

Comparative Analysis Of Implementation Methods Soldier Pile And Sheet Pile Retaining Wall On The Construction Of Gwt Pt. Ubs Surabaya

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Abstract

Generally, a basement construction requires an appropriate Earth Retaining Wall to support the development process in the area. In the project area of PT. UBS Surabaya has the construction of a Soldier Pile which is arranged from Bored Pile and Bentonite Pile, the construction applies the Bottom Up and Dewatering method which means that construction starts from the subgrade level firstly and then the construction work goes up. This research was aimed to examine the existing types of retaining wall (Soldier Pile) with an alternative comparison of Corrugated Concrete Sheet Pile (CCSP). This is aimed to finding the effectiveness retaining wall that has been used with another methods so that it can affect to management in terms of cost and time which has been taken. Based on the comparison result of two methods, it is found that the use of the Soldier Pile method has a cost difference of Rp. 139,533,000,- less than the Sheet Pile method. However, the implementation time of the Sheet Pile method is 28 days faster than the Soldier Pile method, with this comparison, the Sheet Pile method is considered more effectively applied with an implementation time effectiveness ratio of 36.36% considering that the development project area is close to densely populated settlements. Based on the results of the comparison of the two methods, it is found that the use of the Soldier Pile method has a cost difference of Rp. 139,533,000,- less than the Sheet Pile method. However, the implementation time of the Sheet Pile method is 28 days faster than the Soldier Pile method, with this comparison, the Sheet Pile method is considered more effectively applied with an implementation time effectiveness ratio of 36.36% considering that the development project area is close to densely populated settlements.

Keywords

Basement, Corrugated Concrete Sheet Pile and Time Effectiveness, Soldier Pile.

1. Introduction

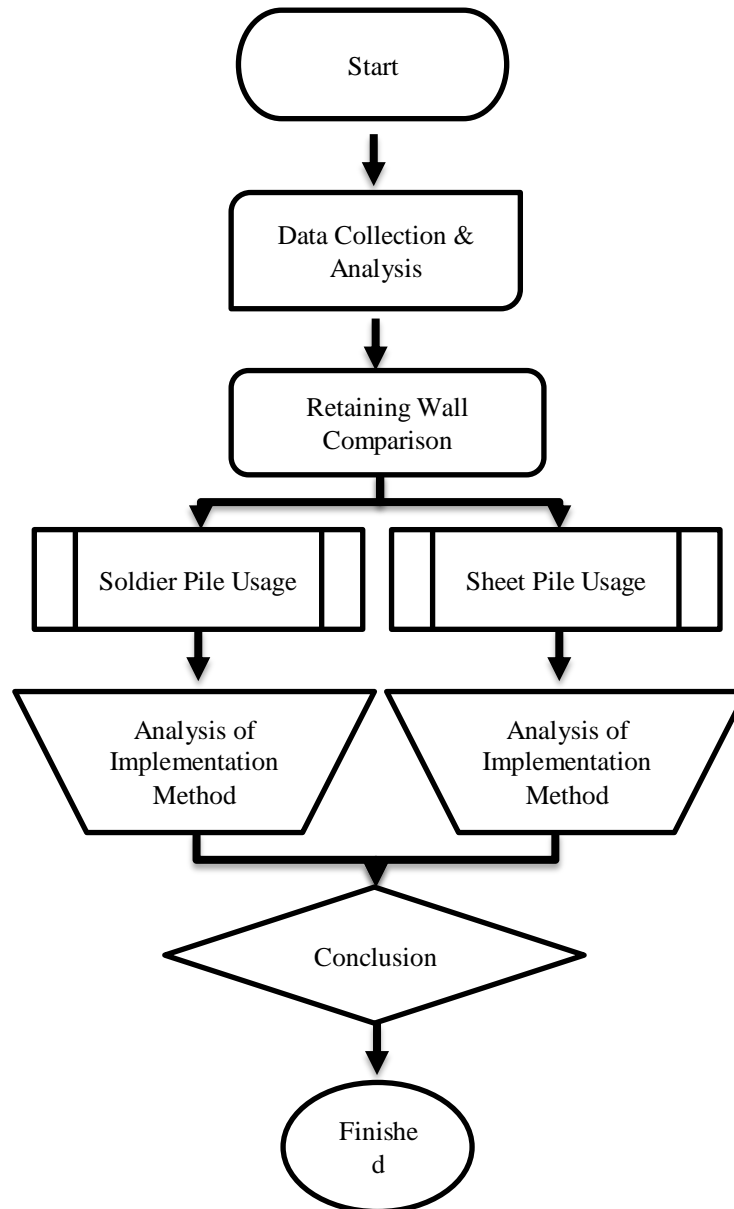
The denser of settlements, make to maximizing space and vertical construction is the solution (Atibrata 2020). In the world of construction, especially high-rise buildings are very important to support the mobilization of life in them, there are parts of buildings that are often included in the construction of high-rise buildings, namely underground / basement buildings. There are many types basement in high-rise buildings ranging from underground parking lots, panel rooms, GWT areas, STP areas, and many more functions and purposes. Construction basement requires its own criteria in design and in stages construction execution (Saputri 2019), special handling is also needed in its implementation so that the construction in question can stand according to a predetermined design, besides that in this modern era development in the construction world is expected to be safe for the surrounding environment/residential residents if the development area is directly adjacent to local residents. For this underground building, the construction of the GWT (Ground Water Tank) area in the PT. UBS - Jl. Kenjeran 395 - 399 Surabaya City which is the object of the author's research. The construction of the GWT building is a clean water reservoir under the ground or commonly called an underground water tank in a multi-storey building with a certain depth. The project uses the construction of an underground area with the Bottom Up and Dewatering method.

This research is to answer several problems related to the above statement, namely:

- How to determine the right Retaining Wall for basement
- How is the implementation method for the Soldier Pile ?
- How is the implementation method for the Sheet Pile ?
- How is the development efficiency between the use of Soldier Pile and Sheet Pile in terms of time and cost?

2. Methodology

The following is the flow of the research plan described in the methodology scheme



Flowchart 1. the research plan described in the methodology scheme

2.1 Analysis of Soil Conditions

When the building of basement designed, the main thing that needs to be taken to make it sense is to look for the character of bearing capacity the soil to be built on it, this is decided to finding the method that will be used when built the basement. There are various stages in determining type of soil from identification of soil character until soil strength testing. In the identification of soil types there is a testing stage in the laboratory, soil strength testing and consolidation tests are carried out on undisturbed soil samples, while to identify soils and obtain soil characteristics, soil tests carried out on disturbed soil samples are soil grain distribution tests, tests for determining Specific Gravity, liquid limit and plastic limit tests.(Harda 2020).

2.2 Soldier Pile

In the work of retaining walls for the Office of PT. UBS Surabaya uses a soldier pile type which consists of an arrangement of Bored Pile and Bentonite Pile along a span of 18.3 m with a diameter of 40 cm and a depth of 20 m and 8 m respectively, also above it there is a Capping Beam structure to bind the soldier pile arrangement. Number of 28-Point Bored Pile and 25-Point Bentonite Pile with alternating arrangements following the direction of the need for retaining soil.

2.3 Sheet Pile

As an alternative to the use of Retaining Walls, Corrugated Concrete Sheet Pile (CCSP) was chosen as a comparison, it was chosen because according to the results of the soil test at the project site it was categorized as soft soil, so this type of retaining wall can be installed at that location. For the Sheet Pile type that will be used is the W-400-A-1000 type with a length of 21 m - 10 m and 11 m respectively with a length of 18.6 m and above it there is a Capping Beam structure like a Soldier Pile pair.

2.4 Time and Cost Analysis

In calculating the volume cost requirement / the number of items needed, it is multiplied by a predetermined unit price to get the required cost and the time taken.

3. Result and Discussion

3.1 Soil Test Results

SPT Value Calculation;

$$\bar{N} = \frac{\sum_{i=1}^m t_i}{\sum_{i=1}^m t_i / N_i}$$

Information ;

\bar{N} : Average Value of SPT

t_i : soil thickness

N_i : SPT value per layer

Table 8. Soil Boring Results Data

Information	Depth (m)	Thickness (m) T_i	N_i (SPT Value)	T_i / N_i
Layer I	2.50 - 2.75	2.5	39.5	0.063
Layer II	2.50 - 2.75	2.75	1.5	1,833
Layer II A	4.00 - 5.75	1.25	5	0.250
Layer III	2.50 - 5.75	1.75	1.5	1,167
IV layer	18.00 - 19.00	12.25	23.5	0.521
V layer	21.00 - 21.50 to 30.00 - 34.50	2	18.5	0.108
VA layer	23.50 - 27.50	6	35	0.171
Layer VI	30.00 - 34.00 to 35.50	7	28	0.250
Layer VII	35.50 - 38.50 to 39.50	3	26.5	0.113
Layer VIII	38.50 - 39.50 to 40.00	1.5	22	0.068
Amount		40		4,545

$$\bar{N} = \frac{40}{4,545} = 8,800$$

8.8 < 15 So the type of soil is soft soil.

3.2 Comparison of Budget Plans

The following are the results of the calculation of the budget plan for both the Soldier Pile and the Sheet Pile, the calculation refers to the 2016 HSPK

Table 9. Comparison of Budget Plans for Retaining Walls

Type of work	Budget (Rp)	
	Soldier Pile	Sheet Pile
Preparatory work	700,000	700,000
Earthwork	105,605,250	151,775,250
Formwork Work	173,108	230,811
Concrete works	127,887,869	396,528,547
Concrete Work	182,057,000	3,722,000
Miscellaneous Jobs	3,000,000	6,000,000
Amount	419,423,228	558,956,608
rounded up	419,423,000	558,956,000

In the calculation of the implementation cost comparison there is a cost difference of Rp. 139,533,000,- is greater than the Sheet Pile retaining wall method, so the use of Sheet Pile is more expensive than Soldier Pile with an increase ratio of 33.27%.

3.3 Comparison of Execution Time

Table 10. Soldier Pile Job Plan

No.	Type	Activity	Preceding Activity	Duration (weeks)
1	Preparatory work	A	-	11
2	Earthwork	B	A	8
3	Formwork Work	C	B	4
4	Concrete works	D	C, E	6
5	Concrete Work	E	F	6
6	Other Jobs	F	A	6

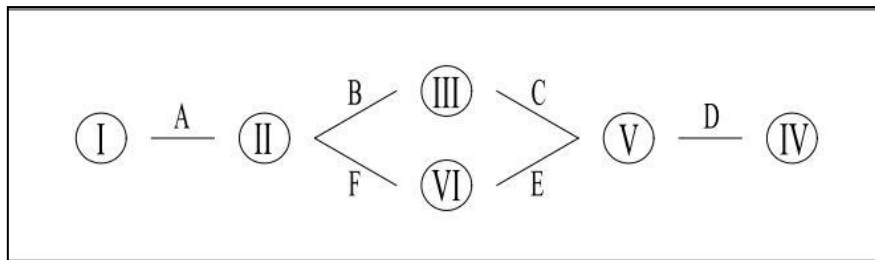


Figure 5. Network Planning Soldier Pile

Table 11. Sheet Pile Work Plan

No.	Type	Activity	Preceding Activity	Duration (weeks)
1	Preparatory work	A	-	11
2	Earthwork	B	A	8
3	Formwork Work	C	B	4
4	Concrete works	D	C, E	6
5	Concrete Work	E	F	6
6	Other Jobs	F	A	6

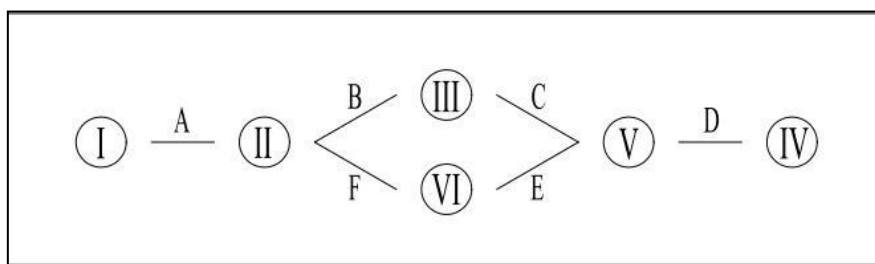


Figure 6. Network Planning Sheet Pile

In planning the work through the Network Planning scheme, it is found that the process of implementing Soldier Pile and Sheet Pile has almost the same flow but with different durations.

4. Conclusion

From the results of the research and discussion that have been described, it can be concluded;

- a. To determine the right type of retaining wall, soil testing is required, including:
 - Identification of soil type in the area to be built (determination of water content, specific gravity, volume weight and atterberg limit)
 - Soil strength test using several methods (Uncosolidated Undrined, Unconfined Compressive Strength Test, Direct Shear Test)
 - Consolidation test
 - Soil grain distribution test (Sieve Analysis, Fine Grained)

- b. In the process of working on the Soldier Pile Retaining Wall, there are several stages of implementation, namely;
- Soil characteristics testing.
 - Determination of the dimensions and needs of the required Soldier Pile
 - Determination of the point where the Retaining Wall will be installed with a waterpass or theodolite.
 - Drilling points for Bored Pile and Bentonite Pile with depth according to the specified plan and carried out alternately with each other.
 - When drilling is carried out, the water content of the soil that comes out is also reduced or commonly called dewatering.
 - Inserting the reinforcing steel frame on the Bored Pile and then casting it immediately using ready mix concrete, the same is done for the Bentonite Pile but the difference lies in the unused reinforcing steel.
 - Installation of the Capping Beam above the completed Soldier Pile pair with the aim of strengthening the structure of the Soldier Pile pair so that it can work optimally simultaneously.
- c. In the process of working for Sheet Pile Retaining Walls, there are several stages of implementation, namely;
- Soil characteristics testing.
 - Determination of the type and number of Sheet Pile adjusted to the needs of the Retaining Wall.
 - Determination of the point where the Retaining Wall will be installed with a waterpass or theodolite.
 - Placement of the Diesel Hammer Crane in the right position according to the direction of the Sheet Pile installation point.
 - Installation of the Guide Beam as a support so that the Sheet Pile can stand upright and help make it easier when the Sheet Pile is hit with a Hammer or the like so that the Sheet Pile position remains stable.
 - Installation of Sheet Pile by hitting it using a Diesel Crane Hammer according to the plan.
 - Installation of the Capping Beam on the embedded Sheet Pile pair with the aim of strengthening the structure of the Sheet Pile pair so that it can work optimally simultaneously.

Construction of the basement area of the Project Office of PT. UBS using the Soldier Pile Retaining Wall method requires a construction cost of Rp.419,423,000,-, while the Sheet Pile method requires construction costs of around Rp. 558,956,000,-. From this difference, the Soldier Pile method costs less with a difference of Rp. 139,533,000 using Sheet Pile method. In terms of implementation time The Soldier Pile Method of Retaining Earth Retaining Walls takes about ± 77 working days, while the Sheet Pile method requires an implementation time of ± 49 days. From these differences, the Sheet Pile method requires a shorter duration of 28 days than the Soldier Pile method, thus the Sheet Pile method is 36.36% more effective than the Soldier Pile method.

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