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PREFACE

We are delighted to introduce the *1st International Conference on Advanced Research in Engineering and Technology “Engineering Breakthrough in Response to Global Shift Post Pandemic”*. The technical program has brought researchers and practitioners around the world to a good forum for discussing, leveraging and developing all scientific and technological aspects during the global pandemic. Global pandemic has forced everyone to adapt, especially about how people are interacting with each other in every aspect. Schools, universities, and industries used the latest communication technology to continue the activities but of course with many limitations and ineffectiveness. Some of them started to break the limitations by doing research and innovations to approach the condition before the pandemic until the effectiveness became higher and higher. This conference is a communication forum about how far our science and engineering research has achieved in recent years while adapting the global pandemic. Moreover, it is with a great pleasure to have the keynote and invited speakers of ICARET 2022, from Indonesia, USA, Libya, and Vietnam. Who will share their knowledge and best innovative research. This conference is held by LPPM Universitas Pembangunan Nasional Veteran Yogyakarta. Location of this conference is at Yogyakarta, Indonesia, on October 25, 2022. This conferences was successfully acquire 101 participant from 3 countries, Indonesia, Libya, and Malaysia.

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Yogyakarta, October 24, 2022
Conference Chair

Dr. Suranto



THE COMMITTEE OF 1ST ICARET 2022

Organising Committee

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1. Dr. Suranto AM (Universitas Pembangunan Nasional “Veteran” Yogyakarta, Indonesia)
2. Dr. Aldin Ardian (Universitas Pembangunan Nasional “Veteran” Yogyakarta, Indonesia)
3. Dr. Shofa Rijalul Haq (Universitas Pembangunan Nasional “Veteran” Yogyakarta, Indonesia)
4. Dr. Johan Danu P (Universitas Pembangunan Nasional “Veteran” Yogyakarta, Indonesia)

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Editors

1. Dr. Johan Danu P (Universitas Pembangunan Nasional “Veteran” Yogyakarta, Indonesia)
2. Dr. Kyubyung Kang (Purdue University, USA)
3. Mohammed Samba (Misurata University, Libya)
4. Dr. Aldin Ardian (Universitas Pembangunan Nasional “Veteran” Yogyakarta, Indonesia)
5. Mochammad Tanzil Multazam (Universitas Muhammadiyah Sidoarjo, Indonesia)



RUNDOWN

No.	Time (Jakarta-Time)	Activity	PIC
1.	08:00 - 08:20	Preparation	Committee
2.	08:20 - 08:30	Participant Join the Meeting Room	Committee
3.	08:30 - 08:40	Opening Singing National Anthem Singing Mars Bela Negara	MC
6.	08:40 - 08:45	Speech from Chairman of the International Conference	Dr. Suranto
7.	08:45 - 08:50	Speech from Head of Institute of Research and Community Service	Dr. Hendro Widjanarko
8.	08:50 - 08:55	Speech from Rector of UPN "Veteran" Yogyakarta	Prof Dr. Mohamad Irhas Effendi
9.	08:55 - 09:00	Photo Session and Break Time Preparation of the 1 st Panel Discussion	MC
9.	09:00 - 09:05	Introduction of All Speakers from Each Panel Discussion Session and Moderator	MC
11.	09:05 - 09:10	Opening of the 1 st Panel Discussion	Moderator: Dr. Yohana Noradika Maharani
12.	09:10 - 10:20	Presentation & QnA Session from Speakers of 1 st Panel Discussion 1. Dr. Awang Hendrianto Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia 2. Kyubyung Kang, PhD Purdue University, USA 3. Dr. Madi Abdullah Naser Academy for Postgraduate Studies, Tripoli, Libya	Dr. Yohana Noradika Maharani and Speakers
13.	10:20 - 10:25	Break Time & Preparation of the 2 nd Panel Discussion	MC
14.	10:25 - 10:30	Opening of the 2 nd Panel Discussion	Moderator: Dr. Partoyo
15.	10:30 - 12:00	Presentation & QnA Session from Speakers of 2 nd Panel Discussion 1. Dr. Mofit Eko Poerwanto Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia 2. Mr. Christopher Nesbitt	Dr. Partoyo and Speakers
		Maya Mountain Research Farm, Belize 3. Dr. Erni Johan Ehime University, Jepang 4. Laszlo Lakatos, PhD Eszterházy Károly Catholic University, Hungary	



16.	12:00	-	13:00	Lunch Break	MC
17.	13:00	-	13:05	Opening of the 3 rd Panel Discussion	Moderator: Dr. Dian Indri Purnamasari.
18	13:05	-	16:00	<p>Presentation & QnA Session from Speakers of 3rd Panel Discussion</p> <ol style="list-style-type: none">1. Prayudi, PhD Universitas Pembangunan Nasional "Veteran" Yogyakarta, Indonesia2. <u>Dr. Siti Darwinda Binti Mohamed Pero</u> University Utara Malaysia, Malaysia3. Prof. Dr. VASA, László Széchenyi István University, Hungary4. Bobur Sobirov, PhD Samarkand branch of Tashkent State University of Economics, Uzbekistan	Dr. Dian Indri Purnamasari and Speakers
19	16:00	-	16:30	Preparing for closing	MC
20	16:30	-	16:40	closing remarks from Chairman of the International Conference	Dr. Suranto
21	16:40	-	17:00	Closing	MC



PRESENTATION SCHEDULE

ROOM 1

Moderator: Anindya Diqza Syafiqqa

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0002	Indriati Retno Palupi	UPDATING FOCAL MECHANISM MODEL FOR YOGYAKARTA (2006) AND PALU (2018) EARTHQUAKE WITH MOMENT TENSOR INVERSION	1	10.30-12.30	1
AR-0004	Wahyu Sugeng Triadi	CHARACTERISTICS OF THE SEMERU VOLCANO ERUPTION, EAST JAVA, AND THE DEVELOPMENT OF AN INTERNET OF THINGS-BASED DISASTER EARLY WARNING SYSTEM	1	10.30-12.30	2
AR-0005	Sugeng	PORE FRACTAL DIMENSIONS AND COAL HARDGROOVE GRINDABILITY INDEX (HGI) ON COAL METHANE GAS ABSORPTION	1	10.30-12.30	3
AR-0006	Partoyo	SALYAPATI: A COLLEGE ACCREDITATION SERVICE SYSTEM	1	10.30-12.30	4
AR-0013	Frans Richard Kodong	DEVELOPMENT OF FLOW MONITORING SYSTEM IN OIL AND GAS PIPELINES USING THE INTERNET OF THINGS (IOT)	1	10.30-12.30	5
AR-0014	Wrego Seno Giamboro	UNCOVER ANCIENT SETTLEMENTS AT LIYANGAN SITES USING ELECTRICAL RESISTIVITY INVERSION AND GEOMAGNETIC SIGNAL ANALYTICS	1	10.30-12.30	6

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ROOM 2

Moderator: Fatma Rahayu Nita

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0020	Nikolaus Loy	DECENTRALIZATION AND THE SUSTAINABILITY OF RENEWABLE ENERGY: THE CASE OF SOLAR POWER PLANT IN FOUR HAMLETS IN NGADA, EAST NUSA TENGGARA	2	10.30-12.30	1
AR-0022	Monica Maharani	MAKING VIRTUAL 3D RECTORATE OF UPN "VETERAN" YOGYAKARTA TO SUPPORT SMART CAMPUS	2	10.30-12.30	2
AR-0023	Bambang Yuwono	STAMPED OFFLINE SIGNATURE VERIFICATION	2	10.30-12.30	3
AR-0031	Wisnu Aji Dwi Kristanto	ENGINEERING GEOLOGY CHARACTERISTICS OF CUCUKAN VILLAGE, PRAMBANAN, KLATEN, CENTRAL JAVA, INDONESIA	2	10.30-12.30	4
AR-0032	Aldin Ardian	STOCHASTIC PROCESS FOR COAL PRICE MODELING	2	10.30-12.30	5



AR-0036	Herry Sofyan	IMPLEMENTATION OF PENETRATION TESTING ON THE WEB SERVER FOR IMPROVEMENT SECURITY OF INFORMATION ASSETS OF UPN "VETERAN" YOGYAKARTA	2	10.30-12.30	6
AR-0042	Dewi Fortuna Dharmasyah	INORGANIC WASTE TO ENERGY POTENTIAL ON 3R SOLID WASTING PROCESSING FACILITY (CASE STUDY: TPS 3R KASIH BANTUL SUBDISTRICT, YOGYAKARTA)	2	10.30-12.30	7

ROOM 3**Moderator: Fitri Rahmawati Astiandani**

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0043	Shoffan Saifullah	TEXT ANNOTATION AUTOMATION FOR HATE SPEECH DETECTION USING SVM-CLASSIFIER BASED-ON FEATURE EXTRACTION	3	10.30-12.30	1
AR-0047	Didi Nuryadin	QUALITATIVE ANALYSIS OF VARIABLE RELATIONSHIPS IN BIOAVTUR DEVELOPMENT USING SYSTEM THINKING	3	10.30-12.30	2
AR-0048	Sri Suharsih	ASSESSMENT OF UNMET NEED ACHIEVEMENT IN SLEMAN REGENCY	3	10.30-12.30	3
AR-0049	Vynska Amalia Permadi	IMPLEMENTATION OF SERVICE STRATEGY ON ITIL V3 TO IMPROVE INFORMATION TECHNOLOGY SERVICES AT PREMIUM LEATHER BAG COMPANY	3	10.30-12.30	4
AR-0050	Ahmad Dzakiiyyul Fuad	HELPDESK SERVICE FOR MONITORING AND NOTIFICATION SYSTEM (MNS) BASED ON TELEGRAM-WHATSAPP CHATBOT USING MIKROTIK-BASED THE DUDE SOFTWARE	3	10.30-12.30	5
AR-0064	Puryani	INVENTORY CONTROL OF MULTI-ITEM PRODUCTS WITH STOCHASTIC JOINT REPLENISHMENT APPROACH A CASE STUDI IN PT MAK YOGAYAKARTA	3	10.30-12.30	6
AR-0065	Ninik Probosari	THE OVOP APPROACH WITH TRIPLE HELIX COMMUNICATION MODEL AS DEVELOPMENT STRATEGY OF SUMBAWA WEAVING INDUSTRY	3	10.30-12.30	7

ROOM 4**Moderator: Zulidyana D. Rusnalasari**

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0067	Chimayatus Solichah	THE EFFECT OF ADDING CHEMICAL INSECTICIDES AT VARIOUS DOSAGES OF METARHIZIUM ANISOPLIAE ON VEGETATIVE GROWTH OF RED GINGER PLANTS DUE TO WHITE GRUB (LEPIDIOTA STIGMA) ATTACK	4	10.30-12.30	1
AR-0069	Muhammad Faizal Zakaria	SEISMIC AMPLIFICATION AND VULNERABILITY INDEX ANALYSIS USING MICRO SEISMIC METHODS IN THE BAYAT AREA	4	10.30-12.30	2



AR-0076	Dewi Asmotowati	A COMPARATIVE LABORATORY STUDY OF THE POLYMER MOBILITY DESIGN METHODS TO ACHIEVE OPTIMUM OIL RECOVERY FACTOR	4	10.30-12.30	3
AR-0078	Dewi Asmotowati	NEW INSIGHT OF SCALE PROBLEMS IN T-115 WELL TANJUNG FIELD	4	10.30-12.30	4
AR-0079	Johan Danu P	SHORELINE CHANGES DETECTION (1999 – 2021) USING DIGITAL SHORELINE ANALYSIS SYSTEM (DSAS) TOOL: A CASE STUDY OF TELUK PENYU BEACH CILACAP, CENTRAL JAVA, INDONESIA	4	10.30-12.30	5
AR-0080	Sri Dwi Ari Ambarwati	IMPACT OF SMART TOURISM TECHNOLOGY AND VISITOR TECHNOLOGY READINESS TO VISITOR'S SATISFACTION IN THE SMART TOURISM DESTINATION IN YOGYAKARTA	4	10.30-12.30	6
AR-0083	Susilastuti Dwi Nugrahajati	BUILDING A DIGITAL PLATFORM FOR EARLY VOTER POLITICAL EDUCATION	4	10.30-12.30	7

ROOM 5

Moderator: Kharisma Idea

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0084	Yenni Sri Utami	COMMUNICATION AND INFORMATION SYSTEMS AT THE SANGIRAN ARCHAEOLOGICAL SITE AS A DESTINATION OF ARCHEOLOGICAL TOURISM THROUGH THE DIGITAL PLATFORM	5	10.30-12.30	1
AR-0085	Intan Berlianty	FIREFLY ALGORITHM OPTIMIZATION ON DETERMINING THE EFFECT OF WORKING TEMPERATURE ON THE AMOUNT OF PRODUCTION	5	10.30-12.30	2
AR-0087	Muhammad Iqbal Ansori	WATER QUALITY ASSESSMENT BASED ON GOVERNMENT REGULATION STANDARD IN SANGKALAMI RIVER, NORTH KALIMANTAN, INDONESIA.	5	10.30-12.30	3
AR-0095	RR Dina Asrifah	EFFECT OF VARIATION TAILINGS – SAND ON GOLD TAILINGS SOLIDIFICATION PROCESS FOR COMPRESSIVE STRENGTH VALUE	5	10.30-12.30	4
AR-0102	Intan Paramita Haty	ROCK POROSITY BASED ON TRACE FOSSILS FOR INTERPRETATION OF RESERVOIR IN THE REMBANG ZONE	5	10.30-12.30	5
AR-0106	Ahmad Taufiq Akbar	SINGLE SIGN ON MODEL USING SAML AND OAUTH FOR ONLINE APPLICATION OF UPNYK	5	10.30-12.30	6
AR-0108	Wibiana Wulan Nandari	UTILIZATION OF WASTE TEAK SAWDUST FOR ADSORPTION OF RHODAMINE B	5	10.30-12.30	7



ROOM 6

Moderator: Restiyan Ragil Putradianto

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0114	Yohana Noradika Maharani	APPLICATION OF GLOBAL GEOSPATIAL LIQUEFACTION MODEL FOR LIQUEFACTION HAZARD MAPPING IN BANTUL REGENCY, YOGYAKARTA, INDONESIA	6	10.30-12.30	1
AR-0115	Hafiz Hamdalah	GEOHAZARD ANALYSIS OF OVERPRESSURE SHALE AND DETERMINATION OF KESONGO VULCANO MUD SOURCE AND ITS SURROUNDINGS	6	10.30-12.30	2
AR-0118	Herry Riswandi	MICROZONATION OF THE EARTHQUAKE HAZARD AS A DISASTER MITIGATION EFFORT IN THE SPECIAL REGION OF YOGYAKARTA	6	10.30-12.30	3
AR-0119	Wahyu Hidayat	IDENTIFICATION OF ROCK MASS STRENGTH BASED ON EMPIRICAL APPROACH VELOCITY OF SEISMIC TOMOGRAPHY AND ULTRASONIC TEST AT UNDERGROUND MINING	6	10.30-12.30	4
AR-0123	Johanes Pembaptis-Chandra Yoga Prathama	THE EFFECT OF GRAIN SIZE AND CYANIDE CONCENTRATION ON AGITATION LEACHING ON THE PERCENT RECOVERY OF GOLD SLUICE BOX TAILINGS AREA OF BATU SOPANG EAST KALIMANTAN	6	10.30-12.30	5
AR-0131	Yasmina	MINIMIZING DEFECTIVE PRODUCTS USING SIX SIGMA METHODS TO INCREASE PRODUCTION RESULTS	6	10.30-12.30	6

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ROOM 7

Moderator: Dwiky Ahmad Effendi

ID Paper	Corresponding Author	Title	Room	Schedule	Presentation sequence
AR-0139	Ariany Zulkania	STUDY ON REACTIVITY AND KINETIC OF IRON ORE-BIOMASS PELLETS REDUCTION USING THERMOGRAVIMETRIC ANALYSIS	7	10.30-12.30	1
AR-0144	Rika Ernawati	DETERMINATION OF EFFECTIVE HYDRATED LIME (CA(OH) ₂) CONCENTRATION ON DORE BULLION GOLD REFINING PROCESS WASTE ON HYDROGEN ION (PH) NETRALIZATION AND TOTAL DISSOLVED SOLID (TDS) PRECIPITATION	7	10.30-12.30	2
AR-0153	Djoko Mulyanto	TERRA ROSSA SOIL AS AN ADSORBENT TO REMOVE HEXAVALENT CHROMIUM IN AQUEOUS SOLUTIONS	7	10.30-12.30	3



Certificate

No. 47/ICARET/UPNYK/2022

This is to certify that:

Herry Riswandi

has participated in

"International Conference on Advanced Research in
Engineering and Technology"
as

PRESENTER

for the paper entitled

**"MICROZONATION OF THE EARTHQUAKE HAZARD AS A DISASTER
MITIGATION EFFORT IN THE SPECIAL REGION OF YOGYAKARTA"**



Dr. Hendro Widjanarko, M.M.

Head of Institute of Research and Community Service

Dr. Suranto, M.T.

Chairman

Microzonation of The Earthquake Hazard as A Disaster Mitigation Effort in The Special Region of Yogyakarta

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Abstract The Special Region of Yogyakarta is tectonic with a high level of risk of earthquake disasters. This condition is due to the location of Yogyakarta which is closer to the subduction zone of the Indo-Australian Plate to the Eurasian Plate in the Indian Ocean in the South of Java Island and there is a very active Opak fault on land. The history of destructive earthquakes in Yogyakarta due to the Opak fault activity last occurred on 27 May 2006. The earthquake caused 5,782 deaths, dozens were injured, and hundreds of thousands of houses were damaged. This study aims to identify potential earthquake hazards using the microzonation method to evaluate and map areas that have a high earthquake risk based on the calculation of the maximum soil acceleration (PGA) value in bedrock and Vs30 data as a site characterization due to the influence of local soil conditions. In this study, the methods used are the calculation of Probabilistic Seismic Hazard Analysis (PSHA), the HVSr inversion method and the Multichannel Analysis of Surface Waves (MASW). Based on the calculations, a map of the maximum ground acceleration (PGA) in the bedrock and a map of the maximum ground acceleration at the ground surface are generated which can be used as considerations in determining the rules regarding the design/standard of earthquake-resistant buildings as an effort to mitigate earthquakes.

Keywords: Earthquake, Microzonation, PSHA, PGA, HVSr, Yogyakarta

1. INTRODUCTION

The Special Region of Yogyakarta is tectonically one of the most active regions in Indonesia. This condition is caused by the location of Yogyakarta which is closer to the subduction zone of the Indo-Australian Plate to the Eurasian Plate in the Indian Ocean south of Java Island. Besides being very prone to earthquakes due to plate subduction activities, the Special Region of Yogyakarta and its surroundings are also very prone to earthquakes due to local fault activities.

The history of destructive earthquakes in Yogyakarta based on the BMKG Damaging Earthquake Data Catalog (Setiyono, et al., 2019) occurred in 2006, 1981, 1943, 1937, and 1867 (Figure 1). The 2006 earthquake occurred on 27 May 2006 in the morning at 05:53:57 WIB, the source of the earthquake at coordinates 8.26 South Latitude and 100.31 East Longitude with a depth of 33 km and a strength of 5.9 M, felt in Bantul and Klaten with an intensity of IX MMI, Sleman and Yogyakarta. VIII MMI, Surakarta V MMI, Salatiga and Blitar IV MMI, Surabaya II MMI and Denpasar. The earthquake caused the death toll in Bantul, Klaten, Yogyakarta and Central Java to reach 5,782 people, dozens of people were injured, and hundreds of thousands of houses were damaged.

Another history of destructive earthquakes is the earthquake on March 14, 1981. This

earthquake occurred at 06:22:35 WIB, the source of the earthquake at coordinates 8.76 South Latitude and 110.43 East Longitude, a depth of 51 km and a strength of M 5.6 was felt in Yogyakarta with an intensity of VII MMI. The earthquake caused cracks in the walls of the Ambarukmo hotel. The earthquake on July 24, 1943 with coordinates 8.6 South Latitude and 109 East Longitude was felt in Yogyakarta VIII MMI, Garut, and Surakarta. The earthquake caused 213 people died, 2096 people were injured, and 2800 houses were badly damaged. The earthquake on 27 September 1937 at coordinates 8.7 South Latitude and 110.8 East Longitude was felt in Yogyakarta VIII-IX MMI, Klaten, Klumpit, Central Java, to East Lombok. There were one-person dead in Klumpit and 1 house split open, a total of 326 Prambanan temple stones collapsed, 2,200 houses were damaged, and underground pipes were damaged in several places. The earthquake on June 10, 1867 was felt in Yogyakarta and Surakarta VIII-IX MMI. As a result of the earthquake, 5 people died, and 372 houses collapsed and partially damaged.

The Special Region of Yogyakarta has a high level of risk for earthquake disasters because it has a relatively high population density and the development of public infrastructure and housing is growing rapidly. Physiographic conditions affect the distribution of the population, the availability of regional infrastructure and facilities, and the socio-economic activities of the population, as well as the progress of development between regions. In relatively flat areas, such as fluvial plains covering Sleman Regency, Yogyakarta City, and Bantul Regency, these are areas with high population density, and have high socio-economic activities.

When earthquake prediction efforts have not been successful, the best effort to anticipate the disaster is through earthquake mitigation. Earthquake mitigation can be carried out in three stages, namely before, during, and after an earthquake. The first step in mitigation efforts before an earthquake occurs is by microzoning the earthquake hazard. This mapping is needed to identify areas that have a high earthquake risk. By knowing areas that have a high earthquake risk, anticipation to reduce the impact of disasters that may arise in these areas can be done as early as possible.

The Special Region of Yogyakarta has a high level of risk for earthquake disasters. Therefore, mitigation efforts through microzoning of earthquake hazards need to be carried out comprehensively. Earthquake hazard microzoning is an attempt to evaluate and describe the potential for earthquake disasters in an area, which are generally caused by strong vibrations during an earthquake. Earthquake hazard microzoning activities include, among others, site characterization due to the influence of local soil conditions, as well as seismic-hazard microzoning analysis by considering the amplification due to the influence of local soil conditions. Earthquake microzoning activities can provide output in the form of studies, maps, and various detailed information on potential earthquake hazards. This is needed as input for authorities at both central and regional levels in spatial planning, practitioners in the initial design of earthquake-resistant structures and infrastructure, earthquake mitigation priorities, and contingency plans for earthquake disasters.

2. MATERIALS AND METHODS

2.1 Case study delineation

The special area of Yogyakarta, Indonesia is the administrative area chosen in the case study in this study, this is considering the potential high risk of earthquake hazard caused by opaque fault activity which is an active fault on land in the Yogyakarta area. The Yogyakarta earthquake that occurred on 27 May 2006 was a major earthquake in Yogyakarta caused by the movement of

the opaque fault, the magnitude of the earthquake was quite large, namely $M=6.4$ which resulted in 6234 fatalities with 36,299 people injured and 1.5 million people lost their homes and resulted in infrastructure damage as many as 616,458 units of residential buildings.

The areas selected for the research include all regencies and cities in D.I Yogyakarta which include the City of Yogyakarta, Sleman Regency, Bantul Regency, Kulonprogo Regency, and Gunung Kidul Regency. In this study, PGA and Vs30 mapping were carried out for the entire Special Region of Yogyakarta, while surface PGA mapping was carried out for each Regency/City obtained by using microtremor data processing, HVSR inversion, Vs30 data obtained from the MASW and USGS methods so that PGA was obtained. bedrock and surface PGA with a probability of exceeding 2% in 50 years.

2.2 Methods

2.2.1 Processing of Microtremor, HVSR Inversion, and Vs30

The microtremor signal from the measurement results was analyzed using Geopsy software. The first step is the windowing process. Window selection is done manually with a window length of 25-50 seconds. Each window is then Fourier transformed, so that every window that was originally in the time domain is transformed into a window in the frequency domain. Each window is then compared with the horizontal direction spectrum with the vertical direction spectrum to produce an HV curve for each window. The curves are then stacked so that the average value of the HVSR curve is obtained from one microtremor recording data. In the HVSR curve, information is obtained from the dominant frequency value and the peak amplitude of the HVSR. Microtremor data processing is done using Geopsy software. The results of microtremor processing are then stored in .hv format.

The HVSR curve was then analyzed again using the OpenHVSR program to obtain a 1D profile of shear wave velocity (Vs). The data needed in this process is the HVSR curve in .hv format and the initial model in .txt format in the form of Vp, Vs, density, layer thickness, Qp, and Qs. HVSR inversion processing is carried out using the OpenHVSR program. The results of further processing are used to calculate the value of Vs30 with the formulation of equation (2). In this study, the Vs30 value used is a combination of the results of HVSR inversion processing, and from secondary data, namely the Vs30 value from the MASW method and Vs30 from the USGS.

2.2.2 Soil Acceleration Microzonation Process

Earthquake microzonation is carried out by estimating the maximum ground acceleration (PGA) value in the bedrock. In this study, the PGA value in the bedrock used refers to the results of the 2017 Indonesia Earthquake Source and Hazard Map (Pusgen, 2017). Local soil conditions will affect the amount of PGA on the soil surface. Local soil conditions will affect the amplification of earthquake waves. The representative soil dynamics parameter that can be used to estimate the PGA on the surface is the value of Vs30.

2.2.3 Mapping of Processing Results and Modeling

After processing the data processing process, the parameter values obtained are then mapped to make it easier to interpret. The results of processing the mapped data are the value of Vs30, PGA in bedrock, and surface PGA with a probability of exceeding 2% in 50 years. In this study, mapping the results of data processing using ArcMap 10.8. software

3. RESULTS AND DISCUSSIONS

3.1. Site Characterization of the Special Region of Yogyakarta

Based on the results of data processing combined HVSR inversion, MASW secondary data, and Vs30 USGS, the average shear wave velocity to a depth of 30 m (Vs30) in the Special Region of Yogyakarta varies with values from less than 175 m/s to 900 m/s. Relatively low values of Vs30 were found in most parts of Bantul Regency and Yogyakarta City, southern and eastern Kulonprogo, southern Sleman and parts of Gunungkidul.

Site characterization in the Special Region of Yogyakarta based on site class classification in SNI 1726:2019 shows that this area has four types of site classes, namely soft soil (SE), medium soil (SD), hard soil, very dense and soft rock (SC), and rock (SB). Soft soil has a value of Vs30 < 175 m/s, medium soil 175 - 350 m/s, hard soil 350 - 750m/s, and rock 750 - 1500 m/s.

3.2. Potential Earthquake Hazards in Bedrock

The potential for earthquake hazard in bedrock in the Special Region of Yogyakarta (DIY) refers to the 2017 Indonesia Earthquake Source and Hazard Map from the National Earthquake Study Center (PuSGeN). Based on the calculation of the Probabilistic Seismic Hazard Analysis (PSHA), the maximum soil acceleration (PGA) map for engineering bedrock is generated with a shear wave velocity of Vs 760 m/s. This map can be used to determine the maximum ground acceleration value probabilistically or to identify potential seismic hazard probabilistically. This map becomes the official reference map for PGA values in bedrock for building design in a city or certain coordinates. The PGA map in the bedrock of the Special Region of Yogyakarta shown in Figure 1.

According to Figure 1 the PGA value of bedrock in the Special Region of Yogyakarta varies from 0.35 to more than 0.6 g. The areas with the highest PGA values for bedrock are distributed in most of Bantul Regency, western Gunungkidul Regency (which is adjacent to the Opak Fault line), Sleman Regency with the closest orientation to the Opak Fault line (Berbah and Prambanan Districts), Yogyakarta City with the closest orientation. with the Opak Fault line (Kota Gede District, Umbulharjo). Meanwhile, the lowest bedrock PGA values were distributed in Sleman District (Cangkringan, Pakem, Turi, Tempel), and Kulonprogo Districts (Kalibawang District, Samigaluh).

3.3. Potential Earthquake Hazards at Ground Surface

The results of mapping the potential for earthquake hazards on the ground surface in this report are initial information which is divided into preliminary reports for Bantul Regency, Yogyakarta City, Kulonprogo Regency, Sleman Regency, and Gunungkidul Regency. Based on PSHA calculations, PGA is generated for engineering bedrock with Vs 760 m/s (Figure 2). These results were further analyzed by considering the condition of the sediment at a depth of 0-30 meters from the surface to produce a map of the maximum soil acceleration (PGA) at the ground surface. This surface PGA map is very necessary to calculate the maximum acceleration of earthquake vibrations when passing certain types of soil that are mapped in the range of 0-30 meters from the surface. Based on the calculation of the surface PGA described above, the resulting vibration levels on the ground surface, as shown in Figure 2.

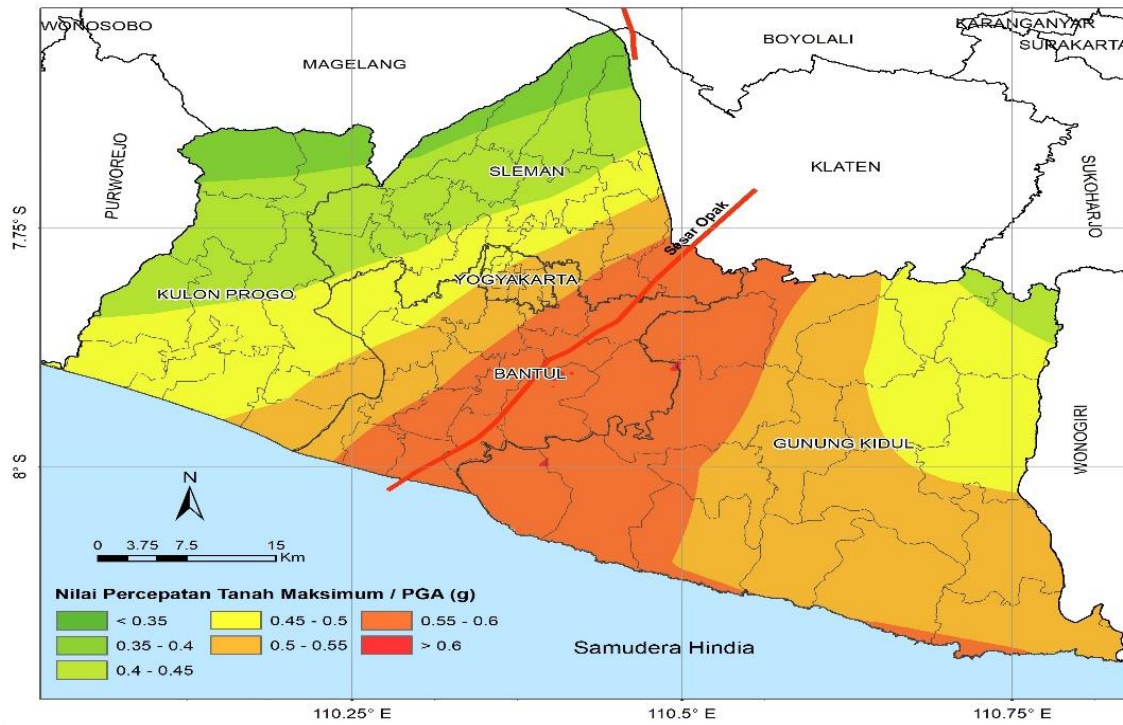


Figure 1. PGA map of bedrock in the Special Region of Yogyakarta

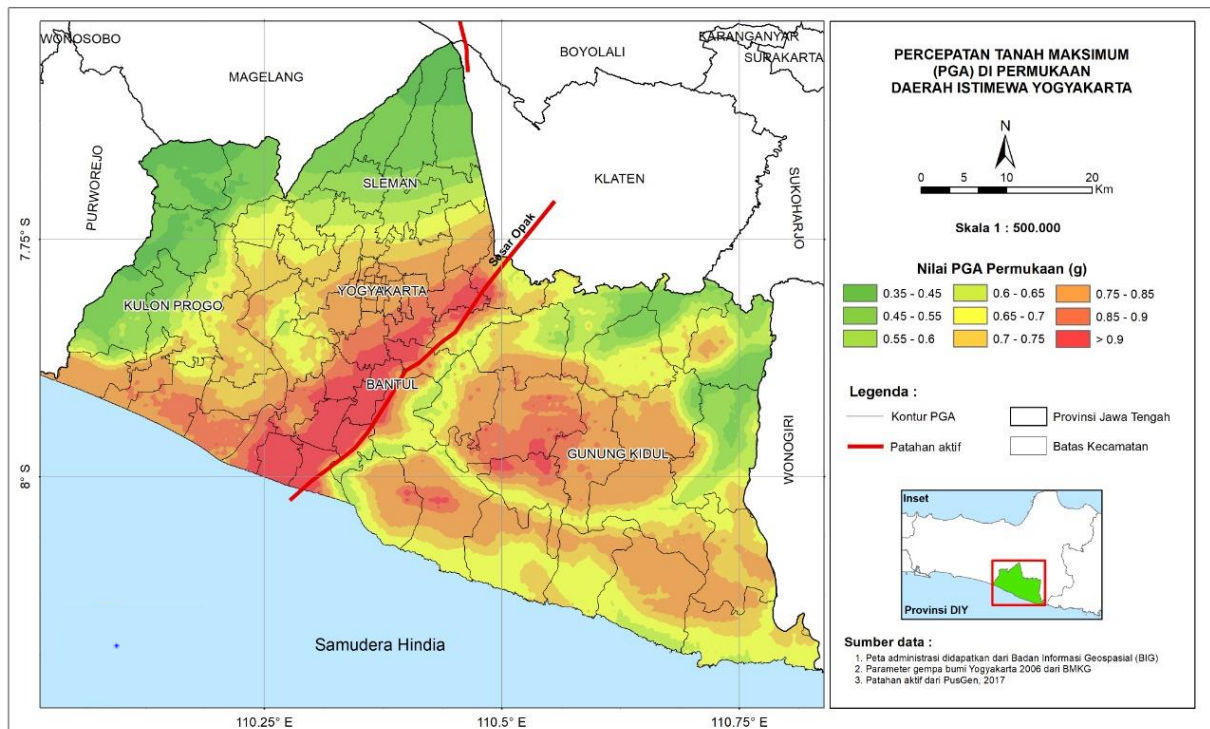


Figure 2. The surface PGA map in the Special Region of Yogyakarta

3.3.1. Bantul Regency Area

The surface PGA map in Bantul Regency is shown in Figure 2. The maps in this report are preliminary information. The surface PGA value in Bantul Regency varies from 0.6 g to > 0.9 g or if converted in the MMI scale it varies between VIII – IX MMI. The potential damage and impacts caused by the earthquake range from minor damage to buildings with strong construction, cracks in buildings with poor construction, walls can be separated from the frame of the house to damage to strong buildings, the frames of the house are not straight, and lots of cracks. Based on Figure 2, the sub-districts with acceleration values of 0.75 g to > 0.9 g or IX MMI are distributed around the Opak Fault line, namely Srandakan, Pandak, Kretek, Sanden, Pundong, Bambanglipuro, Jetis, Bantul, Pleret, Sewon, Piyungan and Banguntapan sub-districts. The area is dominantly located on the east side of the Opak Fault with the predominance of sedimentary material originating from the Qmi Formation (Mount Merapi Muda Sediment) which is composed of tuff, ash, breccia, agglomerates and lava flows. Areas with surface PGA varying from 0.6 – 0.75 g or VIII MMI are found in Sedayu, Pajangan, Kasihan, Imogiri, and Dlingo sub-districts.

3.3.2. Yogyakarta City Area

Based on Figure 2. The maps in this report are preliminary information. The surface PGA value in Yogyakarta City varies from 0.65 to 0.85 g or if converted on the MMI scale it varies between VIII – IX MMI. The potential damage and impacts caused by the earthquake range from minor damage to buildings with strong construction, cracks in buildings with poor construction, walls can be separated from the frame of the house to damage to strong buildings, the frames of the house are not straight, and lots of cracks. Based on Figure 3, the sub-districts with acceleration values of 0.75 g to 0.85 g or IX MMI are located in the southeast of Yogyakarta City with the orientation closest to the Opak Fault Line, namely Kota Gede, Umbulharjo, Mergangsan, Mantrijeron, and Kraton Districts. Geologically, the area is located in the Qmi Formation (Young Mount Merapi Sediment) which is composed of sedimentary material in the form of tuff, ash, breccia, agglomerates and lava flows. Areas with surface PGA varying from 0.65 – 0.7 g or VIII MMI are found in the Districts of Wirobrajan, Ngampilan, Gondomanan, Pakualaman, Gondokusuman, Danurejan, Gedongtengen, Jetis and Tegalrejo.

3.3.3. Kulonprogo Regency Area

The surface PGA map in Kulonprogo Regency is shown in Figure 2. The maps in this report are preliminary information. The surface PGA value in Kulonprogo Regency varies from 0.35 - 0.85 g or if converted in the MMI scale it varies between VII - IX MMI. The potential damage and impacts caused by the earthquake range from vibrations felt by all residents, residents leaving their homes, minor damage to buildings with good construction to damage to strong buildings, misaligned house frames, and lots of cracks. Based on Figure 4, the sub-districts with acceleration values of 0.75 g to 0.85 g or IX MMI are in the Southeast and South of Kulonprogo Regency with the orientation closest to the Opak Fault Line, namely Galur, Panjatan, Temon, Wates, Sentolo and Lendah Districts. Geologically, the area is located in the Qa (Aluvium) Formation which is composed of sedimentary material in the form of sand, cracal, silt and clay, and the Tmps Formation (Fromasi Sentolo) which is composed of limestone and marl sandstone.

Areas with Surface PGA varying from 0.45 – 0.7 g or VIII MMI are found in Kokap, Pengasih, Kalibawang and Nanggulan sub-districts. The area is located in the Menoreh hills which is composed of geological formations, namely the Tmok Formation (Kebobotak), Tmj (Jonggrangan) and andesite. The Tmok Formation is composed at the bottom in the form of well

layered sandstone, siltstone, claystone, shale, tuff and agglomerates, with a thickness of more than 650 meters with the top consisting of alternating sandstone and claystone with thin insertions of tuff, while the Tmj (Jonggrangan) Formation is composed of conglomerate rocks, tuffaceous marl, sandy limestone with lignite insertion and coral-coated limestone. Areas with surface PGA varying from 0.3 – 0.4 g or VII MMI are found in Girimulyo and Samigaluh Districts. The area is located in the Menoreh hills which is composed of geological formations, namely the Tmok Formation (Kebobutak), Tmj (Jonggrangan) and andesite.

3.3.4. Sleman Regency Area

The surface PGA map in Sleman Regency is shown in Figure 2. The maps in this report are preliminary information. The surface PGA value in Sleman Regency varies from 0.35 g to > 0.9 g or if converted in the MMI scale it varies between VII – IX MMI. The potential damage and impacts caused by the earthquake range from vibrations felt by all residents, residents leaving their homes, minor damage to buildings with good construction to damage to strong buildings, misaligned house frames, and lots of cracks. Based on Figure 5, the sub-districts with acceleration values of 0.75 g to 0.9 g or IX MMI are located in the Southeast and South of Sleman Regency with the orientation closest to the Opak Fault Line, namely Prambanan, Berbah, Depok, and Kalasan Districts. Geologically, the area is located in the Qmi Formation (Young Mount Merapi Sediment) which is composed of sedimentary material in the form of tuff, ash, breccia, agglomerates and lava flows.

Areas with surface PGA varying from 0.45 – 0.7 g or VIII MMI are found in Gamping, Godean, Moyudan, Minggir, Seyegan, Mlati, Ngaglik, Ngemplak, Sleman, Tempel, Turi, Pakem, and Cangkirngan sub-districts. The area is located in the Qmi Formation (Young Mount Merapi Sediment) and the Tmok Formation (Kebobutak). Areas with surface PGA varying from 0.35 – 0.4 g or VII MMI are found in the Mount Merapi area, namely in the Turi, Pakem and Cangkirngan sub-districts with the Qmi Formation (Mount Merapi Young deposits).

3.3.5. Gunungkidul Regency Area

The surface PGA map in Gunungkidul Regency is shown in Figure 2. The maps in this report are preliminary information. Surface PGA values in Gunungkidul Regency vary from 0.45 g to 0.9 g or if converted in the MMI scale it varies between VIII – IX MMI. The potential damage and impacts caused by the earthquake range from minor damage to buildings with strong construction, cracks in buildings with poor construction, walls can be separated from the frame of the house to damage to strong buildings, the frames of the house are not straight, and lots of cracks. Based on Figure 6, the sub-districts with acceleration values of 0.75 g to 0.9 g or IX MMI are in the middle and south of Gunung Kidul Regency with the orientation closest to the Opak Fault Line, namely Playen, Purwosari, Panggang, Wonosari, Paliyan, Karangmojo, Semanu, Tepus sub-district, and Rongkop. The area is located in the Tmwl Formation (Wonosari - Punung Formation) and Tmpk Formation (Kepek). Areas with surface PGA varying from 0.45 – 0.7 g or VIII MMI were found in the Districts of Gedangsari, Nglipar, Ngawen, Semin, Ponjong, Girisubo, Tanjungsari and Saptosari. The area is located in the Tmwl Formation (Wonosari - Punung Formation).

The results of the surface PGA in Gunungkidul Regency are initial results because the Vs30 value used is still using Vs30 from USGS (based on topographic slope). It is necessary to re-examine using geotechnical methods and geophysical methods to obtain the actual value of Vs30.

4. CONCLUSIONS

Based on the results and analysis that has been carried out, the conclusions obtained are: (a) Based on the site characterization results, the Special Region of Yogyakarta has a site class of soft soil (SE), medium soil (SD), hard soil, very dense and soft rock (SC), and rock (SB). (b) The PGA value of bedrock in the Special Region of Yogyakarta varies from 0.35 to more than 0.6 g. The areas with the highest PGA values for bedrock are distributed in most of Bantul Regency, western Gunungkidul Regency (which is adjacent to the Opak Fault line), Sleman Regency with the closest orientation to the Opak Fault line (Berbah and Prambanan Districts), Yogyakarta City with the closest orientation with the Opak Fault line (Kota Gede District, Umbulharjo). Meanwhile, the lowest bedrock PGA values were distributed in Sleman District (Cangkringan, Pakem, Turi, Tempel), and Kulonprogo Districts (Kalibawang District, Samigaluh). Surface PGA values in the Special Region of Yogyakarta varied between 0.35 - > 0.9 g or equivalent to VII – IX MMI. With the Highest Surface PGA in Bantul and Sleman Regencies 0.65 - > 0.9 g or equivalent to earthquake intensity VII - IX MMI and the lowest surface PGA in Kulonprogo Regency 0.35 - 0.85 g or equivalent to earthquake intensity VII - IX MMI (c) Preparation of ground acceleration maps Maximum soil acceleration (PGA) in bedrock, as well as maps of maximum soil acceleration on the surface of the Special Region of Yogyakarta have been carried out in five regencies/cities, namely Bantul Regency, Yogyakarta City, Kulonprogo Regency, Sleman Regency, and Gunungkidul Regency.

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