Transmission Coefficient Testing on Sweatbatching Model with Artificial Reef Brick-1 Armor

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Abstract. In Indonesia, planning ocean breakwater (breakwater) has not been done because of the expensive construction costs, while Indonesia is a country that has the fourth-longest coastline in the world and there are plenty of beaches due to damage from waves. This issue is of interest to researchers for study. The purpose of this study was to determine the characteristics of the wave transmission coefficient when using an armor breakwater sink with a brick-first artificial reef. Tests on laboratory models and multiple linear regression analysis methods are used to look at some of the variables expected to affect the size of the transmission coefficient (Kt). Of the model used the results showed that the wave comes (Hi), height (h), and width of the structure (b) of the breakwater, the water surface distance (F) with the breakwater where all variables are divided by gT2, significantly influence the transmission coefficient.

1. Introduction

The State of Indonesia is an archipelagic country, most of whose territory consists of water areas. Indonesia has a wider area than its land area, causing Indonesia to have the fourth longest coastline in the world, which is 95,181 km long. Based on the astronomical location, Indonesia is located at 60 North Latitude - 110 South Latitude (South Latitude) and 950 East Longitude (East Longitude) - 1410 East Longitude (East Longitude). With such an astronomical location, Indonesia has wind potential strong enough to make ocean waves become big [1], [2].

Large sea waves can shift the boundary of the coastline towards the mainland, damaging the surrounding land and buildings. For this reason, a breakwater is needed so that ocean wave energy can be reduced or eliminated. Ocean waves are also caused by the attraction of objects in the sky, especially the sun and the moon, causing tides to occur. Another cause is the fracture layer of the earth's crust which causes seawater to have potential energy due to a high difference, causing a large enough sea wave (tsunami). However, in planning a tsunami breakwater, it is not taken into account because it rarely occurs and the construction costs are high [3], [4]. In the use of various types of armor, it is known that it is expensive, is quickly damaged by waves that continuously hit, and does not pay attention to the survival of marine life [5], [6].
2. Methodology
This research is located in the Civil Engineering Laboratory. The data collection method used was an experimental method. The data processing method used is the tabulation method. The processed data were analyzed using Microsoft Excel 2007, SPSS 21, and Eviews 6.0. The flow chart is a display of the research implementation process from start to finish. The outline of this research is seen in the flow chart below [7].

3. Analysis
3.1. Regression Approach
In the approach of each regression, we will look at the relationship of each independent variable to the dependent variable by looking at the coefficient of determination. The coefficient of determination (coefficient of determination) is a coefficient that states the closeness of the relationship between the dependent variable and the independent variable. The variables used in this analysis are divided by $gT^2$ except for variables which are dependent variables [8], [9].

3.1.1. Correlation $C_t$ dan $H_i/gT^2$

| Model Summary and Parameter Estimates |
|--------------------------------------|
| Equation | Model Summary | Parameter Estimates |
| $R^2$ | $F$ | df1 | df2 | Sig. | Constant | bl |
| Linear | 0.09 | 1.159 | 1 | 139 | 0.278 | 0.899 | 0.021 |
| Logarithmic | 0.02 | 2.857 | 1 | 139 | 0.095 | 0.831 | 0.229 |
| Power | 0.08 | 2.494 | 1 | 139 | 0.117 | 0.810 | 0.095 |
| Exponential | 0.07 | 0.907 | 1 | 139 | 0.334 | 0.846 | 0.024 |

From the coefficient of determination ($R^2$), it can be seen that the coefficient of determination between $C_t$ and $H_i/gT^2$ for all regressions is very small. This means that the $C_t$ and $H_i/gT^2$ relationship is very weak. Significance value $H_i/gT^2$ is seen for all regression equations, not significant. Where the p-value is greater than the alpha value of 0.05 (the expected p-value <0.05). That is, $H_i/gT^2$ as the independent variable does not have a very significant effect on the value of $C_t$ as the dependent variable. For more details, it can be seen the $C_t$ and $H_i/gT^2$ correlation in the graph below:

![Figure 1. Correlation Chart $C_t$ dan $H_i/gT^2$](image)

From Figure 1. Normality test graph above, it can be seen that the data distribution pattern is very random. Where, the data distribution pattern does not follow a certain regression (both linear, logarithmic, power, and exponential regression). This pattern is not good for regression equations. Thus, it becomes clear that the $C_t$ and $H_i/gT^2$ correlation is very weak [10].
3.1.2. Correlation Ct dan b/gT²

From the correlation coefficient of determination (R²), it can be seen that the coefficient of determination of each regression equation is weak, where the linear regression value is 0.084, logarithmic regression is 0.100, power regression is 0.104 and exponential regression is 0.090. The value of the correlation coefficient is very far from the number 1 (one). So that the Ht / gT² and b / gT² correlations are very weak or almost non-existent. But the value of b / gT² has a significant effect on Ct (seen from the p-value <0.05).

Table 2. Correlation Ct and b/gT²

| Equation   | R Square | f | df_f | df_d | Sig. | Constant | t1 |
|------------|----------|---|------|------|------|----------|----|
| Linear     | 0.084    | 12.124 | 1 | 133  | .001 | .890     | -0.13 |
| Logarithmic| 0.100    | 14.721 | 1 | 133  | .000 | .880     | -0.65 |
| Power      | 0.104    | 15.442 | 1 | 133  | .000 | .885     | -0.69 |
| Exponential| 0.090    | 13.100 | 1 | 133  | .000 | .885     | -0.10 |

From the graph above, it can be seen that the data distribution pattern is very random. Where, the data distribution pattern does not follow a certain regression (both linear, logarithmic, power, and exponential regression). This pattern is not good for regression equations. Thus, it becomes clear that the Ct and b / gT² correlations are weak.

3.2. Multiple Linear Regression

3.2.1. Transmission coefficient equation

From the regression model test results discussed, a regression can be taken to describe the research modeling using linear regression. This can be seen from the respective coefficient of determination of each independent variable and dependent variable, using the four regression approaches, namely linear regression, logarithmic regression, power regression and exponential regression, linear regression values, and logarithmic regression which have a determination coefficient value that tends greatly among others. This research will use multiple linear regression. The variables used in the analysis are the Ct variable as the dependent variable and the Hi / gT², h / gT², b / gT², and f / gT² variables as independent variables.

Table 3 Result Test

| Model      | Unstandardized Coefficients | Standardized Coefficients | t    | Sig  |
|------------|-----------------------------|---------------------------|------|------|
|            | b                           |                          | Beta |      |
| Constant   | .890                        | .012                      | 74.124 | .000 |
| Hi/gT²     | .109                        | .002                      | .002 | .926 |
| h/gT²      | -.064                       | .006                      | -.086 | .104 |
| b/gT²      | .023                        | .003                      | .040 | .686 |
| f/gT²      | .027                        | .006                      | .023 | .429 |

a Dependent Variable Ct
On the results of testing using SPSS 21.0, the equation for the research carried out is as follows:

\[ C_t = 0.893 + 0.109 \frac{H_i}{gT^2} - 0.064 \frac{h}{gT^2} - 0.012 \frac{b}{gT^2} + 0.027 \frac{f}{gT^2} \]

When:
- \( H_i \) = the wave
- \( h \) = Structure height
- \( b \) = Structure width
- \( f \) = The distance between the building and the water level
- \( g \) = gravity
- \( T \) = Period

In the above equation, it can be seen that \( \frac{f}{gT^2} \) is directly proportional to \( C_t \), while \( \frac{H_i}{gT^2} \), \( \frac{h}{gT^2} \), and \( \frac{b}{gT^2} \) are inversely proportional to \( \frac{H_t}{gT^2} \). In other words:
1. When all the independent variables are constant, the \( C_t \) value will increase by 0.893 units.
2. When the \( \frac{H_i}{gT^2} \) value increases by one unit, the \( C_t \) value increases by 0.109 where the other variables are constant.
3. When the \( \frac{h}{gT^2} \) value increases by one unit, the \( C_t \) value decreases by 0.064 where the other variables are constant.
4. When the \( \frac{b}{gT^2} \) value increases by one unit, the \( C_t \) value decreases by 0.012 where the other variables are constant.
5. When the value of \( \frac{f}{gT^2} \) increases by one unit, the value of \( C_t \) increases by 0.027 where the other variables are constant.

3.2.2. Classic assumption test

This classic assumption test is used so that the equations obtained in this study can describe the actual population. So that this classic assumption test must be fulfilled.
1. Test the normality assumption
   Based on the results of processing with SPSS 21.0 on the Normal P-P Plot of Regression Residual graph, it can be seen that the data is in the form of points spreading around the diagonal axis and following the direction of the diagonal line. This indicates that the data is normally distributed. To further ensure the assumption of normality, it can be seen from the results of statistical tests for the normality of the remainder, namely the Kolmogorov Smirnov test, the value is 0.085 (the value is greater than the value 0.05). In other words, the hypothesis used fails to reject or the regression used is normally distributed. So it can be concluded that the model formed fulfills the assumption of normality.

![Figure 2. Normality test graph](image)

2. Test the autocorrelation assumption
   The examination of the assumption test for autocorrelation was carried out using the Eviews 6.0 software, namely the serial correlation-LM test method. From the test results, the probability value is
0.0621. This indicates that the value of the autocorrelation test is greater than 0.05. So that the hypothesis used fails to reject or there is no autocorrelation in the model used.

3. Multicollinearity assumption test
Multicollinearity occurs when the VIF value (of each independent variable (independent variable) is greater than 10. Based on the results of processing using SPSS 21 software, the VIF values of each of the independent variables are as follows:

| MODEL      | VIF |
|------------|-----|
| $\frac{H_i}{gT^2}$ | 4.685 |
| $\frac{H_i}{gT^2}$ | 3.594 |
| $\frac{H_i}{gT^2}$ | 2.228 |
| $\frac{H_i}{gT^2}$ | 2.892 |

From these results, it can be concluded that the hypothesis used failed to reject or there was no multicollinearity in the model (there was no significant relationship between the independent variables).

4. Homoscedastic assumption test
Testing the homoscedasticity assumption in this study using Eviews 6.0 software. From the test results with the Breusch Pagan Godfrey method, the value of this probability is 0.3910. The value of this probability is greater than 0.05. So from the test results, it can be concluded that the hypothesis used failed to reject or the assumption of homoscedasticity in the model was fulfilled.

4. Conclusion
Based on all the research that has been carried out, it can be concluded that the transmission coefficient characteristics of the submerged breakwater model with the artificial reef brick-1 armor are given by the equation:

$$C_t = 0.893 + 0.104 \frac{H_i}{gT^2} - 0.064 \frac{h}{gT^2} - 0.012 \frac{b}{gT^2} + 0.027 \frac{f}{gT^2}$$

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