings is practically a new research field in El Salvador, despite its earthquake prone history and the fact that most housing and school buildings are based on this walls system. This study focuses in the Probabilistic Performance Assessment for Masonry Structures of School Buildings in El Salvador, through analytical fragility functions and its application to seismic risk analysis, following the Performance-based Earthquake Engineering (PBEE) methodology developed by PEER Center. Three combinations of two-story masonry buildings with openings (A: Mixed, B: Reinforced Concrete Masonry Infill and C: Confined Masonry Walls) were taken as target structures, based on configurations commonly found in the school's portfolio of the country. Updated results of a Probabilistic Seismic Hazard Assessment (PSHA) and soil amplification effects of El Salvador, were used. Similarly, both the variation of seismic demand response as the deformation capacities of each structure, have been taken into account. Three performance levels, known as Immediate Occupancy (IO), Life Safety (LS) and Collapse Prevention (CP), were deemed, on which the Seismic Demand and Damage Fragility Functions were built, along with the calculation of Failure Probabilities in terms of Mean Annual Frequencies (MAFs) of each combination. Results indicate that for IO and LS limit states, the Combination B has the highest structural reliability (best seismic performance) for both intensity measures [PGA and Sa (T_1, 5%)], due to its low failure probabilities obtained concerning the other combinations. For the CP limit state, the combination C provides the greater structural reliability for both intensity measures. Nevertheless, none of the combinations managed to meet the acceptable MAFs at the less frequent seismic hazard levels of 475 and 975 years of return period. This methodology represents a cornerstone in the structural safety prediction for any structure, considering the importance to manage the uncertainties in seismic demand and structural capacity.

Figures

Target Buildings based on three structural combinations

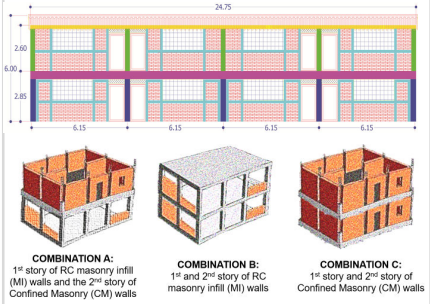


Fig. 1. Typical façade of target buildings with presence of openings, commonly used in school buildings in El Salvador.

Conditional Failure Probability to specific intensity ground motion

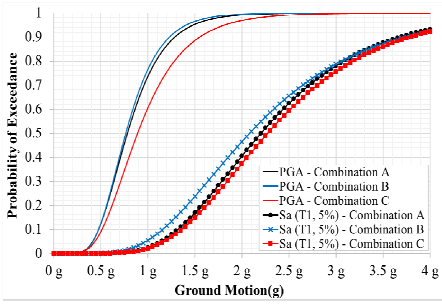


Fig. 2. Seismic Damage Fragility Curves for Collapse Prevention limit State, considering both intensity measures PGA and Sa (T_1, 5%).

Unconditional Failure Probability to entire intensity ground motion domain

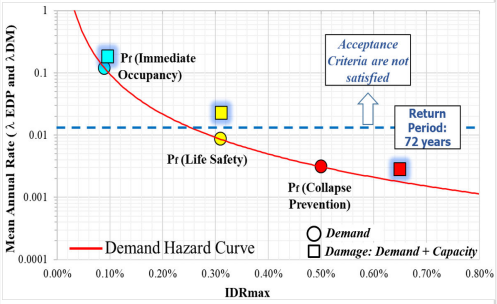
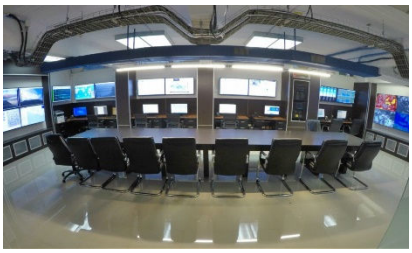


Fig. 3. Seismic Reliability Assessment for structural combination C: Confined masonry walls, considering both seismic demand and capacity uncertainties.

Ministry of Environment and Natural Resources, MARN, El Salvador



The Ministry of Environment and Natural Resources (MARN, for its acronym in Spanish). is the governmental entity in charge of the environmental management of El Salvador. Its mission is to reverse environmental degradation and reduce socio-environmental risks, through research and studies of natural phenomena.

Influence of Large Axial Loads in Rocking Walls and Reinforced Concrete Walls

Rene NUNEZ
Ministry of Public Works, Transportation and Housing and Urban Development, EL SALVADOR
E-mail : rene_nunez2291@hotmail.com
Susumu KONO (Supervisor)
Institute of Innovative Research, Tokyo Institute of Technology, JAPAN

Seismic performance of rocking walls with the property of self-Centering subjected to large axial loads were compared with that of conventional reinforced concrete walls for application in medium to high rise buildings.

The Self-Centering Systems, which successfully emerged from the PRESSS program, can realize the "immediate occupancy" of building structures even after a severe earthquake by reducing residual deformation. In recent years, extensive research has demonstrated the excellent seismic performance of Self-Centering Systems (Marriot, 2009; Nazari, 2016; Lu et al., 2017, Restrepo and Rahman, 2007, Buddika, 2017), and structures such as the Southern Cross Hospital, Christchurch, New Zealand during the Christchurch Earthquakes in 2011 have shown a good seismic performance as well. However, in order for their application in buildings from moderate to high rise, and to clarify the scope of applicability and the effectiveness of these systems more precisely, it is necessary to investigate the influence of large axial loads in Rocking Walls (RWs) or Self-Centering Walls in more detail. In this study, seismic performance of RWs subjected to large axial loads in terms of energy dissipation was investigated and compared with that of conventional Reinforced Concrete (RC) Walls. Analytical models using finite element methods were developed in the software “OpenSees” to predict the non–linear behavior of both RWs and RC Walls. Firstly, the applicability of these analytical models was verified using existing test results. It was cleared that the Multiple Axial Spring Macro Model for RWs and the Shear Flexure Interaction Multi-Vertical Line Element Model (SFI–MVLEM) for the RC walls were able to capture the global and local behavior with reasonable accuracy, bellow 2%. Furthermore, the analytical results about the influence of axial load revealed that base shear increases with axial load ratio, which is more accentuated in the RWs than in the RC Walls with the 86%. The results also showed the hysteretic damping of the RWs increases, while for RC Walls reduces. However, the relative energy dissipation ratio of the RWs according to ACI ITG–5.1–07 criteria is low. Therefore, in order to have a satisfactory seismic performance additional energy dissipation devices should be combined with the RWs.

Figures

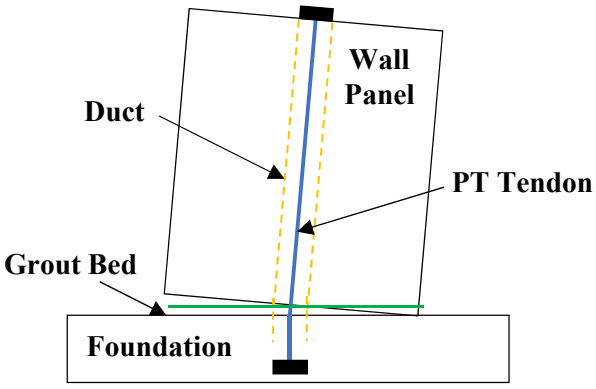


Fig. 1. Single Rocking Wall Without Energy Dissipators (Target of this study).

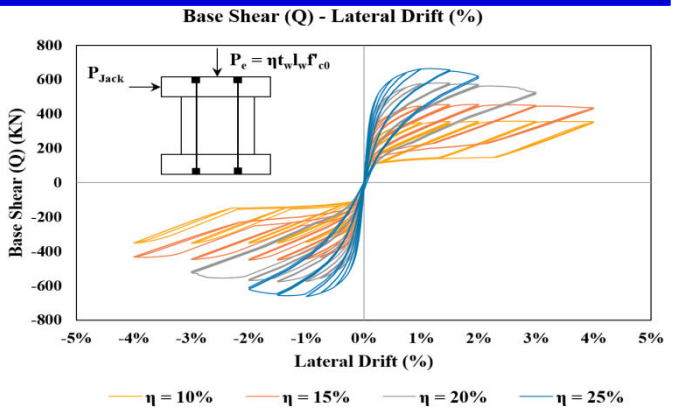


Fig. 2. Analytical Results of Base Shear (Q) – Lateral Drift behavior of RWs for axial load ratios from 10% to 25% to evaluate the influence of axial loads in RWs.

Ministry of Public Works, Transportation and Housing and Urban Development

The Ministry of Public Works, Housing and Transportation and Urban Development is a governmental institution in charge to lead, direct and manage public works, housing and transportation to foster the human development in a territory which integrates public, private and citizens’ efforts with ethics and transparency in a regional perspective.

Application of Seismic Isolation for an Important Building Located in a High Seismic Zone in India

Tarun CHAUHAN
Central Public Works Department, Ministry of Housing and Urban Affairs, Government of India, New Delhi, INDIA
E-mail : tarunchauhancpwd@gmail.com
Tatsuya AZUHATA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Seismic Isolation is an unexplored technique in fast-developing India. It can be used for important buildings for continued use without any damage even after severe earthquakes.

India is a highly earthquake-prone country. Thousands of people die due to moderate earthquakes in India, because of poor seismic resilience of the constructed environment. Particularly, seismic isolation is not very popular in India, mainly because it is considered to be expensive. This paper aims to examine the effect of Seismic Isolation on an Important Building which is located in a high seismic zone of India. Firstly, the building was designed as a fixed base building as per the requirements of Indian codes. Next, seismic isolation was implemented in this building, and the two buildings were compared using the non-linear analysis results. The response was significantly reduced after seismic isolation. Secondly, the results also suggest that the structural member sizes can be reduced if seismic isolation is adopted, and hence the initial cost due to isolator bearings can be compensated. Further, to check for the design of structural elements, the vertical distribution of shear force coefficient was studied for the effect of higher modes, which was found to be a very important aspect. In conclusion, it was seen that seismic isolation can be effectively used, particularly in important public buildings like hospitals, schools, fire stations, etc., which need to be protected against earthquake damage as they serve critical functions after an earthquake. Also, seismic isolation is one of the most effective technology that is available to make new earthquake-resilient structures, and making historical monuments and buildings of cultural value earthquake-resistant. Moreover, damage to non-structural components and expensive equipments can be prevented in these critical buildings.

Figures

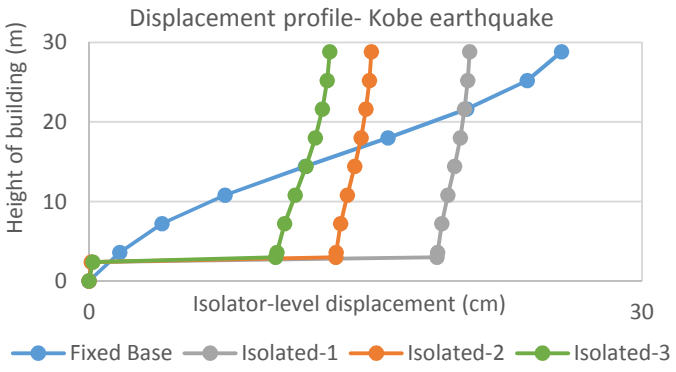


Fig. 1. Most of the shock is absorbed by the isolators and significant reduction in each story (floor) displacement is seen when fixed base building compared with 3 types of Seismically Isolated buildings.

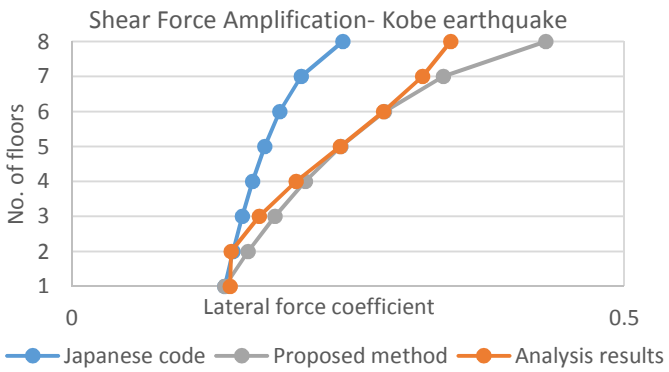


Fig. 2. Analysis results correspond well to the proposed method by Kobayashi for the shear forces generated due to higher mode effect, while the Japanese code underestimates the shear forces, for higher shear coefficient of dampers.

Central Public Works Department

Central Public Works Department was established in July, 1854 by the colonial British government. It continued its role as the leading organization to set the benchmarks for the construction industry in India. Technical manuals, works manual, specifications are all published by CPWD which all the other agencies, public or private, use for their own works. CPWD is the premier construction agency for the Government of India.

Accidental Torsion in the Moroccan Seismic Code: Parametric Study

Nabil MEKAOUI
Mohammadia School of Engineers (EMI), Mohammed V University of Rabat (UM5), MOROCCO
E-mail : mekaoui@emi.ac.ma / nabil.mekaoui@yahoo.fr

Taiki SAITO (Supervisor)
Toyohashi University of Technology, JAPAN

Improvement of the torsional provisions of the Moroccan Seismic Code

Any buildings can undergo torsional motion during an earthquake ground motion. If the rotational vibrations are due to the asymmetry of the weight, the strength or the stiffness distributions adopted by the designer in the analysis, the shaking of the building is referred to as natural torsion. If they are due to the rotational ground motion or the uncertainties in the weight, the strength or the stiffness distributions between those adopted in the analysis and the true ones at the time of the earthquake, the shaking is referred to as accidental torsion. This study investigate the effect of accidental torsion on the total response of the building.

During a rotational movement of the building, the latter can be divided into two sides: The stiff side where there are more lateral resisting elements (columns, shear walls…) and the flexible side. The total displacement of any resisting element has two components: The lateral movement component which is constant for a rigid floor and the rotational movement component varying from zero in the center of rigidity to a maximum values in the farthest points which are the stiff and the flexible edges. Based on time history analyses results, a new method is proposed to estimate the increase in response in the flexible and the stiff edges of the building due to accidental torsion. This method is generalized to a certain category of multi-storey buildings and presents the main advantage to avoid performing many extra seismic analyses as required in the Moroccan seismic code. It leads to conservative results because it's based on design envelopes established for both flexible and stiff edges (Figures 1 and 2), and thus it's very practical and useful for designers. The proposed method is limited to the elastic domain to be compliant with the elastic design procedure of the Moroccan seismic code, that guaranties that the building will reach the required seismic level of performance by inelastic deformations.

Figures

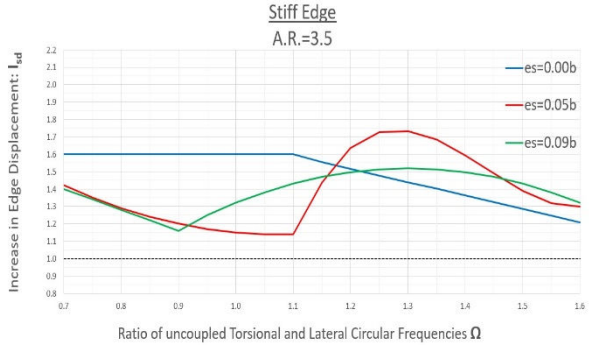


Fig. 1. Design envelopes for the stiff edge. These curves give the maximum increase in the stiff edge displacement with respect to the frequency ratio Ω and the static eccentricity of the building.

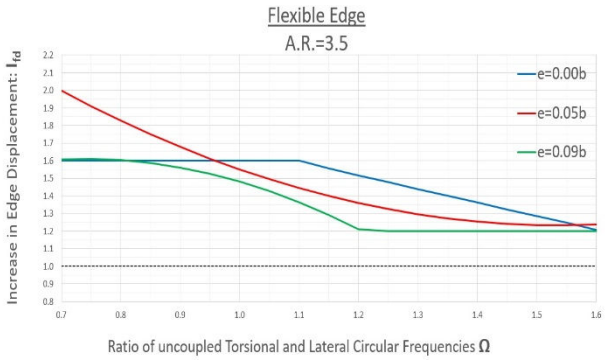


Fig. 2. Design envelopes for the flexible edge. These curves give the maximum increase in the flexible edge displacement with respect to the frequency ratio Ω and the static eccentricity of the building.

Mohammadia School of Engineers (EMI), Mohammed V University of Rabat (UM5)

The Mohammadia School of Engineers (EMI**)** is the first engineering school in Morocco, established in 1959. It's located in Rabat the capital, and it's affiliated to the University Mohammed V of Rabat. Its main objective is to provide the Kingdom with high level engineers from different specialties and to promote the scientific research. The engineering training contains eight different departments.

Feasibility Study of Vs20-based Design Spectra for the Urban Area of Managua, Nicaragua

Jorge Vigarny ROJAS GONZALEZ
Institute of Geology and Geophysics, National Autonomous University of Managua, NICARAGUA
E-mail : jorgerojas2611@hotmail.com

Shoichi NAKAI (Supervisor)
Professor Emeritus, Chiba University, and Visiting Research Fellow, IISEE, BRI, JAPAN

Improvement of the design code considering a new technique to define the site condition effect

Managua, the capital of Nicaragua, is the city with the highest seismic activities. The city is affected by the shallow inland earthquakes product of the effect of the geological settings, geological faults and the soft soil conditions established by an alluvial fan located in the city. Therefore, knowing the inelastic soil conditions allows reducing the uncertainty in soil conditions and facilitates the prediction of the probable affectations that the structures may suffer during a seismic event.

The main objective of this research is proposed the design spectra considering the non-linear site response base on the amplification factor of 40 velocity profiles located in the urban zone of Managua, Nicaragua. The method applied the multichannel surface analysis (MASW) of 22 different places and 18 different reference points provided by Rojas et al. (2016), Escorcia et al. (2013), and Facciolli et al. (1973); to provide the shear wave velocity profile and propose a soil classification map based on the Vs-20 analysis of the study area. The non-linear response spectra were developed from the backbone curve using the linear equivalent and hyperbolic model fitted with the dynamic deformation laboratory test data provided by Facciolli (1973). The soil amplification factors and design response spectra were defined using the soil classification map and the non-linear response spectra. The results showed a soil classification map distributed into 5 categories base in the average of shear wave velocity with ranges between 180 and 540 m/s. Second, the calculation of the reference points using Vs-20 had the best fitted distribution made by geology and land use constraints. Finally, the developed design spectra for this study proposed a soil classification that included a soft soil design spectra and moderate soft soil with three differences range limits in the spectral acceleration branch.

Figures

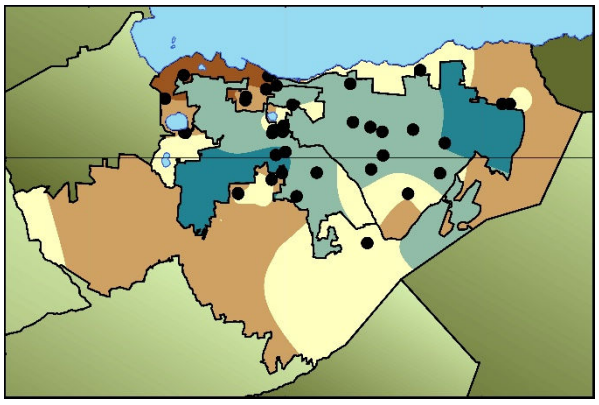


Fig. 1. Soil classification map based on Vs-20 analysis of Managua. The black points represent the investigated points and the color indicate the average shear velocity of the soil.

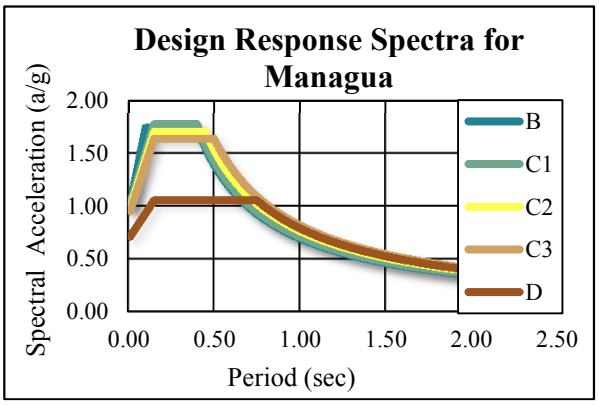


Fig. 2. Proposal of acceleration design response spectra for Managua. The soil type B represent the firm ground, the soil C moderate soft soil and the soil D very soft soil.

Institute of Geology and Geophysics (IGG-CIGEO)

The Institute of Geology and Geophysics of Nicaragua or IGG / CIGEO is a research institute established in October 1990 in the National Autonomous University of Nicaragua (UNAN-Managua), which carries out scientific and technical work in the field of Earth Sciences (Geosciences) and Studies of Disaster Risk.

Effective Retrofit Planning for Masonry Housing Using Steel Mesh

Daniel Felipe ESCALANTE MARINO
Japan-Peru Center for Earthquake Engineering Research and Disaster Mitigation, PERU
E-mail : descalantem@uni.pe
Tatsuya AZUHATA (Supervisor)
International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

To improve non-engineering and self-construction masonry houses by applying steel mesh method

Lima is the capital of Peru, has 30% of the total population of Peru located in Lima and 70% of the houses in Lima are of masonry confined, with 7 million people living in these homes. As the masonry housing are a good solution to the demand of concrete, the seismic code recommends buildings with this system and gives us certain minimum values of their results to be able to use them. The Pandereta brick is a type of masonry that was created for partitions for rooms because they are lightweight and low cost. Some people of low-income use these bricks to build their homes, some of which are auto-construction and non-engineering because those materials are not adequate to resist an earthquake.

The informality in the construction of houses less than 3 floors is very common in Latin America, especially in Peru, to retrofit these housing you need an engineering study that because of the low income presented by these families is almost impossible to realize. In this study consists of two tests of real-scale brick wall (See Figure 1): the first is a wall without retrofitting (original wall) and the second is a retrofitted wall using steel mesh, applying the non linear behavior of the walls and the method of spectral capacity is obtained the non-linear behavior of housing. to obtain the performance point we use the demand curve and the capacity curve.

In the construction of these walls is with Pandereta bricks, these are very brittle, lightweight and above all it has low cost. To determine the displacement limits we use FEMA356 and the behavior during the test. The analysis comes to end when the point of performance is located at the level of life safety. The procedure to obtain the point of performance is repetitive where the percentage of retrofitted walls changes. As a result it was obtained that 69% reinforced walls are needed for the desired level of performance.

Figures

Fig. 1. Original walls of masonry (left), wall retrofitting with steel mesh (right), coating with mortar cement-sand, unit of Pandereta brick (lower right).

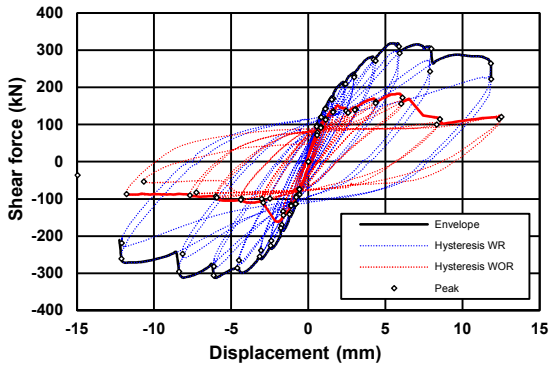


Fig. 2. Non- linear behavior of the masonry walls and hysteresis curve of the walls without retrofitting (red line) and walls with retrofitting (black line).

Japan-Peru Center of Earthquake Engineering Research and Disaster Mitigation (CISMID)

Japan Peru center of earthquake engineering research and disaster mitigation (CISMID) is an organization established in May 1986 for the civil engineering faculty of national university of engineering (FIC-UNI), Dissemination of knowledge in disaster prevention and mitigation through research and application of proprietary technologies to contribute to the sustainable development and prosperity of the country's peoples

Seismic Performance Evaluation of School Buildings Considering the Post-Disaster Function: Case Study for Facilities of Pangasinan State University, Philippines

Rizalyn Centino ILUMIN
Pangasinan State University, PHILLIPINES
E-mail : Rizalyn_Centino@yahoo.com
Shunsuke SUGANO (Supervisor)
Professor Emeritus, Hiroshima University, and Visiting Research Fellow, International Institute of Seismology and Earthquake Engineering, Building Research Institute, JAPAN

Detailed seismic evaluation of structures found effective as a mitigation strategy where the functions of school in times of disaster can be achieved.

Disaster mitigation is a significant issue that must be addressed to avoid the destructive impact of a disaster. Quick inspection was conducted to the eleven (11) school buildings of Pangasinan State University. They were screened and ranked to define the vulnerable and suitable structures for both education and emergency functions of the school as shown in Fig. 1. Engineering Building 2 and Administration Building which are also known as Bldg 2 and Bldg 10, respectively are the two vulnerable buildings considered. The Japan Building Disaster Prevention Association (JBDPA) Standard for seismic evaluation of existing reinforced concrete buildings was used to further investigate their actual seismic capacity. The JBDPA Standard focuses on the reinforced concrete structures with the concrete wall. Therefore, the strength of the reinforced masonry infill walls especially those with openings was determined from the equations of various experts. After following the concept of JBDPA Standard, the result of the second level screening specified that the first floor of these buildings' longitudinal direction need to be strengthened. The reinforced concrete (RC) shear wall was used to increase the strength of the structures. The behavior of the two school buildings before and after retrofitting was analyzed in STERA 3D software to show the effectiveness of using RC shear wall as shown in Fig. 2. The JBDPA Standard found very effective in the Philippines because many existing reinforced concrete school buildings with masonry infill wall need further evaluation. The proposed indices ranges from 1.25-2.00 were also very helpful to trace the importance of the school buildings. They greatly helped to have the accurate value of the standard level of safety for the specific location. Detailed evaluation is better than the rapid visual screening in identifying the actual strength of structures. The methods used ensure the safety of building occupants where structures can also serve as shelter.

Figures

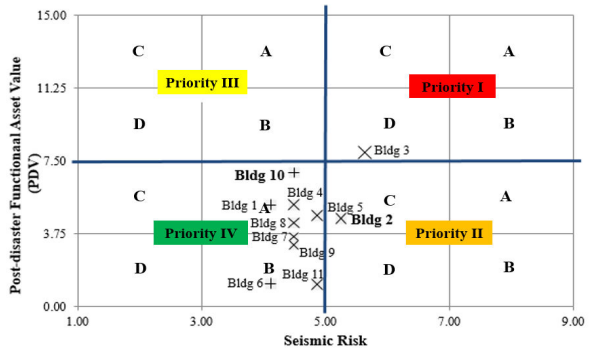


Fig. 1. Seismic risk scores are plotted against the PDV values in x and y axis, respectively. Level of priority was divided into four quadrants. Each quadrant was subdivided into A,B,C, and D.

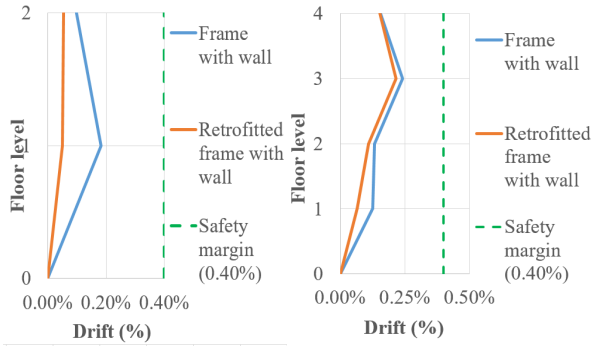


Fig. 2. The Bldg 2 (left) and Bldg 10 (right) before and after retrofitting. The structures are improved considering the post-disaster function against the negative impact of earthquakes using RC shear wall.

Pangasinan State University

The Pangasinan State University, Philippines was chartered through the issuance of Presidential Decree No. 1497 promulgated on June 11, 1978 and became operational on July 1, 1979. The Pangasinan State University, through instruction, research, extension and production commits to develop highly principled morally upright, innovative and globally competent individuals capable of meeting the needs of industry, public service and civil society.

Tsunami Damage Estimation Along the Coast of Laoag City Using Tsunami Fragility Functions

Bhenz RODRIGUEZ
Science Research Assistant, Philippine Institute of Volcanology and Seismology (PHIVOLCS), PHILLIPINES
E-mail : bhenz.rodriguez@phivolcs.dost.gov.ph
Shunichi KOSHIMURA (Supervisor)
International Research Institute of Disaster Science, Tohoku University, JAPAN

Tsunami damage estimation leads to better understanding of the impending effects of the hazard.

The objective of this study is to assess the tsunami hazard and to estimate the tsunami damage in Laoag City. The scenarios used for the assessment of tsunami were obtained from different studies using Manila Trench as the source. For damage estimation, tsunami fragility functions developed for Banda Aceh were used. Tsunami fragility functions is basically a relationship between damage probability of death ratio and the hydrodynamic features of tsunami such as inundation depth, current velocity and hydrodynamic force. The worst scenario S2 has a magnitude of M_w 8.4, with a fault length of 277 km, a fault width of 91 km and a top depth of 5 km. The slip amount was set to 3.72 m with strike, dip and rake angles of 20°, 41°, and 79°, respectively. The maximum uplift and subsidence obtained for this scenario were 2.08 m and 0.25 m. The maximum tsunami height resulted on 4.47 m in which will arrive 20 minutes after the earthquake. Also, the inundation area and maximum inundation depth values were 6.79 km^2 and 6.8 m. In terms of the damage estimation, two different set of exposed data were used. One set was from Philippine Statistics Office (PSA) in which aggregated number of houses and population for each barangay is provided. The other set of data only includes the houses and population inside the inundated area. The estimated damage on exposed buildings and casualties inside the inundated area were 93%, and 70%, respectively. These findings can be used as a reference by local governments, however careful assessment of uncertainties not considered here are necessary for future disaster planning and mitigation.

Figures

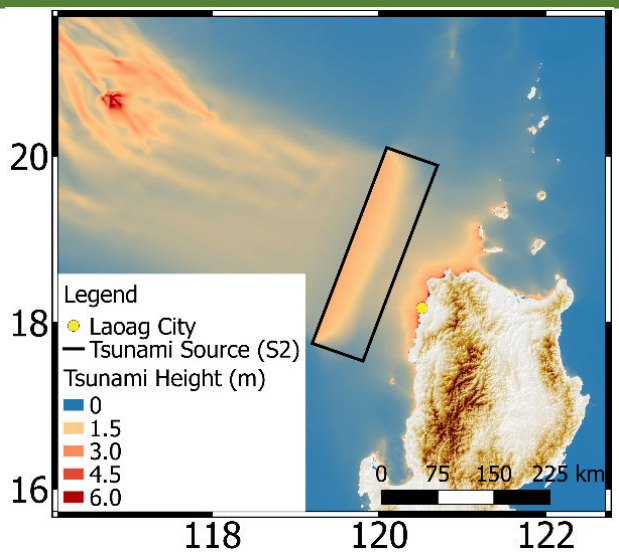


Fig. 1. Seafloor deformation (a) and maximum tsunami heights (b) maps resulted from the worst scenario S2.

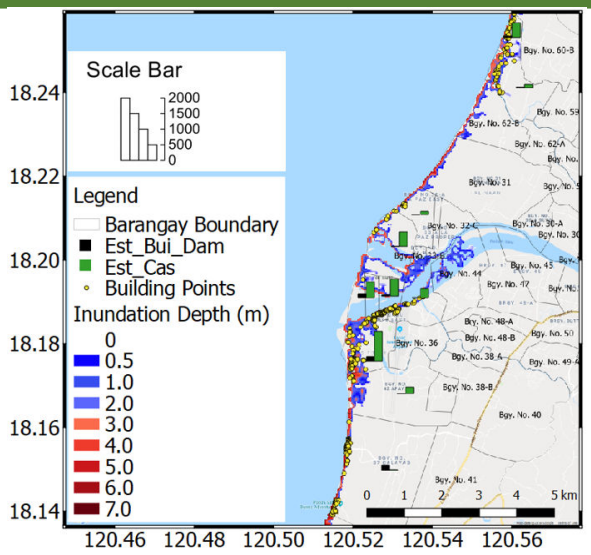


Fig. 2. Building damage map for Laoag City using sample building points (yellow circle) and population density.

Philippine Institute of Volcanology and Seismology

The Philippine Institute of Volcanology and Seismology (PHIVOLCS) is the sole organization of the Department of Science and Technology that is particularly assigned to mitigate disasters that may occur from earthquakes, tsunami, volcanic eruptions and other geotectonic phenomena.

Tsunami Inundation Modeling for Coastal Zone of Alexandria City

Mohamed ELSAYED
National Research Institute of Astronomy and Geophysics (NRIAG), Department of Seismology, Egyptian National Seismic Network (ENSN), EGYPT
E-mail : sayed.mohamed9870@yahoo.com
Yushiro FUJII, Bunichiro SHIBAZAKI (Supervisors)
International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI), Japan

The Alexandria's coastal zone suffered from disastrous tsunamigenic earthquakes; the 142, 365, 1303, and 1222 earthquakes that were mainly produced from the Hellenic and Cyprian arcs. We focused on the Alexandria middle coastal zone to investigate tsunami propagation and inundation by adopting the assumed fault models for the earthquakes. Using TUNAMI (Tohoku University's Numerical Analysis Model for Investigation) code, we performed numerical simulations and constructed inundation maps. We downloaded bathymetry data of GEBCO 30 arc-sec and topographic data of SRTM 1 arc-sec. We divided the computation domain into four grids, such as the finest grid represented inundated area merging GEBCO and SRTM data. We set six coastal output points along the Egyptian shoreline including the real Alexandria gauge to study tsunami height and arrival time. Moreover, we picked out five important points to evaluate tsunami run-up height and inundated depth. Our computation results showed that the first wave arrived at the coastline of the Alexandria after 62 min of the 142 earthquake with the maximum tsunami run-up height of 6.48 m and inundated depth of 7.63 m. While, the 1222 source closest to Alexandria had the maximum tsunami run-up height of 0.55 m and inundated depth of 1.2 m. Computed inundation maps showed that the 142 event covered the largest inundation area than other events. For all sources, the western coastline was more exposed and vulnerable to the inundation than the eastern coastline.

Figures

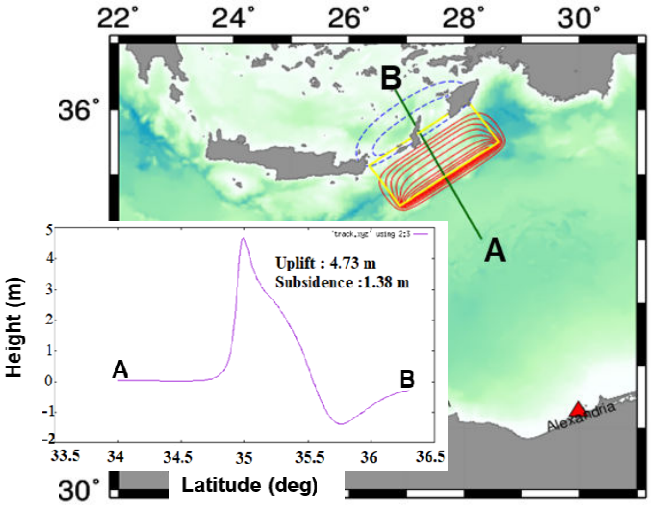


Fig. 1. Seafloor displacement computed for the 142 earthquake. The red and blue contours are uplift and subsidence with the interval of 0.5 m.

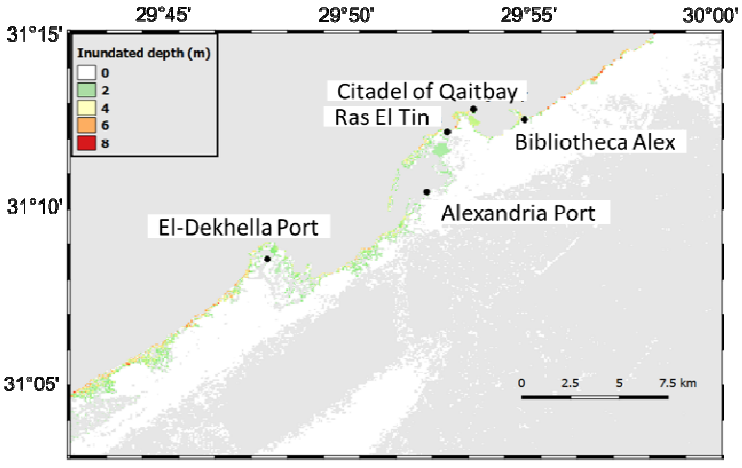


Fig. 2. Calculated tsunami inundation depth for the 142 earthquake with five significant points in Alexandria.

National Research Institute of Astronomy and Geophysics (NRIAG)

The National Research Institute of Astronomy and Geophysics (NRIAG) is one of the oldest scientific institutions in Egypt. NRIAG was erected at Helwan in 1903. Astronomical observations started in 1905, geomagnetic observations at 1907 while seismic registrations started early in 1899. NRIAG has two scientific branches, namely Astronomy and Geophysics.