IDENTIFICATION OF WATER PIPES LINE IN KALIDOH AREA USING MICROTREMOR METHOD

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Abstract—In maintaining underground water pipes are needed to determine the exact location of the pipe. Microtremor method is one of the geophysical methods that can be used to find out the location of objects under the surface. The basic principle of the microtremor method is to use natural vibrations after then detect it using a seismometer. This study aims to identify the location of underground water pipes laterally. Data retrieval of this research was conducted in the Kalidoh area by taking 24 measurement points for 10 minutes at each point. The measurement data is processed by the HVSR method so that the H/V curve shows the frequency value and amplification. At a frequency of 3 Hz there is a circle pattern on each line with an amplification range of 1.4 to 1.75. The fence diagram is used to model all lines so that it is easier to interpret.

Keywords—water pipes, microtremor, HVSR, frequency, amplification.

I. INTRODUCTION

In an effort to distribute clean water evenly and appropriately, it is necessary to regularly maintain, repair and develop pipeline networks. One of the problems that is often faced is to detect the existence of subsurface pipes that are used as pipelines or difficulty finding the location of the pipelines to be developed. This difficulty is caused by changes in environmental structures such as the development of road facilities, building development. This condition is complicated by the unavailability of pipe location drawings, making it difficult to maintain, repair and develop the pipeline. Thus the maintenance work, repairs related to finding the position or layout of the pipe is done by randomly digging so that the existence of pipes to be traced in the ground cannot be known precisely and the excavation of the wrong target so that the work becomes less efficient both time and cost [1]. Therefore we need a method that can detect objects below the surface, such as microtremor.

Microtremor methods began to be widely considered for use in estimating the dynamic characteristics of soils and structures after the HVSR method was introduced by Nakamura [5]. this method can be used to create subsurface profiles [7] and identify buried structures [6].

Microtremor or commonly called ambient noise is ground vibration with an amplitude in the order of the micrometer caused by natural events or human activities that can describe the geological conditions of an area near the surface [2]. Microtremor waves reflected from underground pipes along the survey line form a special diffraction pattern that can be easily distinguished from reflections created by geological boundaries or noise. This method has also been recently applied in non-destructive probing the position of a buried pipes due to fast and mobile measurements.

In this study, data is taken in the middle of the pipeline so that it cuts the pipe. On each line, the amplification pattern is almost identical because it cuts through the middle pipe line. The frequency at each line will also look the same because the pipes are at the same depth at the measurement distance.
II. RESEARCH METHOD

The data was collected on July 2019 in Kalidoh Area, Semarang Regency. In this study successfully measured 24 points of microtremor field measurements. The microtremor field measurements use the GL 240 Midi Data Logger and Seismometer 3 components. The distribution of the data collection is shown in Figure 1.

The results of data collection in the form of position data and microtremor signals in a time function consisting of three components, namely two horizontal components, component X (EW) and component Y (NS) and one vertical component which are then processed into dominant frequency data using Fast Fourier Transform (FFT) from the Geopsy software to obtain the HVSR spectrum curve. Dominant frequency can indicate the type and characteristics of the soil or rock layers in the region [3] and amplification factor is the magnification of seismic waves that occur due to significant differences between layers. Seismic waves will experience magnification if it propagates in a medium that is softer than the initial medium in its path. The greater the contrast of the wave propagation parameters (density and speed) in the two layers, the higher the amplification value [4]. The output value in the form of frequency and amplification values is used as input to make the contour in Surfer 13. The research was conducted in the Seleseh Reservoir area by taking 24 measurement points as shown in Figure 2.
III. RESULTS AND DISCUSSION

The results of the study in the Kalidoh Region are HVSR curves that are modeled in 2 dimensions so that they become a contour map of the H / V curves of each line as shown in Figure 3. In line A there is a circular pattern at a frequency of 3 Hz at a distance of 1.5 meters as well as at line B which shows a circle pattern at the same frequency and distance but with different amplification values, if on line A the pattern has an amplification of 1.5 while on line B of 1.4. In line C, line D, and line E there is also a pattern that is a circle at a frequency of 3 Hz and a distance of 1.5 meters. The pattern is thought to be an underground water pipe because according to the condition of the pipe that stretches long if slashed in the middle of the lane it will be seen the same pattern on each line.

The incision in line I is also made so that the results are more clearly seen in Figure 4. At line I at a frequency of around 2.5 Hz - 3 Hz, there is a pattern extending from end to end, line A to line E. The pattern has an amplification range of 1.4 - 1.75 which is almost the same as the circular pattern on line A to line E. The line H also shows the elongated pattern from line A to line E at a frequency of about 3 Hz with amplification ranges from 2.1 to 1.7 but the pattern looks like it has been cut off around line C and line B. In line G no longer visible pattern is elongated at 3 Hz as seen in line I and line H.
To simplify the analysis, a fence diagram is used consisting of line A, line B, line C, line D, line E, and line I. Line A to line E are arranged and then insert line I as in Figure 5. Fence diagram in Figure 5 shows that at 3 Hz frequency there is an elongated pattern and also on each line that is crossed there is a circle pattern. At frequencies of 5 Hz to 7 Hz there is a large and continuous circle pattern from line C to line E which has a fairly high amplification range of 3.

Figure 6 shows the point of taking or survey design from the study. White dots indicate taking points and dashed lines indicate approximate pipe locations according to the results of the H/V curve. The results of the five lines show a circle pattern at a distance of 1.5 meters so that if inserted in the survey design it will be as seen in Figure 6.
IV. CONCLUSION

Based on the results of the research that has been done, it can be concluded that from the acquisition of 24 points of underground water pipe objects in the Kalidoh area, it is known that there is a horizontal cylindrical structure model in the form of a subsurface pipe indicated by the contours on line A to line E which contains a circular pattern at a frequency of 3 Hz and a distance of 1.5 meters with an amplification range of 1.4-1.7. The fence diagram also shows an elongated pattern such as a pipe if sliced in the same direction as a pipeline at a distance of 1.5. The elongated pattern has an amplification range that is almost the same as the circle pattern on each line.

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