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APPLICATION OF SEISMIC WAVE ON EARTHQUAKE PHENOMENON: A REVIEW

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ABSTRACT
Indonesia is one of the countries that rank as a country that holds a potential earthquake disaster. Earthquakes are a natural event characterized by a sudden shaking of the earth that can cause catastrophic damage to the regions that are experiencing it. Large earthquakes can shake the earth's surface with significant, even cracks that arise can make cars and motorcycles mired. Many other great houses and buildings have become corrupted. Earthquakes are a natural phenomenon that we cannot avoid, but behind the threat, we can anticipate even learn how the earthquake occurred and what are the benefits of the phenomenon.

KEYWORDS: Earthquake, Wave Seismic, Seismograph, Method, Application.

1. INTRODUCTION
The earth is surrounded by two very large seas, namely the sea of air and the sea of water. Both are moving, resurrected by the energy of the Sun and Earth's gravitational style. In the earth itself, the earth consists of a solid layer of crust on the outside and the magma fluid that sits on the inner layer.

The high temperature and magnitude of pressure on the inner earth allow for an activity that triggers the occurrence of seismic waves. Seismic waves can produce energy that will cause earthquakes. This wave was used as a method by scientists to estimate the internal structure of our earth. The seismic waves propagate within the earth and can be measured using a seismograph called sensitive detector. The result of detection by a seismograph is called a seismogram. Scientists installed a seismograph across the entire hemisphere to observe the movement of a plate of earth's crust.

2. DISCUSSION
2.1 Understanding and Relationship of Seismic Waves with Earthquakes
The earthquake can be interpreted as vibration or shock arising on the surface of the earth that occurs because of the movement of the earth's plates. Earthquakes itself is one of the natural phenomena that occur due to the release of energy in the earth is suddenly marked by the break of the rock layer on the Earth's crust in the form of tectonic activity, volcanic eruptions, celestial bodies, as well as the explosion of bombs due to human behaviour. Accumulated energy causes earthquakes resulting from the movement of tectonic plates. The energy produced is emitted in the form of waves so that the effect can be felt to the surface of the earth.

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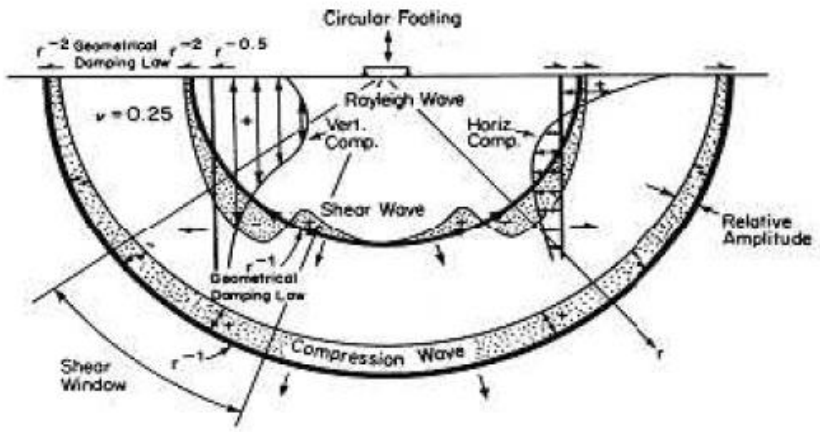
Vol.1 No.3; 2020



Wave Type	Per Cent of Total Energy
Rayleigh	67
Shear	26
Compression	7

Figure 1. The spread of seismic waves (Richart, Hall, & Woods, 1970)

Seismic waves (Figure 1) are mechanical waves that arise due to earthquakes. While the wave, in general, is the phenomenon of distraction in the surrounding medium. This disorder first occurs locally, which causes the oscillation (shifting) position of the medium particles, the oscillation of the pressure, and the oscillation of the mass meeting.

2.2 Various Seismic Waves

2.2.1 Body Wave

The body waves a wave that propagated in the elastic media and the direction of the decay throughout the Earth. These waves are distinguished into two types.

1. Primary wave/P-wave

ISSN: 2582-6271

Vol.1 No.3; 2020

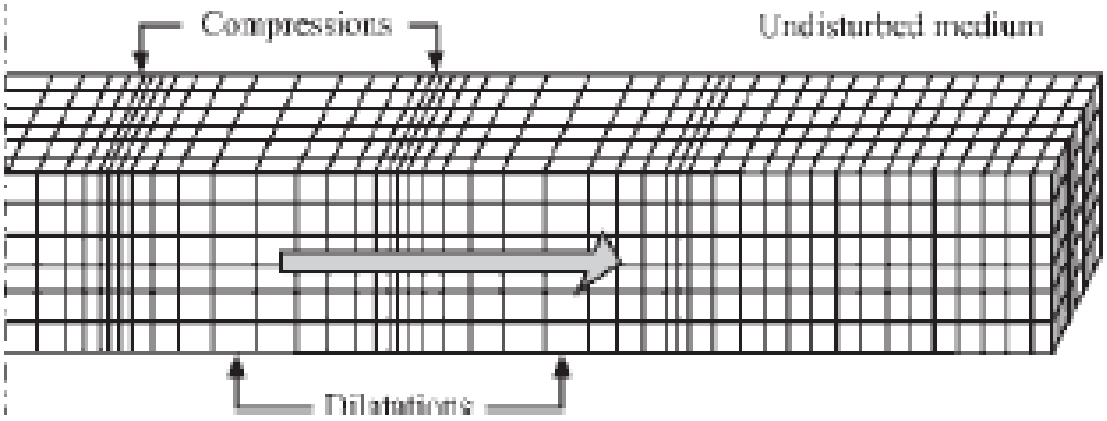
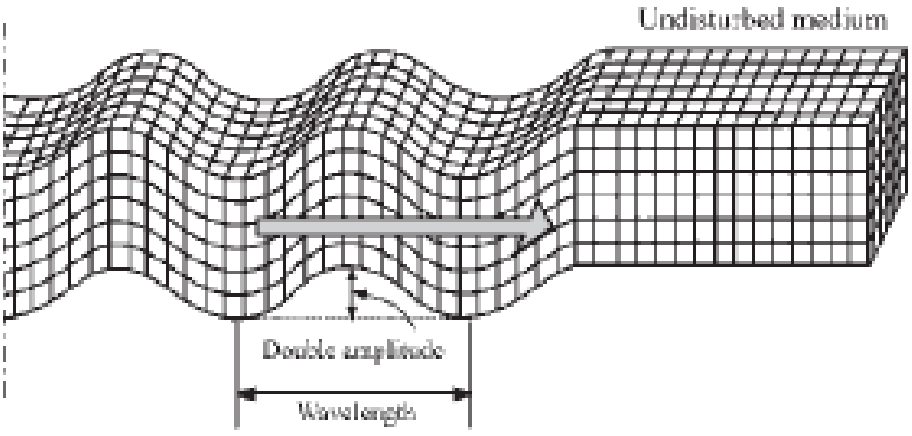


Figure 2. Wave-P (Elnashai & Di Sarno, 2008)

Characteristics of primary wave (Figure 2):

- Waves that were first recorded seismographs
- The longitudinal wave, which is the wave that is the direction of the particle movement in the direction of the propagation.
- Speeds of 330 m/s in air, 1450 m/s in water, and 5000 m/s in granite.
- Can vine in any medium (solid, liquid, gas)
- Relatively most "gentle" compared to other waves.
- Small amplitude

2. Secondary wave/S-wave



ISSN: 2582-6271

Vol.1 No.3; 2020

Figure 3. Wave-S (Elnashai & Di Sarno, 2008)

Characteristics of secondary wave (Figure 3):

- Transversal wave, which is the wave that is the direction of the particle movement perpendicular to the direction of the propagation.
- Speed 60% of P-wave (meaning slower).
- Can vine in solid medium only.
- The damage effect is greater than the primary wave.
- Greater amplitude of a primary wave.

2.2.2 Surface Wave

Surface waves are waves that exist on a medium surface boundary. Type of surface wave is two types.

1. Love Wave

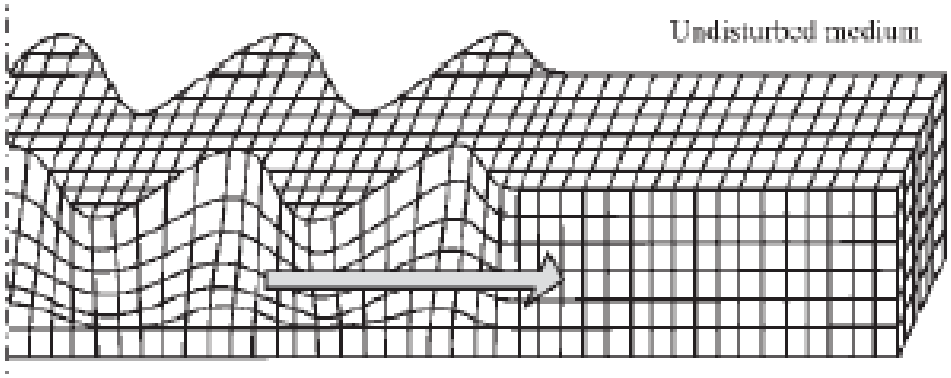


Figure 4. Waves of Love (Elnashai & Di Sarno, 2008)

Characteristics of the love wave (Figure 4):

- The Transversal waves are perpendicular to the movement of the particles.
- 70% speed of a secondary wave
- Most damaging, especially in the area near Epicentrum
- The first-time human perceived vibration
- Found by A.E. H Love in 1911.

2. **Rayleigh Wave**

ISSN: 2582-6271

Vol.1 No.3; 2020

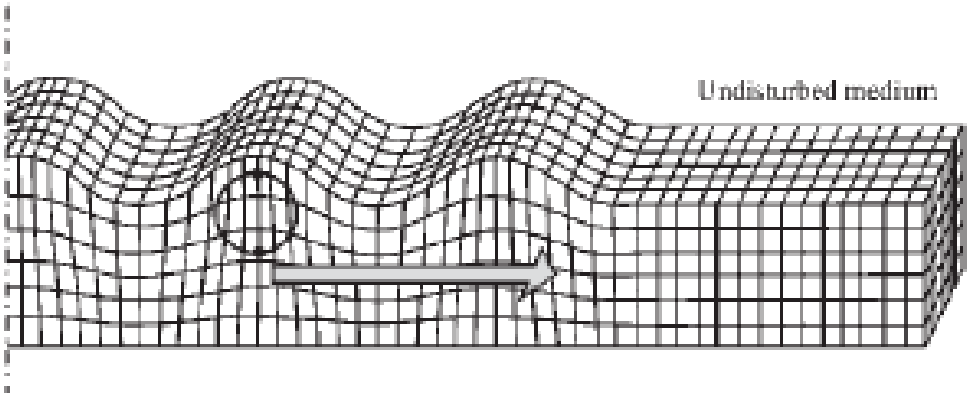


Figure 5. Rayleigh Wave (Elnashai & Di Sarno, 2008)

Characteristics of Rayleigh wave (Figure 5):

- The elliptic movement of the retrograde/ground roll (ground twisting backwards), but in general the waves go forward. The analogy is like a sea wave.
- A little faster than Love wave (90% of secondary wave speed)
- Discovered by Lord Rayleigh in 1885.

2.3 Seismic Wave Application

2.3.1 As a method of analysis to evaluate the bending and rigid paces of the road

This method is often referred to as Spectral Analysis of Surface Wave (SASW) (Bawadi, Anuar, Rahim, & Mansor, 2018; Yablokov & Serdyukov, 2018), which involves three main stages of analysis.

1. The data retrieval process in the field, using the Spectrum analyzer.
2. Production of the Rayleigh wave speed experiment dispersion curve against the frequency or wavelength,
3. The inversion process of the experimental dispersion curve to get the final profile.

2.3.2 Analyzing earthquake intensity relations with PGV (Peak Ground Velocity)

PGV is the largest value of land speed that has occurred in an area within a certain period due to the vibration of earthquakes (Boatwright, Thywissen, & Seekins, 2001; Çağnan, Akkar, Kale, & Sandıkkaya, 2017). This value has been obtained from Broadband Seismic sensor waveform Analysis which is then processed and calculated with metrically Intensity data (MMI) issued by BMKG after it obtained the results of empirical formula correlation between PGV and MMI.

2.3.3 Identifying increased volcano activity

Volcano activity can be identified using ambient noise seismic data and Realtime Seismic Amplitude Measurement (RSAM). RSAM (IP, Hidayah, & Rizki, 2019; Yoshida et al., 2016) is an average output

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measurement of Amplitude that was recorded for a certain period of the seismic station. After the data is collected, the data is processed to obtain a variation of the value of the pseudo speed (δv/v), then connect it with the eruption to get the interpretation and identification of the increase of volcano activity.

3. CONCLUSION

Earthquakes are a natural phenomenon that occurs due to seismic waves. For a seismologist, the earthquake waves that occur around the world are very beneficial to learn the state of the subsurface layers. This wave phenomenon applied various fields to obtain value/measurement price, which can be used as a method to identify the strength of structures, roads, bridges, and supervise volcano activity.

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