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Ir. Aniek Prihatiningsih, M.M.

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11 Februari 2021

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Analysis the effect of piling activity using diesel hammer on surrounding construction

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Abstract. Construction starts with earth work that takes a long time. To reducing these problems, acceleration is usually done on the site. For example, doing basement excavations at same time with driven piling. Early basement excavation work has the potential to cause the foundation piles that has been driven will be slided. Besides being supported by expansive soil, use of diesel hammer which has large blow energy as driven machine will also affect additional lateral load on the ground which causes pile or wall to slide or roll. In this study, the calculation of additional loads due to piling and soil using Boussinesq and Rankine Theory. The Reese and Matlock Method is used to calculate the lateral deflection of the pile. Pile will experience lateral deflection 30 mm exceeding the permit tolerance of 25 mm. Earth retaining wall with 3,2 m and 6,4 m excavations, the wall does not slide and roll. On the earth retaining wall with 9,6 m excavations, the wall does not slide but it will be rolled. The conclusion of this study is doing excavation when piling work has not been fully completed, it will potentially causing damage to the construction that has been made.

1. Introduction

According to [1], heaving is the upward movement of soil in one dimension due to water absorption causing a high increase. While swelling is the development or enlargement of the soil in all directions due to the absorption of water. In addition to mechanics, the development of an expansive soil is generally caused by interactions between water and minerals from clay particles [2]. Piling on piles which results in vertical ground movement is commonly referred to as heave [3]. The erection of poles that are close to each other will result in lifting (heave) on the ground and the pole that has been installed, enlarging the pore number, and the existence of lateral movements that will have an impact on the structure or building that is next to it [4].

2. Method and materials

2.1. Method

Dynamic formulas have been widely used to predict pile capacity. A method is needed in the field to determine whether a pile has achieved sufficient carrying capacity other than just piling it to a predetermined depth. Piling up to a predetermined depth may not get the carrying capacity needed, due to the variation of normal soil to the lateral and vertical direction. Rational pile formula depends on the principle of impulse and momentum [5]. In the calculation of stress distribution due to structural loads, stresses that occur are usually expressed in terms of stress increment, Δσ. Because in reality, the stresses caused by structural loads are additional stresses to overburden pressure (vertical pressure due to the weight of the soil itself). So, in fact the soil is experiencing stress before the structure load works [6]. Horizontal loading of a pole or generally referred to as lateral load will cause a shift in the mast head. Shifts that occur must be controllable and may not exceed certain limits. According to [7], it is stated that the estimated lateral capacity of the pile must correspond to the lateral deformation of the pile head permit. The lateral deformation magnitude of the mast clearance is 12 mm for planned earthquakes and 25 mm for strong earthquakes in single pole and free-head conditions. Then, to assume the type of soil can be determined by determining the depth of 4 to 5 times the diameter of the pole [8]. Reese and Matlock in 1960 found some similarities in the calculation of vertical piles which were laterally loaded [9]. Lateral soil pressure analysis is used for the design of retaining walls and other retaining structures, such as: bridge bases, plaster, tunneling, underground concrete channels and others. Lateral ground pressure is the force caused by the force of the soil behind the soil retaining structure. The amount of lateral pressure is strongly influenced by changes in the location (displacenzent) of the retaining wall and the properties of the soil [6].

3. Results and discussion

3.1. Result of pile

The voltage increase diagram is converted to forces acting on the top end of the pole. Here are the results of the calculation of the lateral deflection of the pile:

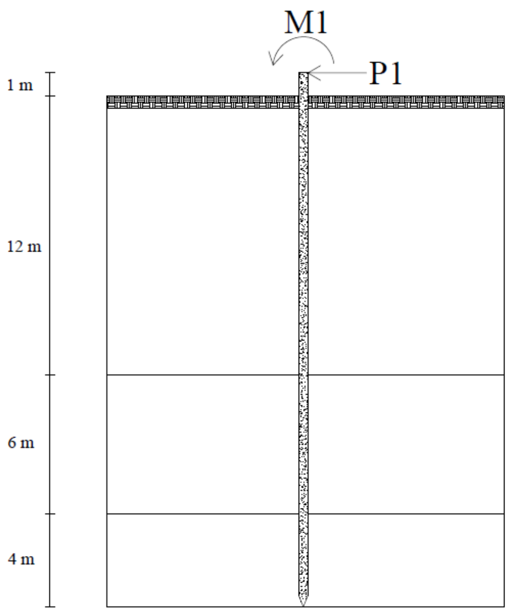

Figure 1. Sketches and styles that work at the end of the pile

After calculating, P1 = Pt = 59.35 kN and M1 = Mt = 120.47 kN.m. So with these forces acting, the pole will experience lateral deflection as far as = 30 mm.

Table 1. The results of checking lateral deflection of piles due to piling activities

Lateral Force (kN)	Moment (kN.m)	Lateral Deflection (mm)	Lateral Deflection SNI 8460:2017 (mm)	Information
59,35	120,47	30	25	NOT OK

3.2. *Result of earth retaining wall*

The following is an analysis of the calculation of piles lined up resembling retaining walls caused by the activity of piling on the right and where the condition of the soil to the left has been excavated. In this analysis 3 excavation conditions will be taken into account, namely as deep as 3.2 m, 6.4 m and 9.6 m. The burden that is calculated is the loading due to piling and soil load.

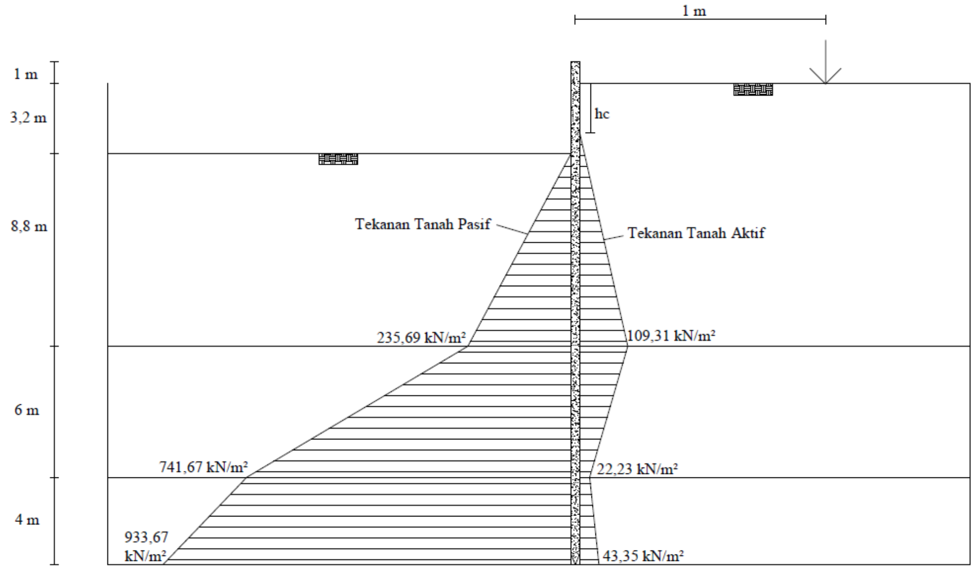

Figure 2. Diagram of active and passive soil pressure when excavating 3.2 m

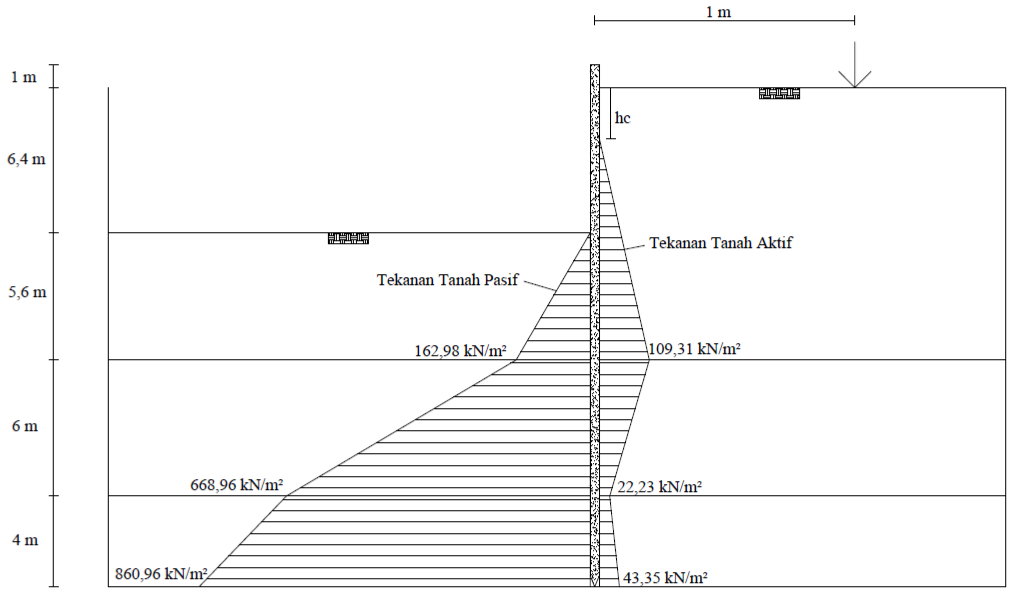

Figure 3. Diagram of active and passive soil pressure when excavating 6.4 m

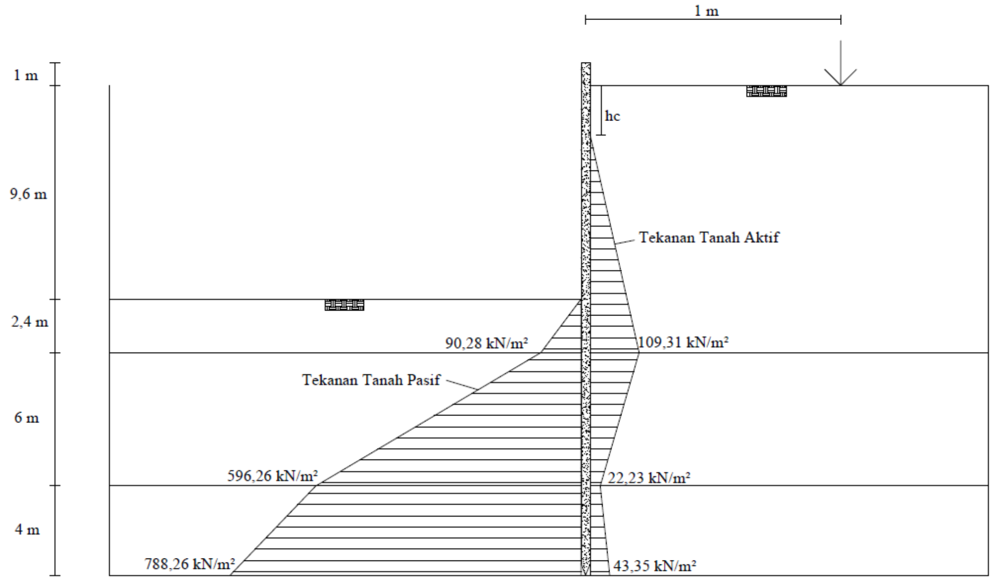

Figure 4. Diagram of active and passive soil pressure when excavating 9.6 m

Table 2. The results of checking the retaining wall due to piling activities with excavation

Excavation Depth (m)	Shear Safety Factor	Roll Safety Factor	Shear Check	Roll Check
3,2	6,01	2,87	OK	OK
6,4	4,93	2,01	OK	OK
9,6	4,05	1,43	OK	NOT OK

4. Conclusion

In the lateral shift analysis of the pile using the Reese and Matlock method due to the next piling activity, the pile will experience a deflection of 30 mm. Deflection that occurs exceeds the permit deflection recommended by SNI 8460: 2017 that is equal to 25 mm. In checking the failure of the retaining wall due to piling activity and carried out digging as deep as 3.2 m, obtained a sliding safety factor of 6.01 and rolling safety factor of 2.87. Because the safety factor is greater than 2, it can be concluded that the wall will be safe against sliding and rolling. In checking the failure of the retaining wall due to piling activity and carried out excavations as deep as 6.4 m, the sliding safety factor was 4.93 and the rolling safety factor was 2.01. Because the safety factor is greater than 2, it can be concluded that the wall will be safe against sliding and rolling. In checking the failure of the retaining wall due to the erection activity and carried out excavation as deep as 9.6 m, obtained a sliding safety factor of 4.05 and a rolling safety factor of 1.43. Because the shear safety factor is greater than 2, it can be concluded that the wall will be safe against sliding. However, because the rolling safety factor is smaller than 2, it can be concluded that the wall is not safe against bolsters.

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