Identification of Damaged Infrastructure on Sheet Pile Musi at Palembang City

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Abstract. Sheet pile infrastructure is an aquatic infrastructure that serves as a retaining wall. The tour located on the banks of the river Musi Palembang that has been functioning until now has not been held further maintenance. Seen on the condition of the building now in some parts of the structure there is damage. The purpose of this research is to know the existing condition of sheet pile based on physical damage condition of sheet pile which is observed from the classification of condition. The method used is direct survey method to know the existing condition visually. From this research it is found that the biggest percentage of minor damage is found in pile structure component 13.953% at 11-14 Ulu and for floor plate 11.103% is in plaster 16 Ilir.

1. Introduction
Musi River is a river that divides the City of Palembang into two areas namely Seberang Ilir (northern part) and Seberang Ulu (southern part) right and left is limited by river border. In determining the river border can not be separated from the concept of Musi river bank arrangement due to the length of the territory adjacent to the water body.

In the development planning, Musi river sheet infrastructure is the City Masterplan in the development of Palembang City, the realization of water front city and efforts to cope with river bank scrubbing. According to [1] the concept of the Musi river bank arrangement is to plan the arrangement of water front (river bank) in the city of Palembang which is one of the efforts to restore the territorial water body into public property and plan the space along the water-oriented Musi river bank by building retrofitting cliff or sheet pile along the banks of the Musi river.

From the condition of sheet pile Musi Palembang city has occurred some decline in the condition of sheet pile infrastructure associated with the age of sheet pile services. In the planning, musi Palembang sheet pile is utilized as a Cliff reinforcement, border of water bodies, docks, Green Open Space and inspection road. For the utilization of sheet pile function maximally and feasible to be used, it is necessary to do identification of damaged infrastructure of sheet pile musi which aims to find out the existing condition of sheet pile based on physical damage condition of sheet pile observed from the classification of the condition so that it is expected to maintain the consistency of life sheet pile musi.
2. Study of Literature
The sheet pile wall is a relatively thin, flat-shaped vertical wall, usually made of steel or concrete material that serves to retain the soil also serves to resist the entry of water into the excavation pit [2]. The sheet pile consists of prefabricated parts or pre-cast, [3]. In Palembang City musi sheet pile the type of sheet pile used is a sheet pile wall with a foundation.

The turbine structure components that require maintenance to extend the function are pile, sheet pile, pile cap and floor plate. The purpose of this maintenance so that sheet pile can be utilized in accordance with the planned age. The following conditions and infrastructure performance of Water Resources can be seen in fig. 1.

![Figure 1. Conditions and Performance of Water Resources Infrastructure [4]](image)

The level of damage analysis required the physical condition of the sheet pile for the criteria for determining the maintenance of sheet pile. According to [5] concerning Maintenance of River Infrastructure and River Maintenance in appendix II classification of river infrastructure condition ie good condition, if damage level still below 10% (ten percent) from initial condition of development. The condition is slightly damaged, if the damage level is 10% (ten percent) to below 20% (twenty percent) of the initial condition of development. Moderate damage conditions, if the damage rate of 20% (twenty one percent) to below 40% (forty percent) of the initial conditions of development and severe damage conditions, if the damage rate already exceeds or equal to 40% (forty percent) from the initial conditions of development.

3. Method
3.1. Location
This research area is located in Palembang City South Sumatera Province where there is Musi River which stretches along 15 km which divide its territory into two areas. Both sections are connected by the Ampera bridges in the middle of the city. This research take 3 sample location that is in border of river of Musi opposite Ulu there are 3 research samples that is area of area 9-10 Ulu and 11-14 Ulu and Ilir opposite there are 1 research location that is 16 Ilir areas. The location of the research can be seen in fig. 2.
3.2. Tools
The tools used in the field survey are roll meters, camera, caliper digital and stationary

3.3. Method of Research
The method used in this research is direct survey method to know the existing condition. This method in the form of data collection, data analysis and analysis results to obtain information percentage damage sheet pile musi Palembang City. In determining the location of sheet pile of Ulu and Ilir section and sampling, it is done classification of sheet pile age

In this study, the age of sheet pile is classified into 3 (three), the sheet pile is <5 years old located at 11-14 Ulu, the age of 5-10 years old is located at 9-10 Ulu and the sheet pile age> 10 years located at 16 Ilir. After done data of physical condition of visual building of sheet pile it will get information of data in the form of damage and dimension of damage so that will yield volume damage obtained from calculation and initial volume value obtained from data sheet pile (as built drawing). To calculate the level of damage done calculation percentage damage obtained by using the formula:

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\text{Percentage of damage} = \frac{(\text{Damage Volume})}{(\text{initial volume})} \times 100\% \quad (1)
\]

The percentage value of damage is classified into 4 (four) ie good condition, lightly damaged condition, moderate damage condition and severe damage condition. Where the percentage of damage will be the priority scale of physical maintenance of sheet pile components

4. Result
Structural component damage data obtained from the survey results from the three locations based on the sheet pile age is 11-14 Ulu plaster, 9-10 Ulu turbine and 16 Ilir sheet pile which has been classified based on the condition of each sheet pile location.

a. Sheet Pile 11-14 Ulu (<5 years old)
Table 1. Percentage of good condition

| Field    | Component   | Unit | Initial Volume | Volume of Damage | Percentage of Damage |
|----------|-------------|------|----------------|------------------|---------------------|
| Structure| Sheet Pile  | m³   | 83.2           | 7.16             | 8.589               |
|          | Pile Cap    | m³   | 117.648        | 0.65             | 0.552               |
|          | Floor plates| m³   | 412.8          | 1.145            | 0.277               |

Table 2. Percentage of light damage conditions

| Field    | Component | Unit | Initial Volume | Volume of Damage | Percentage of Damage |
|----------|-----------|------|----------------|------------------|---------------------|
| Structure| Pile      | Point| 86             | 12               | 13.953              |

b. Sheet Pile of 9-10 Ulu (5-10 years old)

Table 3. Percentage of good condition

| Field    | Component | Unit | Initial Volume | Volume of Damage | Percentage of Damage |
|----------|-----------|------|----------------|------------------|---------------------|
| Structure| Pile      | Point| 173            | 4                | 2.312               |
|          | Sheet Pile| m³   | 89.6           | 1.594            | 1.779               |
|          | Pile Cap  | m³   | 150.472        | 0.009            | 0.006               |
|          | Floor plates| m³ | 214.96        | 10.132           | 4.713               |

c. Sheet Pile of 16 Ilir (> 10 years old)

Table 4. Percentage of good condition

| Field    | Component | Unit | Initial Volume | Volume of Damage | Percentage of Damage |
|----------|-----------|------|----------------|------------------|---------------------|
| Structure| Pile      | Point| 143            | 6                | 4.196               |
|          | Sheet Pile| m³   | 73.6           | 1.16             | 1.576               |
|          | Pile Cap  | m³   | 142.424        | 0.515            | 0.362               |

Table 5. Percentage of Light Damage Conditions

| Field    | Component | Unit | Initial Volume | Volume of Damage | Percentage of Damage |
|----------|-----------|------|----------------|------------------|---------------------|
| Structure| Floor plates | m³ | 10.12          | 1.124             | 11.103              |

Seen in the table above on the component structure of 11-14 Ulu sheet pile, the largest percentage of damage occurred in the pile structure of 13.953% and the smallest percentage of damage was on the floor plate component of 0.277%. At the 9-10 sheet pile location, the biggest percentage was 4.713% for the floor plate structure component and the smallest percentage was found in the pile cap structure component, which was 0.06%. The same is true for the sheet pile in
16 Ilir location, the percentage of damage to the floor plate structure is 11.103% and the smallest percentage is found in the pile cap structure of 0.362%.

5. Conclusion
From the results of research conducted on 3 locations of sheet pile that is in 11-14 Ulu, 9-10 Ulu and 16 Ilir can be concluded as follows:

a. The largest percentage of minor damage was found in pile structure component 13.953% at 11-14 Ulu and for floor plate 11.103% was on sheet pile 16 Ilir.

b. Damage that occurs on the sheet pile musi included in minor damage conditions caused by one tidal river water, it is feared will aggravate the condition of the sheet stack so that the need to care for the sheet stack remains to function optimally.

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