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PIDIE JAYA CITY AND RUPTURE AREA AFTER THE EARTHQUAKE THAT HAPPENED IN DECEMBER 7, 2016

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ABSTRACT

Pidie Jaya has experienced a very severe earthquake on December 7, 2018. The depth of the epicenter is estimated to be approximately 8.7 km. Data processing was conducted by using Matlab and Geopsy software and mapping of Rupture and Pidie Jaya area through GIS software. It is obtained from the results of research through data signals of Pidie Jaya earthquake that the direction of earthquake rupture moving from the northern center of the epicenter to the east with a range of back azimuth value of 30.1o - 46.5o with the duration of rupture is 100 seconds. For 100 seconds the direction of the rupture undergoes a twist in the 20th seconds that is initially heading northeast in the direction of 40o from the epicenter. Rupture area is an area prone to earthquake disasters. This research can be a basic reference for the development of the pidie city spatial pattern.

KEY WORDS: Rupture area, earthquake, mapping.

INTRODUCTION

The earthquake that occurred on Wednesday, December 7, 2016 at 05:03 WIB centered in Meureudu Pidie Jaya with magnitude Mw 6.5 is a strike slip. The location of the earthquake is located in the sea adjacent to the Samalanga Fault but slightly to the west. Based on the earthquake mechanism, the strike direction from the earthquake is estimated to lead to the northwest. From the map of the surface elevation model of the earth there is seen a fault adjacent to the Samalanga Fault and it looks like the earthquake is located along the fault.

In Law Number 24 of 2007 concerning Disaster Management, states that the Unitary State of the Republic of Indonesia (NKRI) is responsible for protecting all of the Indonesian people and all Indonesian bloodshed with the aim of providing protection for life and livelihood, which is enshrined in protection against occurrence disaster, in order to realize public welfare based on Pancasila. In disaster mitigation-based planning, efforts that can be made are the implementation of spatial planning, development arrangements, infrastructure development, building management and no less important is the implementation of education, counseling, and training both conventionally and modernly.

Rupture at the time of the tectonic earthquake, is a strike on the hypocenter that drains circular seismic waves that spread in all directions. The spread of these seismic waves will lead to small tears on the Earth's crust below the surface along the rips field. This little tear is called rupture.

In the fault area, a new fracture will be visible after the rock deformation shifts. At the time of shifting the deformation of rock between the two plates, then there is a tear along the fault plane. This tear occurs because the rock structure is rigid and not elastic. Below are some rupture examples that occurred during the earthquake.

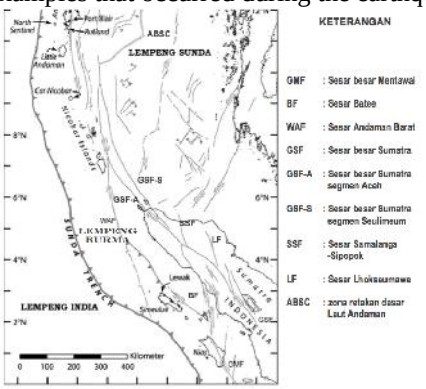

Fig 1. Map of the structure of the northern tip of the complex island of Sumatra, as a result of the complicated interaction between the Indian plate, the Sunda plate and the Burmese microplate. This interaction has led to the formation of a number of active faults on land, which will be the source of potential future earthquakes. (Source: Natawidjaja, 2006)

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Fig 2. Rupture of an earthquake that occurred on December 7, 2016 in Pidie Jaya region, Aceh. (*https://www.theweathernetwork.com/us/ news / articles / indonesia-earthquake- leaves-scores-dead-many- injured / 75641 /*).

The purpose of this research is to obtain fast, precise and accurate earthquake signal wave data in the event of December 7, 2016 earthquake. When the earthquake wave signal has been obtained quickly, the calculation of maximum ground acceleration can be calculated. This calculation will be used to get the rupture pattern in Pidie Jaya. This rupture pattern will help the designers of buildings in earthquake prone areas, especially in Pidie Jaya to plan the structure of the building.

LITERATURE REVIEW

The earthquake

An earthquake is a natural event whose time and place can not be predicted. A vulnerable earthquake occurs in a ring of fire area, but the exact time of the occurrence can not yet be determined scientifically. In general, the territory of the Indonesian archipelago is mostly located in the circle of fire located from the island of Sumatra, Java, Bali, Nusa Tenggara, Sulawesi, Maluku, up to Papua. The entire region in Indonesia is prone to earthquake hazards. This is evidenced by several major and minor earthquakes that occurred in the past, such as the earthquake that occurred in Sumatra area in 2004, the earthquake that occurred in Yogyakarta in 2006, and the earthquake that occurred in Bali in 1976 and 1979 (Lilik Kurniawan, et al. 2011). There have been several major earthquakes over the past 17 years that rocked Aceh and seized the public's attention, the first being the Aceh Earthquake of 26 December 2004 with 9.2 ricter scale causing the Tsunami and hundreds of thousands of deaths. According to Natawidjaja, (2007) This earthquake occurred in the subduction zone of Sumatra-Andaman. This earthquake broke the subduction zone contact area along about 1600km, starting from Simelue Island to the Andaman Islands region. As a result of the Indies plate moving continuously around 30 mm / year, the Sumatran-Andaman plate, at the end of December 2004, the elastic energy from accumulated pressure for a long time was finally released in a very strong beat from the earthquake of magnitude Mw 9.2. The islands and ocean floor in the eastern trough along the 1600 km were suddenly thrown westward 10-30 meters, and lifted upwards of several meters. It can be imagined how terrible the earth shook and how much the volume of sea water that suddenly participate lifted by the rising seabed. No wonder the tsunami that happened so terrible. The earthquake in Central Aceh district occurred on 2 July 2013 causing damage to buildings and landslides. Based on the position of the epicenter of the earthquake and the damage occurring, the earthquake of July 2, 2013 is not caused by the Sumatran Fault, but is caused by active cesarean activity in Central Aceh (Hidayati, et al, 2014).

Rupture

At the time of the tectonic earthquake, there is a strike on the hyposenter that circulates the circular seismic waves in all directions. The spread of these seismic waves will cause small tears on the earth's crust below the surface along the rip field. This little tear is called rupture. In the fracture area, a new fracture will be visible after the rock deformation shifts. At the time of shifting the deformation of rock between the two plates, then there is a tear along the fault plane.

The process of rupture formation takes time or is called the duration of rupture. In addition to duration, rupture also has an area and direction. The length of the rupture is proportional to the duration of rupture, this may be expressed in seismology with respect to the occurrence of rupture. This rupture problem has been investigated by Wang and Mori in fig 3. In their research, they used 22 seismogram stations spread across several countries and the results show the speed of the Japanese earthquake rectification on 11 March 2011 between 1.0 km / sec to 3.0 km / sec. The duration of the rupture time is 160 seconds and the maximum rupture shift 50m towards the southeast of the epicenter (Wang & Mori, 2011.

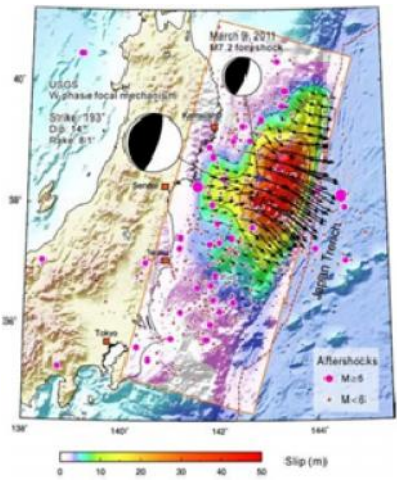

Fig. 3. The direction of the Japanese earthquake rupture March 11, 2011 with an analysis towards the southeast epicenter based on 22 array stations (Wang & Mori, 2011)

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METHODOLOGY

Research Methods

This study involved the collection of primary and secondary data. secondary data obtained from various literature. As shown in Fig. 4

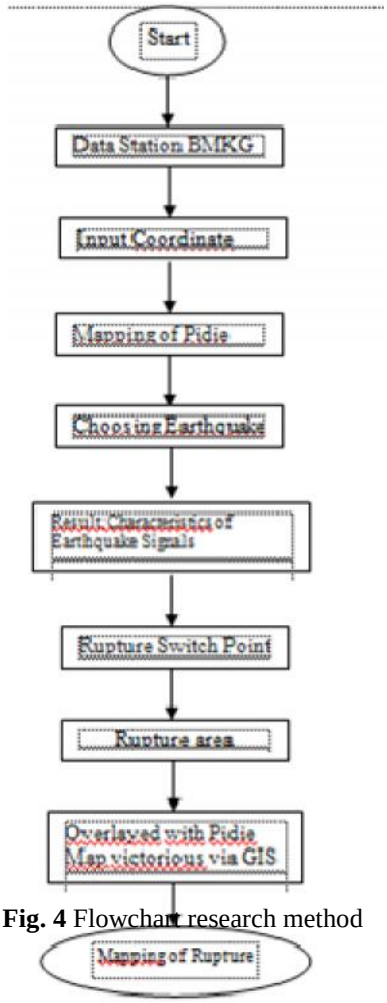

Fig. 4 Flowchart research method

RESULT

Seismological Analysis.

The earthquake that occurred on Wednesday, December 7, 2016 at 05:03 WIB centered in Meureudu Pidie Jaya region with magnitude Mw 6.5 is a shear fault earthquake. The location of the earthquake is located in the sea adjacent to the Samalanga Fault but slightly to the west. Based on the earthquake mechanism, the strike direction of the earthquake is estimated to lead northwest. From the map of the surface elevation model of the earth there is seen a fault adjacent to the Samalanga Fault and apparently the earthquake is located along the fault. Fractures in the Pidie and Pidie Jaya Regions are not yet fully known, and so require more in-depth study using a variety of methods.

Impact Analysis on Houses and Infrastructure.

Based on the rapid observation along Banda Aceh - Pidie Jaya - Bireueun Aceh road, the earthquake has caused many buildings collapsed and damaged. Most collapsed buildings are more than one storey building. Some of the collapsed buildings are public buildings such as school / dayah buildings, universities, mosques, shop (shop houses) and markets and health facilities such as hospitals. Public houses are also severely damaged, medium and light, including only one-storey community houses. Based on the level of damage in each region, the heavily damaged area is Trieng Gading sub district, Pidie Jaya. The residents' houses were severely damaged. Including mosques at the intersection Trieng Gading also collapsed. This area is the area surrounding the epicenter earthquake.

Many cause damage to buildings caused by the earthquake. There are some impacts of building damage caused by the earthquake. Can be damaged in the structure part of the building, can also only be a non-structural damage to the building. The structural damage of the buildings is the impact that can cause massive loss of life and loss of economy. There are many causes of structural failure due to earthquake that can be summarized from the results of rapid observation in the field. The lack of detail of repeating in critical areas of columns or columns or in the connection between columns and beams causes the columns to be damaged at the edges so that they can not withstand building loads. This can be seen from Fig. 5.

Fig.5. Repeat Failure that was detected in Pidie Jaya Earthquake victims December 7, 2016. (Source : https://bnpb.go.id/).

The results of the BMKG shake map analysis showed that the impact of earthquakes in the form of strong shocks occurred in the Sigli, Busugan, Meukobrawang, Pangwabaroh, Meukopuue, Tanjong, Meukorumpuet, Panteraja, Angkieng, and Pohroh on the SIG-BMKG III-IV scale (VI-VIII MMI).

Based on the above data, all of these areas have the potential to experience earthquake impacts in the form of

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damage. This is in accordance with reports from the earthquake zone that the impact of the earthquake did indeed cause damage to houses, school buildings, places of worship, and bridges in various places.

Tectonically, the Aceh region is an active and quite complex seismic area. Aceh region is prone to earthquakes. Aceh has the potential to be rocked by earthquakes due to plate subduction activities originating in the western Indian Ocean of Sumatra, and the Sumatran Fault System found on land.

"Distribution of active fault structures on land in the form of active fault segments includes segments of Aceh, Seulimeum, and Tripa. In addition there are other local fault structures such as Lhokseumawe Fault and Samalanga-Sipopok Fault. If viewed from the depth of the hypocenter, Pidie Jaya earthquake is an earthquake type shallow due to strike-slip fault activities in accordance with the results of analysis of the BMKG output source mechanism which shows that the earthquake that occurs has a horizontal fault type By looking at the location of the earthquake epicenter, it is suspected that the earthquake that caused the earthquake is Samalanga-Sipopok fault, because the epicenter point of the BMKG analysis is located close to this fault line.

The signal data obtained is a 24-hour signal data for the overall recording of earthquake vibrations on December 7, 2016. 24-hour time is a time span with too much signal capacity making it difficult to indicate an earthquake event. On December 7, 2016 there was a big earthquake in Pidie Jaya at 05.03 Wib. Fig.6 shows the seismogram recording that has been through the restitution process. for 24 hours. The amount of noise greatly inhibits the appearance of earthquake waves thoroughly, although the earthquake event faced is an earthquake event with a large magnitude. The process of cutting and filtering will further explain the desired earthquake event signal.

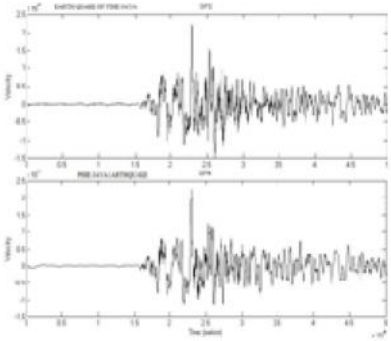

Fig.6. Recordings of seismograms that have undergone a restitution process during the earthquake

The movement of the lobes shows the actual rupture movement in the epicenter through representation at the center of the array. Rupture begins to move from north toward the east of the center of the array as far as 40.18º, and by the time 100 seconds the direction of the rupture has moved as far as 46.5º. Based on the results of rupture movement, it can be represented the direction of rupture for the earthquake that occurred on December 7, 2016 in Pidie Jaya as in Fig.7

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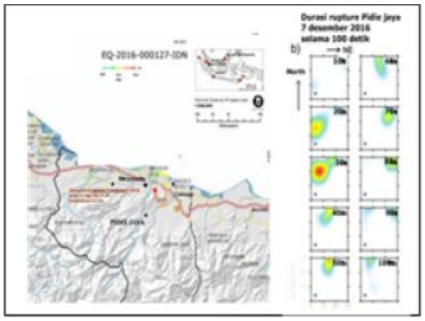

Fig.7. The slip model for the earthquake on 7 December 2016 was obtained using earthquake waves with strong movements from the stations depicted on the map. a) Projection of the surface of the slip distribution throughout the error. The location of the epicenter (star) and centroid (colored circle) shows the illumination of the rupture. b) The amount of time the rupture occurs.

Factors Affecting Development of Housing Areas Development direction of settlements after the earthquake disaster in 2016 until 2018 it leads to the northern region or coastal area the city of Pidie Jaya, especially on Subdistrict that was destroyed by the earthquake on December 7, 2016 like Trieng Gadeng and Merdu sub-districts. The development of these settlements experienced rapid development 1 year after the earthquake happened, namely in 2016 until by 2018, this is because a lot of housing assistance since after the earthquake. Development of residential areas against policies or plans housing development can be seen in the following figure that explains the development of housing to policy for plans to develop residential areas in the city of Pidie Jaya.

The combination of a very shallow earthquake source and the amount of energy release made the 2016 Pidie Jaya Earthquake produce very destructive vibrations. The loudest vibration has an intensity of 8 MMI (modified mercalli intensity), a level of vibration that is capable of breaking down many buildings in a settlement in Indonesia. Vibration 8 MMI is mainly felt on the face of the Earth which is right above the source of the earthquake and the surrounding area. All Pidie Districts, Pidie Jaya Regency and Sigli City were rocked by 7-intensity MMI vibrations, which were classified as very loud vibrations. MMI 7 vibration is a type of vibration that is capable of breaking down buildings, especially low quality ones. The city of Banda Aceh was rocked by vibrations with an intensity of 5 MMI. This is a type of vibration that is strong enough for everyone to feel and able to make sleeping people awaken, but not yet strong enough to damage buildings. While the rest of Aceh province was rocked by a vibration of 4 intensity MMI, which was classified as a mild vibration.

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Figure 8. One of the villages affected by the 2016 Pidie Jaya Earthquake, namely Paru Keude village, Bandar Baru sub-district, Pidie Jaya district. Damage distribution of buildings has been mapped with unmanned aerial aircraft (PUNA / drone) as a result of cooperation between BIG, BNPB and a number of institutions. Source: BIG / Hasanudin Z Abidin, 2016.

CONCLUSION

1. From the results of research through data signals Pidie Jaya earthquake on December 7, 2016 at 05.03 obtained by the direction of earthquake rupture moving from the north central epicenter to the east with a range of back azimuth value 30.1^{o} - 46.5^{o} with the duration of rupture is 100 seconds .
2. For 100 seconds the direction of the rupture undergoes a twist at the 20th seconds that is initially heading northeast in the direction of 40^{o} from the epicenter veering southwestward then spinning and returning again to the northeast at the 70th to form a direction 45o from the north of the epicenter.

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