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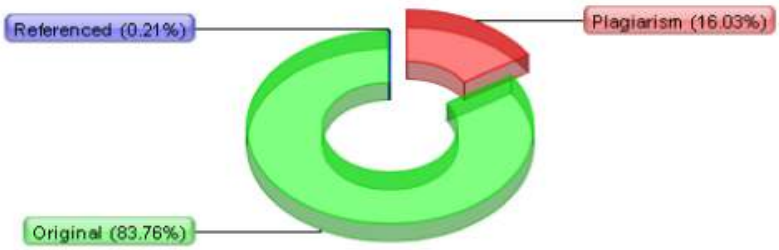

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Journal of Physics: Conference Series PAPER : OPEN ACCESS Mapping of weathered layer thickness and Seismic Vulnerability in Tegal using HVSR method To cite this article: NAF Tanjung et al 2021 J. Phys.: Conf. Ser. 1951 012053 View the article online for updates and enhancements. This content was downloaded from IP address 118.96.130.188 on 21/07/2021 at 08:41 Content from this work may be used under the terms of theCreativeCommonsAttribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Published under licence by IOP Publishing Ltd International Symposium on Physics and Applications(ISPA 2020) Journal of Physics: Conference Series 1951 (2021) 012053 IOP Publishing doi:10.1088/1742-6596/1951/1/012053 1 Mapping of weathered layer thickness and Seismic Vulnerability in Tegal using HVSR method NAF Tanjung1,a, I Permatasari2, and AHP Yuniarto3 1 Software Engineering, Faculty of Informatics, Institut Teknologi Telkom Purwokerto, Indonesia 2 Telecommunication Engineering, Faculty of Telecommunication and Electrical Engineering, Institut Teknologi Telkom Purwokerto, Indonesia 3 Physics, Faculty of Science and Technology, Institut Teknologi dan Sains Nahdlatul Ulama Pekalongan, Indonesia E-mail : ania@ittelkom-pwt.ac.id Abstract. The Baribis-Kendeng-Tegal fault is part of the Baribis-Kendeng fault segment that extends from West to East in the north of Java Island. The existence of this fault segment affects seismic activity in Tegal. The research was conducted by microtremor measurement to determine the earthquake susceptibility index and

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the thickness of the weathered layer in Tegal City. The data collection method in the study used the HVSR (Horizontal-to-Vertical Spectral Ratio) method to determine the subsurface conditions of the study area. The results of the horizontal component analysis of the vertical component showed a spectrum peak at the dominant frequency and amplification factor. The thickness of the weathered layer was obtained from the comparison of the value of Vs 30 of the study area

to its natural frequency value. The seismic vulnerability index was obtained by squaring the amplification and dividing it into its natural frequency. Measurements carried out at 37 points in Tegal City obtained varying thickness of the weathered layer, ranging from 4.29 meters to 88.14 meters and seismic vulnerability values ranging from 0.08 to 16.65. 1. Introduction The subduction process of the Indo-Australian Plate against the Sunda Block Order in the south of Java Island resulted in high geodynamic conditions on the Island of Java so that the Java mainland region was formed which can be seen through fault patterns. These fault patterns contributed to shallow earthquakes that occurred in Java Island [1]. The Baribis-Kendeng Fault is a reverse fault that is known to be active since the Late Neogene period until now. The Baribis-Kendeng fault pattern can be traced from west to east in the northern part of the island of Java [2]. Through GPS observations, it is known that the Baribis-Kendeng fault movement is 0.2 - 5 mm / year [3]. This fault is an active fault that causes some damage, such as the Karawang earthquake (1862), the Kuningan earthquake (1842), the Majalengka earthquake (1912), and the Madiun earthquake (2016) [4] [5]. The West Pantura region has several faults in the form of plate faults in Cirebon, Brebes, Pemalang, and Pekalongan. Three faults are squeezing the City and Tegal Regency areas, namely the BaribisKendeng Fault of Cirebon (0.5 mm / year), the Baribis-Kendeng Brebes Fault (4.5 mm / year), and the Baribis-Kendeng Fault of Pemalang (4.5 mm / years) (Gumilang, 2018). The Tegal region itself is traversed by the Baribis-Kendeng Tegal Fault (4.5 mm / year) with East North East (ENE) Strike and Dip 45S [6]. This causes Tegal City to become a city that is prone to earthquake activity. International Symposium on Physics and Applications(ISPA 2020) Journal of Physics: Conference Series 1951 (2021) 012053 IOP Publishing doi:10.1088/1742-6596/1951/1/012053 2 Based on the Geological Map of Purwokerto and Tegal, Tegal City is composed of alluvium rocks such as gravel, sand, silt and clay; as river and coastal sediment with a thickness of up to 150 m [7]. Earthquake damage is not only affected by the magnitude of the earthquake, but also by the geological conditions of an area [8]. Areas prone to damage caused by earthquakes occur in areas of thick soft sediment that are above the hard bedrock [9]. The less compact the rocks form an area, the greater the effect of an earthquake that will occur in that area. This is due to areas that have non-dense rock properties, so they are easily damaged and if an earthquake occurs, the damage caused by the earthquake will be even greater [10]. Therefore, It is necessary to map earthquake-prone areas in Tegal City, seeing the high seismic activity, constituent rocks, and

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the thickness of the sedimentary layers. The use of natural microseismic waves of an area can describe the subsurface conditions. By using the HVSR method, the subsurface characteristics parameters will be obtained in the form of natural frequency (fo) and amplification (A) [11]. These parameters can be used to determine the thickness of the

weathered layer and the level of soil vulnerability in the study area. 2. Method This research was conducted by measuring the microseismic signal at 37 points in 4 sub-districts of the Tegal City. The research was conducted using a 3-component LE-3D lite seismometer (Vertical, North-South, West-East) with a distance between points of ±1km. The data collection duration measured at each point varies around 30-45 minutes. The data recorded was a three-component signal (Vertical, North-South, West-East) stored in Mini Seed (.msd) format. The data was processed using geopsy software by comparing the H / V spectrum to obtain subsurface characteristics parameters in the form of natural frequency (fo) and amplitude (Ao). According to [12], the thickness of the sediment layer (H) is related to the natural frequency (fo) and the speed of the S wave on the surface (Vs), so that the Equation 1 was used to obtain the thickness of the weathered layer: ▯▯ = ▯▯▯▯ 4▯▯▯▯ (1) The value of the S wave velocity (Vs) on the surface was determined based on data from the [13] by entering the research area data. S waves at ground level are shear waves that occur up to a depth 30m (Vs30) which can deform rock layers [14]. The value of shear wave velocity up to a depth of 30m can be used as a determination of geotechnical parameters in infrastructure development [15]. Furthermore, the value of soil vulnerability was calculated using Equation 2 [11]. ▯▯▯▯ = ▯▯▯▯2 ▯▯▯▯ (2) Then, the value of weathered layer thickness and soil vulnerability index were interpreted into a map, then analyzed and made conclusions. 3. Results and Discussion The calculation of thickness of sediment layer used the dominant frequency and shear wave velocity at a depth of 30m (Vs30) using Equation (1). Based on the processing result data, the value of the weathered layer thickness around Tegal City ranges from 4.29 m–88.14 m as in the Figure 1. The figure can be seen that

the entire sub-district tegal selatan has a thick-weathered layer. In Margadana sub-district, there is a contrasting thickness of the weathered layer. The western part of Margadana sub-district has a thin-weathered layer thickness, while in the western part it is thick. The northwestern part of Tegal Barat sub-district is composed of a thick-weathered layer, while in the northeast, it has a thin-weathered layer. In the sub-district Tegal Timur, it can be seen that the value of the weathered layer thickness in the center of the sub district is high, while in the north and south it is low. This is consistent with the geological map of the Purwokerto and Tegal sheets which states that the City of International Symposium on Physics and Applications(ISPA 2020) Journal of Physics: Conference Series 1951 (2021) 012053 IOP Publishing doi:10.1088/1742-6596/1951/1/012053 3 Tegal is composed of alluvium: gravel, sand, silt and clay; as river and coastal sediments with varying thickness below 150 meters [7]. Figure 1. Distribution map of weathered layer thickness values in Tegal City Figure 2. Distribution map of Seismic Vulnerability in Tegal City Based on the seismic vulnerability mapping in Tegal City (Figure 2), the area that has the highest seismic vulnerability value is in the

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"Tegal Selatan"

sub-district, while in the other three sub-districts International Symposium on Physics and Applications(ISPA 2020) Journal of Physics: Conference Series 1951 (2021) 012053 IOP Publishing doi:10.1088/1742-6596/1951/1/012053 4 it has a low seismic vulnerability value. High seismic susceptibility values are generally found in soils with soft sedimentary rock lithology. This high value describes that the area is prone to earthquakes. In contrast, small seismic susceptibility values are generally found on soils with strong and stable constituent rocks so that when an earthquake occurs, the area only experiences minor shocks [16]. Based on Figure 1 and Figure 2, the areas prone to damage in the event of an earthquake are located in the northern part of the

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"South Tegal"

sub-district. This is because it has a thick weathered layer value and a high seismic intensity value compared to other areas. 4. Conclusion Through this research, we can conclude that the weathered layer thickness in Tegal City varies from 4.29 m - 88.14 m. The area that has the highest vulnerability value in the event of an earthquake is the Tegal Selatan sub-district. It can be seen from the high thickness of the weathered layer and the seismic vulnerability index in the area. 5. Acknowledgement We are thankful to Ristekdikti for funding this research and to the National Unity and Community Protection Agency, Bappeda, and BPBD of Tegal Regency who have granted permission to collect data in the Tegal City area. We also express our gratitude to the IT Telkom Purwokerto academic community who helped in completing this paper. References [1] Ilahi R 2018

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