FOREWORDS

This proceeding aims to disseminate valuable ideas and issues based on research or literature review in the field of vocational, technical and engineering studies, which have been presented in 4th International Conference on Technical and Vocation Education and Training. This conference has taken place in Hospitality Center Universitas Negeri Padang, November 9-11, 2017.

The theme of Conference focused on the perspective of technical and vocational education and training for sustainable society to face the challenges of 21st century, globalization era, and particularly Asian Economic Community. To overcome the challenges, we need the innovation and change in human resources development. Technical vocational educational and training have essential roles to change the world of education and work in order to establish sustainable society.

Undoubtedly, TVET need to enhance the quality of learning by developing various model of active learning, including learning in the workplace and entrepreneurship. Create innovation and applied engineering as well as information technology. Improvement of management and leadership in TVET Institution, and development of vocational and technical teacher education.

Many ideas and research findings have been shared and discussed in the seminar, more than 176 papers have been collected and selected through scholars, scientists, technologist, and engineers’ as well as teachers, professors, and post graduates students who participated in the conference.

Eight keynote speakers have taken a part in the conference, namely Prof. Intan Ahmad, Ph.D. (Director general of learning and student affairs, Kemenristek Dikti) and Prof. Josaphat Tetuko Sri Sumantyo, Ph.D. (CEReS Chiba University) and Prof. Dr. Maizam Alias (UTHM Malaysia) and Prof. Ganefri, Ph.D. (Rector of UNP) and Prof. Dr. Ramlee bin Mustapha (UPSI Malaysia) and Prof. Nizwardi Jalinus, Ed.D. (Chair of TVET doctoral program, FT UNP) and Prof. Michael Koh, Ph.D. Dr. Fahmi Rizal, M.Pd., MT (Dean of FT UNP). They all have a great contribution for the success of the conference.

Finally, thank a million for all participants of the conference who supported the success of 4th International conference on TVET 2017 and most importantly, our gratitude to all scholars who support and tolerated our mistake during the conference.

Padang, 9 November 2017

Prof. Dr. Nizwardi Jalinus, M.Ed
Chair of Scientific Committee
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PREPAREDNESS FOR FUTURE DESTRUCTIVE EARTHQUAKE IN PADANG, INDONESIA

RUSNARDI RAHMAT PUTRA

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ABSTRACT

In this study, we estimated a ground profile in Padang City, Indonesia, using microtremor observations. Indonesia is located on the boundaries of three major tectonic plates, namely the Indian-Australian, Pacific, and Eurasian plates. Consequently, subduction-related major earthquakes occur repeatedly, including, even in the 21st century, such large inter-plate earthquakes as the 2004 Sumatra earthquake, the 2006 Nias Island earthquake, the 2007 Bengkulu earthquake, and the 2010 Mentawai earthquake. The 2009 Padang earthquake was also one of the most destructive earthquakes in recent times, although it was an intra-plate based earthquake. This earthquake was of magnitude Mw7.6, producing severe tremors and causing extensive damage to buildings and casualties. To prevent loss of human lives and dwellings from a devastating earthquake, we investigated the shaking characteristics of the ground in Padang. Spectral ratios for horizontal and vertical motion, H/V, from single-station microtremor records were used to identify the predominant periods of the ground vibrations.

Key Words: Dispersion Curve, H/V Spectral Ratio, Microtremor Observation, The 2009 Padang Earthquake
1. INTRODUCTION

1.1 Regional Geology and Recent Earthquakes

The city of Padang, with a population of 856,814 people as of 2008, is the capital of West Sumatra province. The location of the city center is at 100.38°E, 0.95°S. The main part of Padang is situated on an alluvial plain between the Indian Ocean and the mountains. For the most part, the mountainous area is formed of Tertiary sedimentary rocks with outcrops of metamorphic rocks seen in some places. The alluvial plain spreads along the base of the mountains and is roughly 10 km wide in the east-west direction and 20 km wide in the north-south direction.

The topography of the Padang region (Fig 1) is very similar to the tsunami-damaged area of Miyagi Prefecture in Japan, that was inundated by as much as 4-5 km from the coast after the March 11, 2011 the off the Pacific Coast of Tohoku Earthquake (Mw 9.0). In Padang, about 600,000 people live in the coastal area (covering about 60 km²). The population density is very high, about 8500 people/km². The city is located on the coast of the Indian Ocean between the Sumatran Fault and the Sunda Trench Fault. Both faults are active with slip rate ranging from

![Fig 1. Topography of Padang.](image)
10 to 27 mm/year (Natawidjaja et al., 2007). According to our catalog, 2995 events with a magnitude greater than 4 occurred in this region from AD 1779 to 2010 (Fig 5). The seven giant earthquakes mentioned previously have all been strongly felt here. For example, the source of the 2009 Padang earthquake was located in the ocean slab of the Indo-Australian Plate.

It produced extensive shaking and severe damage to houses and buildings in Padang and Padang Pariaman, because its epicenter was about 60 km offshore from Padang (Fig 2). As the Padang earthquake was an intra-slab earthquake at intermediate depth with a comparable magnitude, the event did not generate a tsunami of significance (EERI, 2010).

Due to this earthquake, 1117 people were reported killed, 1214 severely injured, 1688 slightly injured, and 3 were left missing in West Sumatra. The earthquake also destroyed many houses, buildings and infrastructure (heavily damaged houses numbered 114,797, with 67,198 moderately damaged and 67,837 slightly damaged). In Padang, 5458 buildings sustained damage (Report, BNPB. 2009). This event occurred at the end of the working day, just 15 minutes after offices and schools closed; if it had struck earlier, the number of causalities would definitely have been higher as a result of building collapses.

![Fig 2. Padang earthquake on September 30, 2009, Mw 7.6.](image)
There are four accelerometers in Padang. Three were donated by Engineers Without Borders Japan (EWBJ) and installed in 2008, and the other was installed by the Indonesian Government’s Bureau of Meteorology, Climatology and Geophysics (BMKG). However, only one ground motion record is available for the Padang earthquake. Due to an electric power cut during the earthquake, only the BMKG device recorded the time history of the earthquake. The observed record shows about 20 s of strong shaking with a peak ground acceleration (PGA) of 0.3 g and a predominant period of 0.5 s. The location of this station is a mountainous suburb about 12 km in from the coast. The subsurface condition at this station is rocky; the average shear wave velocity for the upper 30 m of the subsurface here, $V_{s30}$, is 697 m/s (Rusnardi et al., 2010).

4 Site Characterization by Microtremor Observation

4.1 Single observations

A microtremor is a very small ground motion that can be recorded on the ground surface. It can be produced by a variety of excitations (e.g., wind, traffic, breaking sea waves). A full microtremor record can be described by one vertical and two horizontal components. Our analysis was conducted using the recorded microtremor. First, the
horizontal and vertical spectrum ratios (HVSR) were computed for all sites (Fig 4). The peak period of the HVSR is known to correspond to the resonant period of the site. This method postulates the shape of the Fourier spectrum (Nakamura et al., 2000).

Fig 4 shows four types of the measured HVSRs. We observed examples of HVSR that showed a clear peak with a long period range (> 1.0 s; Fig 4(a)), two peaks (Fig 4(b)), a clear peak with a short period range (< 1.0 s; Fig 4(c)), and no apparent peak (Fig 4(d)).

We performed 110 single site surveys that sampled every district of the city of Padang. These observations were carried out in November 2008, September, November, and December 2009 and January 2010.

![Fig 4. Example of HVSRs (red line is average and black is cut window),](image)

(a) The peak greater 1 s, (b) HVSRs has two peaks, (c) The peak less 1 s, (d) No apparent peak.
Eq. (1) shows the method used to calculate HVSR using the observed records.

\[ \text{HVSR} = \sqrt{\frac{F_{NSi}(\omega)^2 + F_{EWi}(\omega)^2}{F_{UDi}(\omega)^2}} \]  

(1)

where \( F_{NSi}(\omega) \) and \( F_{UDi}(\omega) \) denote the Fourier amplitude of the NS, EW and UD components of each interval, respectively, and \( \omega \) is the frequency.

The locations of observations are plotted in Fig 5(a). Microtremor was measured using a GPL-6A3P sensor (Photo 1). The two horizontal (NS and EW) and the vertical (UD) components were recorded simultaneously for 10 minutes with a 100 Hz sampling frequency.

We estimated the distribution of the peak periods of the HVSRs for all sites in Padang using the ordinary kriging technique. From single observations, we obtained a predominant period of 2.0 to 4.0 s in the central business district and less than 1.0 s in the mountainous areas (Fig 5(b)). These results indicate an affect related to the thickness of alluvium in the coastal area of Padang city, which decreases in thickness inland.

Photo 1. Microtremor device.
CONCLUSIONS

Padang has a thick alluvial layer in the coastal area (with a predominant period between 2.0 and 4.2 s) that thins toward the mountains (with a predominant period less than 2.0 s).

These results provide critical information for making shaking maps, updating hazard maps, and developing disaster prevention countermeasures in Padang.

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4 REFERENCES


This is to certify that

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Jam Gadang

Big Ben Tower is the name for the tower clock located in the center of Bukittinggi, West Sumatra, Indonesia. This clock has a tower with a large building on the four sides called Clock Tower, designation Minangkabau language meaning “big ben”.

Sianok Canyon is a steep valley (ravine) located in the border town of Bukittinggi, in the district IV Koto, Agam, West Sumatra. The valley is elongated and meandering as the southern boundary of the city of Koto Gadang to nagari Sianok Anam Tribe, and ends in the district Palupuh. Sianok canyon has a very beautiful view and also became one of the flagship attraction province.

Ngarai Sianok

Japan holes Bukittinggi (also spelled Japanese hole) is one of the historical attractions in the city of Bukittinggi, West Sumatra, Indonesia. Japan hole is a tunnel (bunker) protection built Japanese occupation army around 1942 for defense purposes.

Source : - http://flickr.com
- http://indonesia-tourism.com
- http://id.wikipedia.org

Labang Tepang