



Main Menu

- Home
- About Us
- Founders
- Partner Universities
- Partner Institution
- Honorary Members
- Past Conference
 - Conference 2015 Surabaya, INDONESIA
 - Conference 2013 SINGAPORE
 - Conference 2011 Yogyakarta, INDONESIA
 - Conference 2009 Lankawi Island, MALAYSIA
 - Conference 2007 Jakarta, INDONESIA
- Publication
 - 5th EACEF 2015 Surabaya
 - 4th EACEF 2013 SINGAPORE
 - 3RD eacef 2011 Yogyakarta
 - 2nd EACEF 2009 Langkawi Island
 - 1st EACEF 2007 Jakarta

EACEF

The 3rd International Conference of European Asian Civil Engineering Forum

Yogyakarta, INDONESIA, 20 - 22 September 2011

Designing and Constructing in Sustainability



EACEF 2017

- NEWS

EACEF 2015

- NEWS
- BROCHURE
- GERMAN DAAD ALUMNI EVENT

EACEF 2013

- Gallery

EACEF 2011

- Gallery

EACEF 2009

- Gallery

EACEF 2007

- Gallery

Keynote Speakers

- Ir. Agus Widjanarko, MIP (German Alumni- University of Stuttgart), Secretary General of Public Works Ministry of the Republic of Indonesia
- Dr. Norbert Baas, His Excellency, the Ambassador of Republic Federal of Germany

Invited Speakers

- The Development of Nanotechnology for Construction Materials ◻
 Prof. Dr.-Ing. habil. Michael Schmidt (University of Kassel)
- Real-Time Rainfall and Flood Forecasting in Ta Tapao River Basin, Thailand ◻
 Prof. Tawatchai Tingsanchali, D.Eng. (Nakhon Pathom Rajabhat University)
- Designing the Future ◻
 Klaus Thorsten, M.Sc. on behalf of Prof. Dr.-Ing. habil. Werner Sobek (University of Stuttgart, GERMANY)
- New Structural Systems Employing Innovative Structural Materials ◻
 Keiji Ando (The Japan Iron and Steel Foundation, Japan)
- Optimisation of Sustainable Geotechnical Structures in Urban Civil Engineering
 Prof. Dr.-Ing. habil. Christian Moormann (University of Stuttgart)
- The Development of Construction Safety Management Systems ◻
 Prof. Chan Weng Tat (National University of Singapore)
- Construction Management Research and Education Activities Moving Up Asian Universities Collaboration ◻
 Prof. Shunji Kusayanagi (Kochi University of Technology, Thailand)

BM - Building Materials Engineering (Nanotechnology)

- The Use of Local Materials in the Flexible Pavement Structure Towards the Sustainable Pavement Materials in Indonesia
 Bambang S. Subagio

- Multiphases Hydration of the Activated Binary Blend Portland Cement – Trass □
Vera Indrawati Judarta
- Utilisation of Soft Drink Can as Fibre Reinforcement in Concrete □
A.S.M. Abdul Awal, Dianah Mazlan, and Md Latif Mansur
- Another Looks: Application of Stick Scanner in RC Structures Assessment □
Achfas Zacoeb, Yukihiro Ito, and Koji Ishibashi
- The Comparison of Microscopic and Macroscopic Characteristics between Low Calcium Fly Ash Geopolymer Binder and High Calcium Fly Ash Geopolymer Binder Using Indonesian Fly Ash □
Simatupang, P.H., Pane, I., Sunendar, B., and Imran, I.
- Mechanical Properties of Concrete Using Rubber Tire Chips as Partial Coarse Aggregate Replacement □
Ezahtul Shahreen A.W., Nor Ashikin M.K., and Roslina O.
- Material Development of Nanosilica Based on Indonesia Silica Sand for Concrete Mix □
Jonbi, Harianja, B., Imran, I., and Pane, I.
- The Characteristic of Durability in High Performance Concrete □
Chao-Lung Hwang, Chun-Tsun Chen, Fransiscus Mintar Ferry Sihotang, and Tuan Le Anh Bui
- Self-Compacting Concrete in Its Durability Performance □
Chao-Lung Hwang, Chun-Tsun Chen, Fransiscus Mintar Ferry Sihotang, and Tuan Le Anh Bui
- The Utilization of Tailing Sand Ex Bangka Island for Rehabilitation Materials of Rigid Pavements □
A. Setyawan, K.A. Sambowo, and Z. Senaring
- Evaluation of Current Models for Estimating Long-Term Shrinkage of Lightweight Aggregate Concrete □
S.A. Kristiawan
- Multi Criteria Decision of Type and Building Material for Simple House Construction □
Wahyu Wuryanti
- Properties of Building Block Incorporating Waste Aggregates Bound With Alternative Binders □
I Nyoman Arya Thanaya
- Behavior of Baggage Ash – Cement Stabilized Soil with Fiber Inclusion □
John T. Hatmoko and Yohanes Lulie
- Analysis of the Use of Brackish Sand for Making Mortar in Mutun Beach, South Lampung Regency □
Lilies Widojoko
- The Effect of Carbon Black and Natural Rubber Latex on Rheological Characteristics of Bitumen □
Ismail bin Yusof, Madi Hermadi, Saad, and Abdulqader Ali Joda
- Strength and Sulphate Attack Resistance of Roller Compacted Concrete with Circulating Fluidized Bed Combustion Ash □
Mao Chieh Chi and Run Huang
- Reaction between Alkaline Metal Ions and ASR Reactive Aggregate and Behavior of Na⁺ and K⁺ in Cement Paste Replaced by Li⁺ □
Wei-Chien Wang, Chih-Chien Liu, and Chau Lee
- Mechanical Properties of Concrete Containing Recycled Steel Fibres (RSF) □
Norahwani Modtrifi and Izni Syahrizal Ibrahim
- Enhancement on Strength Properties of Steel Fibre Reinforced Concrete □
Noor Nabilah Sarbini and Izni Syahrizal Ibrahim
- The Compressive Strength of Baggage Ash-Based Geopolymer Concrete □
Ade Lisantono and John Tri Hatmoko
- Comparison of Infrastructure Designs for Quay Wall and Small Bridges in Concrete, Steel, Wood and Composites with Regard to the CO₂-Emission and the Life Cycle Analysis □
David Dudok van Heel, Trude MAAS, Jarit de Gijt, and Mozafar Said
- Maturity Function to Predict Strength of Mortars Containing Ground Granulated Blast Furnace-Slag Cured at Different Curing Temperatures □
Gidion Turuallo and M.N. Soutsos
- Rutting and Fatigue Behavior of Nanoclay Modified Bitumen □
Saeed Ghaffarpour Jahromi
- The Effect of Cold Lava Aggregate as a Filler Material of Concrete □
Ika Bali and Oskar Sitorus
- Experimental Study to the Load-Displacement Response of The Interfacial Transition Zone in Concrete □
Han Ay Lie and Parang Sabdono
- The Influence of Compaction Methods on the Properties of Hollow Concrete Bricks Utilizing Fly Ash and Bottom Ash □
Djwantoro Hardjito and Antoni
- The Use of Spent Catalyst RCC-15 as Powder on Environmental-Friendly High-Performance Self-Compacting Concrete □
Bernardinus Herbudiman and Ayu Setyaning Pijar Kemala
- Influence of Curing Method on High Strength Self Compacting Concrete □
Bernardinus Herbudiman and Ruli Adi Prasetya
- Flexural Performance of High Strength Concrete Containing Steel Fibres □
Sholihin As'ad and Andreas Saxer
- Shear-Friction Strength of Recycled Aggregate Concrete □
Khalidoun Rahal, Abdul Lateef Al-Khaleefi
- A Fundamental Study on the Diagnosis Method of Existing RC Structures Using the Characteristics of Hammering Sound □
Yuki Fukui and Yoshimi Sonoda
- The Recent Development of Ultra High Performance Concrete (UHPC) in Indonesia □
Harianto Hardjasaputra, Joey Tirtawijaya, and Giovano Tandaju

CM - Construction Management and Project Management

The Productivity Analyzes of Bored Pile Foundation in the Main Bridge Area

Sentosa Limanto, Jonathan HK, Stephen H.S, and Hendri W

Best Practice for Safer Construction from Designers' Perspective

Abdul Rahim Abdul Hamid, Bachan Singh and Tan Kin Liang

Best Practice for Safer Construction from Contractors' Perspective

Abdul Rahim Bin Abdul Hamid, Bachan Singh and Mazni Binti Mat Zin

Optimal Bid Price in a Competitive Bidding under Risk Aversion

Andreas Wibowo

Project Financing and Risk Management in Transportation Projects: A Public Private Partnerships Framework

I Putu Mandiartha Colin F. Duffield, and Gigih U Atmo

Fault Tree Analysis of Work Accident Cause Factors in Mud Volcano Sidoarjo Disaster Management

Cahyono Bintang Nurcahyo Farida Rahmawati, and Diar Farobi

Productivity Problems Encountered by Indonesian Construction Foremen

Peter F. Kaming

Relationship Between Implementation of Safety Policy and Craftsmen's Productivity

Peter F. Kaming and Martino Ardianto

Risks Analysis in Public Private Partnership (Case Study: Traditional Market Development Projects in Surabaya)

Farida Rahmawati and Carla Widha Permatasari

The Implementation Effect of Aspects Relating to the Issues of Occupational Safety and Health Against Productivity in Construction

Anton Soekiman and Syamsuduha

Cost of Quay Walls

J.G.de Gijt

Knowledge Management and Corporate Performance in Construction

Mochamad Agung Wibowo and Rudi Waluyo

Exploring Contractors' View on Green Construction

Jati Utomo Dwi Hatmoko, Ferry Hermawan, And Tia Putriani Styianingsih

Preliminary Study on Pre-Project Planning Activities of Public Infrastructure Projects

Febrina P.Y. Sumanti and M. Agung Wibowo

The Analysis of Building Reliability in Karawaci

Manlian Ronald A. Simanjuntak and Mukhodos Syuhada

GT - Geotechnical Engineering

Effective Reuse of Fly Ash as Fill Materials for Embankment Construction

Muhardi Aminaton Marto, Khairul Anuar Kassim, and Wan Suhairi Yaacob

Peak Base Acceleration of Semarang City with Three Dimensional Seismic Source Model

Abdul Rochim

Dimension Effects of Upstream Filter of Rockfill Dam Against Hydraulic Fracturing

D. Djarwadi, K.B. Suryolelono, B. Suhendro, and H.C. Hardiyatmo

Improvement of the Load Carrying Capacity of UTHM Soft Clay Soil by Electro Osmotic Consolidation

Khairul Nizar Mohd Yusof and Abdul Kaharudin Arsyad

Analysis of Basal Heave Stability for Excavations in Soft Clay Using the Finite Element Method

Aswin Lim, and Chang- Yu Ou

Squeezing Potential Evaluation of Tunnel in Tropical Area

Vahed Ghiasi, Husaini Omar, Bujang Kim Huat, Zainuddin b. Md. Yusoff, Sina Kazemian, Mehrdad Safaei, Samad Ghiasi, Zainab Bakhshipour, and Ratnasamy Muniandy, Habibeh Valizadeh

Predicting Erosion Rate During the Hole Erosion Test as Affected by Clay Concentration and Wall Roughness

Kissi Benaissa, Khamlichi Abdellatif, Bezzazi Mohamed, and Miguel Angle Parron Vera, Rubio Cintas Maria Dolores

Validating the Juang Method in Order to Assess Liquefaction Potential of Soils in the Northern Moroccan Region of Tangier

Touil Noufal, Bezzazi Mohammed, Khamlichi Abdellatif, and Jabbouri Abdellah

Overview on Remotely Sensed Earthquake Precursors

Habibeh Valizadeh Alvan and Farid Haydari Azad

Influence of Construction Stages on Surface Settlement in NATM Tunnelling

H. Sohaei, M. Hajihassani, A. Marto, and M Karimi Shahrabaki

IS - Infrastructure (environmental, coastal, transportation, water) Engineering

Exploring the Passenger Loyalty: An Integrated Framework for Service Quality, Satisfaction and Loyalty for Informal Public Transportation

Taslim Bahar, Ofyar Z Tamin, and Russ Bona Frazila

Financial Innovation for Toll Road Infrastructure Development

Lukas B. Sihombing, Ismeth S. Abidin, and Yusuf Latief

The Influence of Land Use in Transportation Planning

J. Dwijoko Anusanto Ahmad Munawar, Sigit Priyanto, and Bambang Hari Wibisono

Modeling Freight Transportation for Crude Palm Oil (CPO) in Central Kalimantan

Noor Mahmudah, Danang Parikesit, Siti Malkhamah, Sigit Priyanto, and Mark Zuidgeest

History, Conservation, and Development of Rail Transport in Indonesia □

R. Didin Kusdian

Transportation Performance Indicator Survey on Transportation Agencies at Nanggroe Aceh Darussalam Province □

Medis Sejahtera Surbakti, and Prof Yuwaidi Away

The Comparison of V/C and Travel Time Reliability Factor Affecting Daily Route Choice Behavior at Medan City □

Medis Sejahtera Surbakti

Considerations of Composite Signalised Intersection Control System □

Ben-Edigbe J. and Mashros N.

Travel Expenditure of Urban Transportation in Yogyakarta □

Imam Basuki, Siti Malkhamah, Ahmad Munawar, and Danang Parikesit

Land Value and Transportation Provision Modeling (Case Study: Yogyakarta City) □

Muiz Thohir and Ofyar Z. Tamin

Binder Type Selection for Foamed Cold Mix Asphalt □

Sri Sunarjono

Trend of Rainfall Pattern and Extreme Rainfall in Jakarta □

Cilcia Kusumastuti and Sutat Weesakul

Formulating Model to Separate Liquid Terminal Operation □

Anwarudin and Ofyar Z. Tamin

Informal Settlement Mapping and Urban Riverside Poverty Analysis Case: Kahayan Urban Riverside Area

Noor Hamidah

Probabilistic Roughness Progression as a Measure of Road Network Pavement Maintenance Effectiveness □

I Putu Mandiartha, Colin F. Duffield, Russell G. Thompson

Properties of Porous Asphalt Mixed Subjected to Laboratory Ageing □

Che Norazman Che Wan, Meor Othman Hamzah, Ramadhansyah Putra Jaya, Mohdzuan Ahmad

Simulation of Shore Protection Structures Layout □

Slamet Hargono

Using Geographic Information System for Flood Reduction in Bekasi City, Indonesia

Trihono Kadri

High Rate Water Treatment Plant System: Successful Implementation and Financial Prospect □

Mohajit

Potential Application of Biomembrane System for Wastewater Reuse in Urban Housing Area □

Elis Hastuti and Haryo Budi

Modeling Groundwater Flow and Salinity Intrusion by Advective Transport in the Regional Unconfined Aquifer of Southwest Bangladesh □

Sajal Kumar Adhikary, Ashim Das Gupta, and Mukand S. Babel

Indonesian Water Capacity Building Programme □

J.Q.J.C. Verberk, R. Garsadi, S. Notodarmojo, and A. Maenhout

Performance Analysis of Hydrology and Water Management for Flood Control System (A Case Study of Solo) □

A. Padma Lakstaningty

SC - Structural and Construction Engineering

Partial Capacity Design, an Alternative to the Capacity Design Method □

Benjamin Lumantarna and Ima Muljati

Finite Element Modeling for Reinforcing Steel Subjected to Reversed Cyclic Loading with Moderate Compressive Stress and Strain Demands □

Data Iranata

The Effect of Structural Modelling on the Analysis of P-Delta Effect Case Study: Second-Order Analysis by a Commercial Computer Program, SAP2000 □

Wiryanto Dewobroto

Seismic Reinforcement Against Shear Failure by "Post-Installed Rebar" on Walls of Existing Underground Structures □

Kensuke Yamamura and Osamu Kiyomiya

Lateral Torsional Buckling of Web Tapered I Beam □

Paulus Karta Wijaya

Numerical Analysis of Circular Concrete Columns Confined with FRP Sheets Under Concentric Axial Load □

Nico Nirwanto Laban and Andreas Triwiyono

Shear Strengthening Effect of RC Beams Retrofitted by Steel Reinforcement and PCM Shotcrete □

A. Arwin Amiruddin

Analysis on the Contribution of Cross Beam to a Torsional Buckling of Thin, Rectangular Beam Section □

Sri Tudjono, Windu Partono, and Joko Purnomo

Seismic Performance of Steel Special Moment Resisting Frame Using Reduced Beam Section □

Ima Muljati and Hasan Santoso

Bonding Capacity of Self Compacting Concrete Containing Fly Ash and MIRHA □

Agus Kurniawan, Nasir Shafiq,

Steel Fiber Concrete Slab Application as Replacement of Ordinary Roof Tiles □

Agus Kurniawan

Analysis of Structural Healthiness Using Hilbert Transform □

Jack Widjakusuma

Seismic Performance of Structure with Vertical Set-Back Designed Using Partial Capacity Design □

- Pamuda Pudjisuryadi Benjamin Lumantarna, S. Teddy, And H. Wijoyo
Analysis of Factors Influencing Elevation of Balanced Cantilever Structure for Precast Segmental Box Girder Bridge Construction
 Gambiro and Heru Purnomo
- The Analysis of Slab Beam in Tall Buildings with Earthquake Load**
 Ernie Shinta Yosephine Sitanggang and Johannes Tarig an
- A Proposal of Tensile Test of Pultruded GFRP Plate**
 Jongsung Sim, Hyunjoong Kim, and Kihong Lee
- Performance Based Design Review of 16-Story Twin Tower with Connecting Bridge-Way**
 Amelia Kusuma and Naveed Anwar
- Lesson and Learning from 5 Big Earthquakes in Sumatra 2004 - 2010**
 Johannes Tarigan
- The Flexural Strength And Rigidity Of Composite Plywood-Meranti Stress Skin Panel**
 Johannes Adhijoso Tjondro, Dina Rubiana Widarda, Leonardus Eka Dharma
- Parametric Study of Modified Continuous Bang-Bang Controller**
 Yoyong Arfiadi
- Reconstruction of Distributed Force Characteristics in Case of Non Punctual Objects Impacting Elastic Beams**
 A. Elbakari, F. El Khannoussi, A. Khamlichi, R. Dkiouak, A. Hajraoui, M. Bezzazi, A. Limam, E. Jacquelin
- Bolts Connections in Steel Bridge Structure Theory and Facts**
 Lanny Hidayat and Demson Sihaloho
- Composite Columns in Low-to-Medium-Rise SCBFS with Braces in the Two-Story X-Configuration**
 Junaedi Utomo
- Empirical Modeling of Storm Processes**
 B.M. Nguyen, J. A. Roelvink, and P. H. A. J. M. van Gelder
- A Fundamental Consideration of Defect Evaluation of Concrete Structures Using Infrared Thermography**
 Tatsuro Watanabe and Yoshimi Sonoda
- Dynamic Behaviour of Footbridges Subjected to Human-Induced Dynamic Loads; A Case Study of Footbridges in Surabaya**
 Endah Wahyuni, asdamnu, Ananta S.Sidharta and Dicky Ardhan Prasetya
- Mechanical Behavior of GFRP Rock Bolt for Permanent Support of Tunnel**
 Jongsung Sim and Hyunjoong Kim
- The Development of Green Structural Concrete In Indonesia**
 Hadi Rusjanto Tanuwidjaja
- A Discussion on Durability of High Strength Concrete (HSC) in View Point of Micro Pore Structure**
 Rita Irmawaty, Hidenori Hamada, Yasutaka Sagawa and Sho Yamatoki
- The Aerodynamic Derivatives of Suramadu Cable Stayed Bridge**
 Sukamta
- Shear Capacity of the Composite Styrofoam Filled Reinforced Concrete Beams**
 Rudy Djamaluddin
- The Flexural Strength of African Wood Flange–Plywood Web I-Joist**
 Johannes Adhijoso Tjondro and Michael Pio
- Ductility Performance of Precast Concrete Beam Confined by Nylon Mesh**
 Rr. M.I. Retno Susilorini, Kusno Adi Sambhowo and Budi Waluyo
- Bond and Strength Properties of Recycled Aggregate Concrete with Replacement Ratio of Recycled Aggregate**
 J. Sim, C. Park, Y. Kim, H.G. Lee and M. Shahid
- Flexural Buckling Resistance of Laminated Glass Columns**
 M. Feldmann and K. Langosch
- Use Technique of Solidifying Fly Ash to Make Aggregate for Pervious Concrete**
 Le Hoang Thanh Nam and Nguyen Van Chanh
- Sustainable Development of Construction Works in Bangladesh**
 Mohammed, T. U., Hasnat, A., Sarwar, N., Das, H. K., Miah, J. M., and Awal, M. A.
- Ductility of Timber Beams Strengthened Using Glass Fiber Reinforced Polymer Bars**
 A. Yusof

PEAK BASE ACCELERATION OF SEMARANG CITY WITH THREE DIMENSIONAL SEISMIC SOURCE MODEL (GT-006)

Abdul Rochim

Department of Civil Engineering, Sultan Agung Islamic University, Semarang, Indonesia
e-mail of corresponding author: abd_rch@yahoo.com

ABSTRACT

This study presents seismic hazard analysis that aims to estimate peak ground acceleration of Semarang for 500 – year return period earthquake that is to validate the Indonesia seismic rules. The seismic hazard analysis is based on geology and history condition by probabilistic seismic hazard analysis (PSHA) method using EZ FRISK program that models fault sources in three dimensional representations. The seismic sources considered are the acknowledged earthquake potential to a depth of 200 km within radius of 500 km from Semarang. This study utilizes a logic tree to cover uncertainties within one method of earthquake assessment. Seismic parameters are calculated by the method of Kijko & Sellevoll and Weichert. Three attenuation models are chosen for determination of the ground motion. The attenuation model of Youngs is selected to represent the subduction environment of Java and attenuation models of Boore et al. and Sadigh et al. are selected to represent shallow crustal fault surrounding Semarang. The result of the analysis shows that the peak base acceleration of Semarang is 0.17 g for 500 – year return period. The value is still on the range of that of Indonesia seismic rule.

Keywords: Ground motion, peak base acceleration, probabilistic seismic hazard analysis, three dimensional seismic source.

1. INTRODUCTION

According to its seismo-tectonical condition, Indonesia is a country that is much suffered from earthquakes. The records of earthquakes hitting this country in last 15 years have been representing how much it is risky to damage due to earthquake. A large number of devastating quakes have striken, such as the Aceh earthquake that triggered the catastrophic tsunami, Padang earthquake, and Yogyakarta one. For this reason, the analysis of seismic hazard must be inserted in a building design.

This seismic hazard analysis was conducted using Probabilistic Seismic Hazard Analysis (PSHA) method since this was quite flexible to estimate ground motion probability in earthquake prone areas having seismic sources that clearly or not measured (Frankel, A, 1998). The result of PSHA was a seismic hazard curve that displayed a probability of exceedence as a function of ground motion. The first estimation of seismic hazard using this method was conducted by Cornell (1968). In addition, the building codes dominantly occupied by American had been using seismic zone maps based on PSHA in which represented the seismic hazard (Leyendecker et al., 1995). Several recent researches also exhibited to use PSHA and it was believed that the method was still used in the future.

In the previous years, the analysis of seismic hazard was used to having two dimensional analysis to design earthquake-resistant buildings. Indonesian seismic codes was still based on the same two dimensional analysis in which this method was done to simplify the desirable calculation in which the effect of seismic source geometrical shape that was real three dimension could be minimized. As to the development of knowledge and technology, a three dimensional analysis of seismic hazard could be easily conducted. Therefore, a three dimensional seismic source model should be considered as the best way to represent the real condition on the field and have an accurate estimation.

The objectives of this research were: 1) to estimate the peak base acceleration (PBA) of Semarang for 200, 500, and 1000 year return period earthquake using a seismic source model in three dimensional representation, attenuation functions, and a suitable logic tree with a help of EZ Frisk version 7.2 program. 2) to develop the response spectra of bed rock of Semarang as a picture of seismic wave in it. 3) to describe an accurate and sophisticated seismic hazard analysis by explaining the calculation with respect to used analysis.

Some restrictions in this research are 1) the seismic sources considered were the acknowledged earthquake potential to a depth of 200 km within radius of 500 km from Semarang. 2) the acceleration was produced by utilizing a logic tree. 3) only accelerations of the year return period earthquake of 200, 500, and 1000 years were estimated.

2. METHODOLOGY

Seismic Data. Seismic data occupied, the hypocenters, were from both Indonesian and International geological boards such as Indonesian Meteorological and Geophysical Board (BMG), United States Geological Survey (USGS), International Seismological Center (ISC), and Preliminary Determination of Epicenter (PDE). The seismic sources considered were the earthquake potential to a depth of 200 km within radius of 500 km from Semarang from February 1903 to July 2007.

Processing Seismic Data. Based on Firmansjah (1999), the correlation between M_s and m_b , and M_s and M_w , for only earthquakes occurred in Indonesia, were created.

$$M_s = 1.33 m_b - 1.98 \dots\dots\dots(2.1)$$

$$M_w = 1.10 M_s - 0.64 \dots\dots\dots(2.2)$$

Separating between Mainshocks and Aftershocks. Among empirical criteria to identify foreshocks such as Arabasz & Robinson (1976), Gardner & Knopoff (1974), Uhrhammer (1986) dan Firmansjah (1999), in this research the Uhrhammer was occupied.

Completeness of Seismic Data Catalog. According to Stepp, J.C. (1972), seismic rate (λ) was defined as the number of earthquakes (N) recorded during a period (T) being divided by the period (T).

$$\lambda = \Sigma N / T \dots\dots\dots(2.3)$$

Standard deviation of rate (σ) was defined as the square root of rate (λ) divided by the period (T).

$$\sigma = (\sqrt{\lambda / T}) \dots\dots\dots(2.4)$$

A seismic rate was assumed to be constant only for long period observation. The period in which rate (σ) was observed started to break and steeper than the previous one denoted seismic data were no longer homogenous.

Characterizing Seismic Data. Identifying and evaluating seismic source were done based on geological and seismological data. Knowledge on the tectonic condition, and the history of geological and seismic data was required to identify seismic sources. In this stage, seismic source zone was created.

To calculate the seismic parameters in the zones needed a prior modelling used to obtain hypocenter distributions in which the dip of each subduction zone observed was estimated. The seismic sources considered are the acknowledged earthquake potential to a depth of 200 km.

When determining a maximum magnitude for each seismic source zone, a maximum magnitude in the areas can be determined geophysically from plate / tectonic structure. A maximum magnitude (M_w) can be a function of seismic moment (M_o), combined with the Kanamori formula (1977).

$$\sigma = (\sqrt{\lambda / T}) \dots\dots\dots(2.4)$$

$$M_w = (\log M_o / 1.5) - 10.7 \dots\dots\dots(2.6)$$

While the maximum magnitudes for subduction zone from tectonic structure by Mulyadi, 1999, were used that were Megathrust zone = 8.2 and Benioff zone = 7.2, the ones for strike slip zone by Irsyam, 1999 were used that were Sukabumi fault = 7.6, Bumiayu fault = 6.7, and Yogyakarta fault = 6.3.

Seismic Hazard and Rate Recurrence Parameters. Seismic hazard analysis using probabilistic method required a-b parameters to determine the rate recurrence. The two common models in PSHA were Gutenberg-Richter (G-R) (1944) and characteristic earthquake models.

$$\log N(m) = a - bm \dots\dots\dots(2.7)$$

$$\ln N(m) = \alpha - \beta m \dots\dots\dots(2.8)$$

with $\alpha = 2.303a$, $\beta = 2.303b$.

Several methods of G-R model development used to obtain a-b parameters were Least Square (1954), Weichert (1983), dan Kijko & Sellevol (1989).

Attenuation Function. Considering the research that has been done by LAPI-ITB (2000) on attenuation functions with a slight standard error, this research occupied several of them, that was, Youngs (1997) to represent subduction mechanism, Boore et al. (1997) and Sadigh et al. (1997) to represent strike slip (shallow crustal).

Logic Tree. A probabilistic calculation enabled systematic uncertainties of a parameter in seismic hazard model. In many cases, the best method for determining parameters in a model was not absolutely clear. However, using a logic tree could minimize the uncertainties in a model. A logic tree approachness gave a

chance to use an alternative model in which each alternative was given a weighted factor. Hence this could be a good model that provide suitable value.

Seismic Hazard Analysis. A method that was sophisticated to analyze seismic hazard using probability concept was probabilistic seismic hazard analysis (PSHA). This method ensured that the uncertainties from magnitudes, locations, and rate of recurrence of earthquakes were explicitly taken into account in seismic hazard evaluation. This analysis was conducted with a help of EZ-FRISK version 7.2 program from Risk Engineering, which represented seismic sources in three dimension. Peak base acceleration (PBA) was the result of this program.

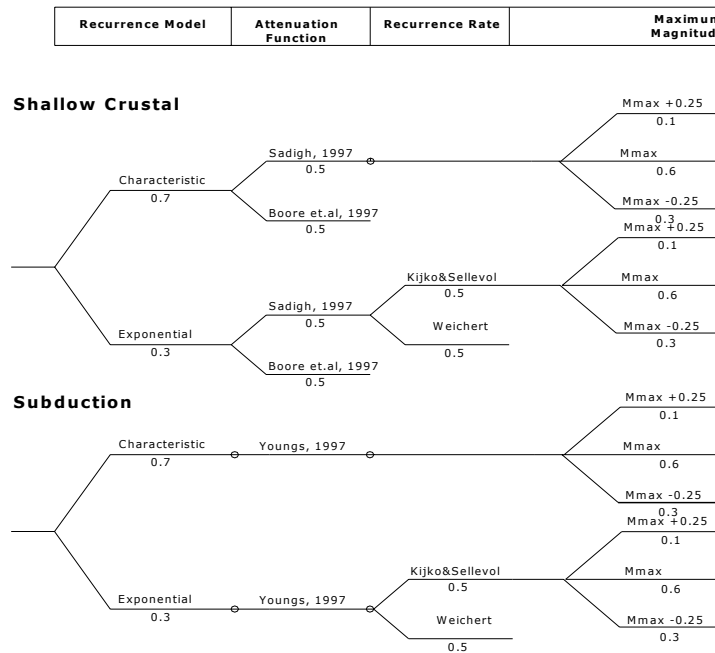


Figure 2.2. Logic Tree for seismic hazard analysis

3. RESULT AND DISCUSSION

Processing seismic data was conducted in a sequence. First, converting the magnitude scale based on the Firmansjah formula (1999), then separating main shocks and aftershocks using empirical criteria from Uhrhammer (1986), and finally estimating the completeness of seismic data based on the Stepp method (1973). The analysis result demonstrated that earthquake data with magnitudes (M) more than 7.0 were completed for last 103 years. However, the magnitudes in the range of 6.0 – 7.0 and the magnitudes in the range of 5.0 - 6.0 were completed only for last 40 years (Figure 3.1).

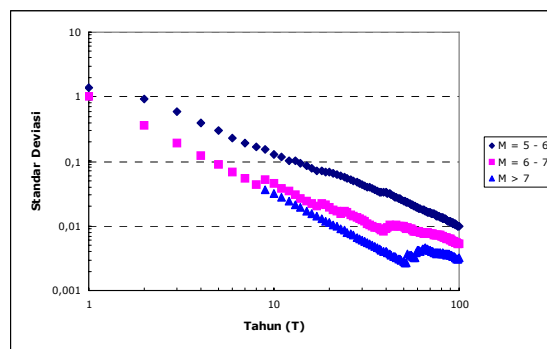


Figure 3.1. Time of completeness of seismic data catalog

The seismic sources considered in this research were the acknowledged earthquakes potential to a depth of 200 km within radius of 500 km from Semarang, and moment magnitudes higher than 5.0 in which consisted of Java's subduction and shallow crustal seismic sources as shown in Figure 3.3. While Java's subduction to a depth of 50 km was modeled as interface or megathrust seismic source (2-1a, 2-2a, 2-3a),

subduction in a depth more than 50 km was modeled as intraslab or benioff seismic sources (2-1b, 2-2b, 2-3b). Shallow earthquakes to a depth of 50 km but outside of subduction areas were considered as shallow crustal quakes. These Java's faults such as Sukabumi, Bumiayu, Baribis, Semarang, Lasem, and Yogyakarta faults were rested in an average depth of 25 km. In this study, the seismic source model was based on the Indonesian seismic source map by Firmansyah and Irsyam (1999) and Kertapati (1999) as shown in Figure 3.2

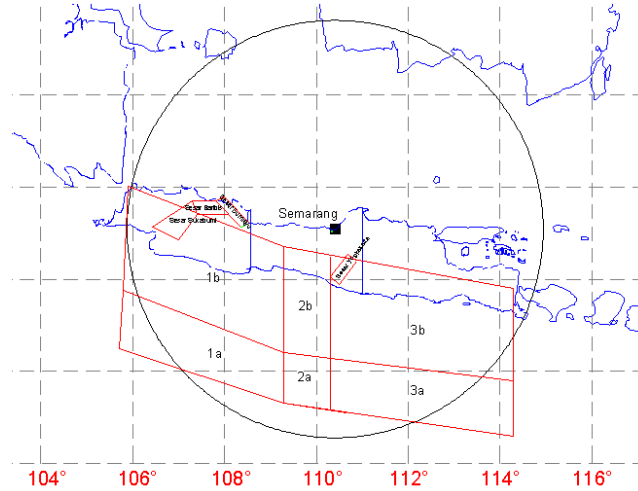


Figure 3.2. Model of seismic source area

The hypocenter profiles in each seismic zone could be seen in Figure 3.3 – 3.5. In these southern – northern side view, shallow crustal hypocenters have been separated from subduction ones. It could be noticed that the number of quakes in sub zone 2-2 were a bit less than those of other zones. This demonstrated that the seismicity of central Java was lower than that of both western and eastern sides.

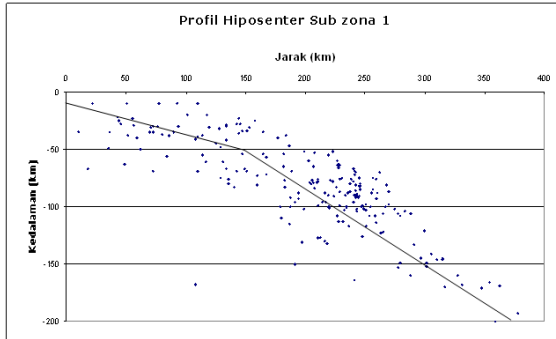


Figure 3.3. Hypocenter profile of sub zone 2-1

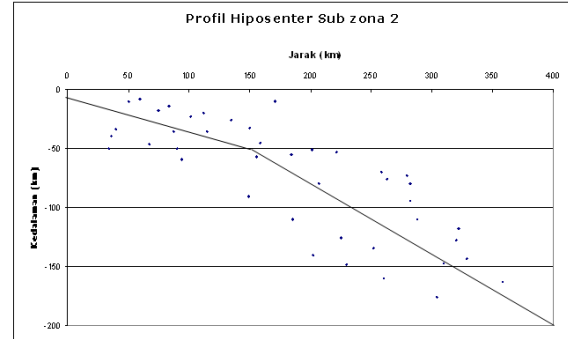


Figure 3.4 Hypocenter profile of sub zone 2-2

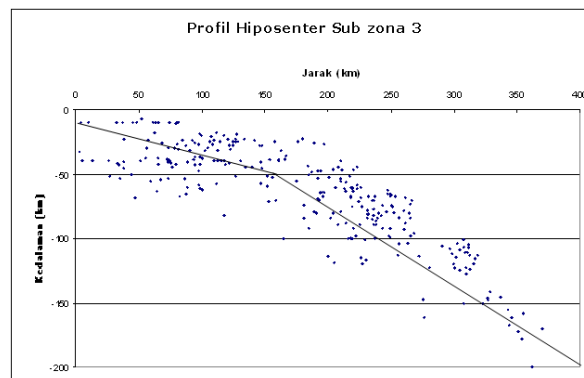


Figure 3.5. Hypocenter profil of sub zone 2-3

The seismic hazard analysis using probabilistic method required a-b parameters to determine seismic rate based on Guyenberg-Richter equation $\log N(m) = a - b.M$. Least square, Weichert (1980), and Kijko & Sellevol (1989) models have been chosen to calculate the a-b parameters. Interface seismic sources in Java were united to obtain stable a-b parameters and seismic rates, so did the intraslab and shallow crustal seismic sources. Since epicenter data in Java's fault were not sufficient to obtain stable seismic parameters, the values of a-b parameters for Sukabumi, Lasem, and Yogyakarta faults were estimated by joining all the epicenter data of the faults then they were allocated back to each fault according to number of epicenter contribution. In Baribis, Bumiayu, and Semarang faults it could be found no epicenter there thus a background earthquake as a substitution was occupied in which the rate obtained was from a seismic rate for an area of 10000 km². A maximum magnitude 7.0 ± 0.25 was defined, considering the biggest earthquakes that have occurred surrounding Semarang was Pati earthquake with Mw 6.8. Seismic parameter values for each seismic zone used in this research could be seen in Tabel 3.1.

Tabel 3.1. Seismic parameters according to Weichert and Kijko & Sellevol method

Zone	Weichert's method					Kijko & Sellevol's method				
	a-value	b-value	Beta	Rate	Allocation	a-value	b-value	Beta	Rate	Allocation
Java Interface:	4.247	0.91	2.095	0.498	1.00	4.606	0.97	2.234	0.570	1.00
1a	3.929	0.91	2.095	0.239	0.481	4.288	0.97	2.234	0.274	0.481
2a	2.834	0.91	2.095	0.019	0.039	3.192	0.97	2.234	0.022	0.039
3a	3.929	0.91	2.095	0.239	0.480	4.287	0.97	2.234	0.274	0.480
Java Interslab:	4.851	0.96	2.211	1.125	1.000	5.153	1.02	2.349	1.130	1.000
1b	4.441	0.96	2.211	0.437	0.389	4.743	1.02	2.349	0.439	0.389
2b	4.074	0.96	2.211	0.188	0.167	4.376	1.02	2.349	0.189	0.167
3b	4.499	0.96	2.211	0.500	0.444	4.801	1.02	2.349	0.502	0.444
Shallow Crustal:	4.550	1.00	2.307	0.355	1.00	4.330	0.99	2.320	0.240	1.00
Sukabumi fault	4.101	1.00	2.307	0.126	0.355	3.881	0.99	2.320	0.085	0.355
Bumiayu fault	4.077	1.00	2.307	0.120	0.337	3.857	0.99	2.320	0.081	0.337
Yogyakarta fault	4.039	1.00	2.307	0.109	0.308	3.819	0.99	2.320	0.074	0.308
Background (Purwana, 2001)	6.14	0.84	1.940	0.047	-	6.6	0.93	2.150	0.048	-

Based on the a-b parameter values, maximum magnitudes from each source, and the logic tree as the inputs of seismic hazard analysis, PBA's and uniform hazard spectra (UHS) curves of Semarang for 200, 500, and 1000 year return period earthquake could be produced (Table 3.2 and Figure 3.6 – 3.9).

Tabel 3.2. Semarang's PBA values for several return periods

Peak Base Acceleration of Semarang (g)		
200 years	500 years	1000 years
0.138	0.170	0.197

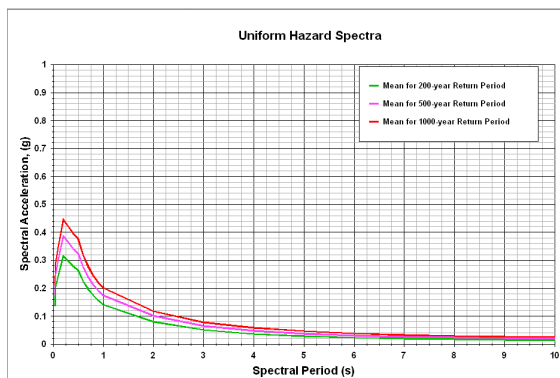


Figure 3.6. Uniform Hazard Spectra (UHS) for several return periods

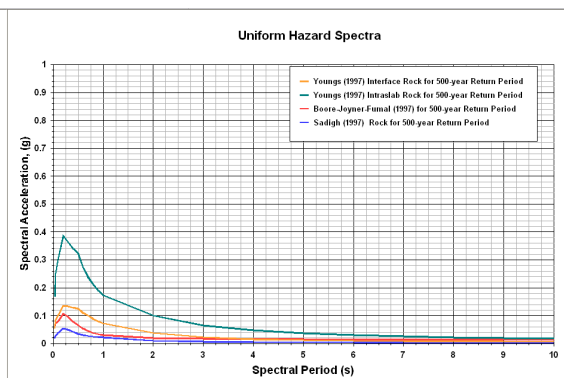


Figure 3.7. Uniform Hazard Spectra 500 years return periods for several attenuation functions

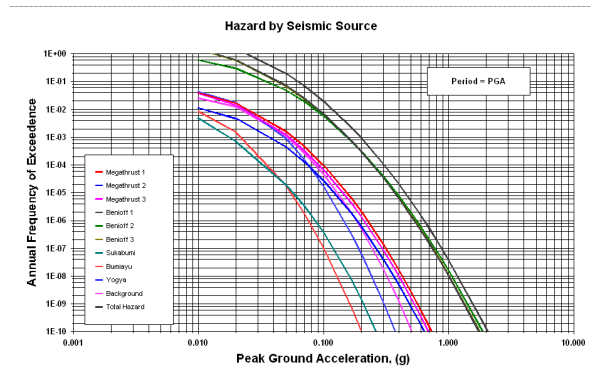


Figure 3.8. Hazard for each seismic source

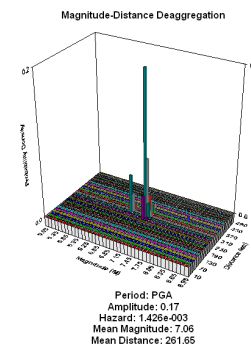


Figure 3.9. Deaggregation on T = 0 second

It could be shown from deaggregation result that seismic hazard of Semarang was dominated by intraslab seismic source with the mean magnitude and distance were 7.06 and 261 km respectively. Comparing to PBA of other studies in the same city, that were Purwana (2001) 0.14 g, Widhiono (2000) 0.162 g, this study obtained PBA a bit higher than that of them, 0.17 g.

4. REFERENCES

- [1] Boore, D.M., W.B. Joyner, and T.E. Fumal (1997). Equations for estimating horizontal response spectra and peak acceleration from western North American earthquakes: a summary of recent work, *Seismological Research Letters* 68 (1997) 128-153.
- [2] Cornell, C.A. (1968). Engineering seismic risk analysis, *Bulletin of Seismological Society of America* 58 (1968) 1583-1606.
- [3] Firmansyah, J., Irsyam Masyhur (1999). Development of Seismic Hazard Map for Indonesia, *Prosiding Konferensi Nasional Rekayasa Kegempaan*, Institut Teknologi Bandung.
- [4] Frankel, A., E. Safak (1998). Recent trends and future prospects in seismic hazard analysis, *Geotechnical Special Publication – ASCE* 75 (1998) 91-108.
- [5] Kanamori, H. (1977). The energy release in great earthquakes, *Journal of Geophysical Research* 82 (1977) 2981-2987.
- [5] Kertapati, E.K. (1999), Probabilistic Estimates of the Seismic Ground Motion Hazard in Indonesia, *Prosiding Konferensi Nasional Rekayasa Kegempaan*, Institut Teknologi Bandung.
- [6] Kijko and Sellevoll (2005). *HN2 Release 2.10 Program Manual*, Council for Geoscience, Geological Survey of South Africa, Pretoria South Africa.
- [7] Kramer, S. L. (1996), *Geotechnical Earthquake Engineering*, Prentice Hall Inc., New Jersey.
- [8] LAPI-ITB, (2000), *Development of Attenuation Model and Engineering Practice Level Acceptance Criteria*, Report for ARCO Bali North Inc., Terang Sirasun Development.
- [9] Mulyadi, Y. (1999), *Evaluasi Percepatan Tanah dan Respon Spektra Rencana untuk Tektonik Jawa*, Tesis Program Magister, Jurusan Teknik Sipil, Institut Teknologi Bandung.
- [10] Risk Engineering, Inc. (2005), *EZ-FRISK Version 7.2 – User's Manual*, Boulder – Colorado.
- [11] Sadigh, K., C.Y. Chang, J.A. Egan, F. Makdisi, and R.R. Youngs (1997). Attenuation relationships for shallow crustal earthquake based on California strong motion data, *Seismological Research Letters* 68 (1997) 180-189.
- [12] SNI-1726-2002, (2002), *Standar Perencanaan Ketahanan Gempa Untuk Struktur Bangunan Gedung*, Puslitbang Teknologi Permukiman, Bandung.
- [13] Wells, D.L. and Coppersmith, K.J. (1994). New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement, *Bulletin of Seismological Society of America* 84 (1994) 974-1002.
- [14] Youngs, R.R., S.J. Chiou, W.J. Silva, J.R. Humprey (1997). Strong ground motion attenuation relationships for subduction zone earthquake, *Seismological Research Letters* 68 (1997) 58-74.