Research on appropriate public capital facility management levels considering change over time of actions and performance —Towards building strategic maintenance methods for breakwaters—

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1. Outline of the research

The purpose of the research is to develop a method that can calculate anticipated values and scattering of life cycle costs during the period of use of breakwaters, to study appropriate maintenance and management levels (safety level) of breakwaters. Life cycle cost has been defined as the cumulative total during the period of use of [1] initial cost of construction of the breakwater, [2] cost of repair of the breakwater when it is deformed and cost of restoration when it is severely damaged (value of direct damage), and [3] logistics rerouting cost incurred in a port if a breakwater protecting the port is damaged (value of indirect damage).

2. Outline of results of the research

The following are results of a trial calculation of appropriate block settlement management of a caisson type breakwater covered with wave dissipating blocks.

As shown in Figure 1, wave dissipating blocks on a wave dissipating block covered breakwater often gradually settle over time because of scattering produced by high waves during typhoons. If this settlement is ignored, wave force acts directly on the caisson body, and according to circumstances, the waves may break so the impact wave force acts on the caisson, resulting in the high probability of even more severe damage, such as the caisson sliding off the rubble mound. But generally, even if a wave dissipating block settles, it is often ignored, because at normal times, breakwaters remain adequately stable under the normal waves, ensuring a degree of calmness behind the breakwater, so its repair is judged to be of low urgency.

So we used a newly developed tool to perform a trial calculation to determine what degree of settlement of a wave dissipating block requires repair work (settlement repair start criterion) in order to be able to minimize the life cycle cost. Figure 2 shows the results of a trial calculation of an actual breakwater section, with the lateral axis showing the settlement repair start criterion of wave dissipating blocks, and the vertical axis plotting the anticipated value and standard deviation of the total value of parts [2] and [3] of the life cycle cost explained above.

The figure shows that repairing the block immediately after the settlement of the block becomes equal to the height of about 1 wave dissipating, it will be possible to minimize the anticipated value of the life cycle cost, and at the same time, limit the

Figure 1. Image of Progression of Damage to a Caisson Type Breakwater Covered with Wave Dissipating Blocks

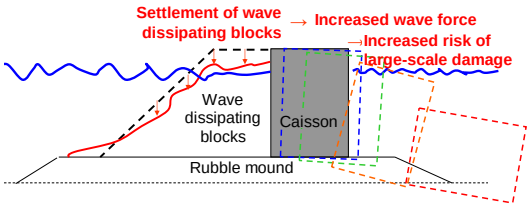
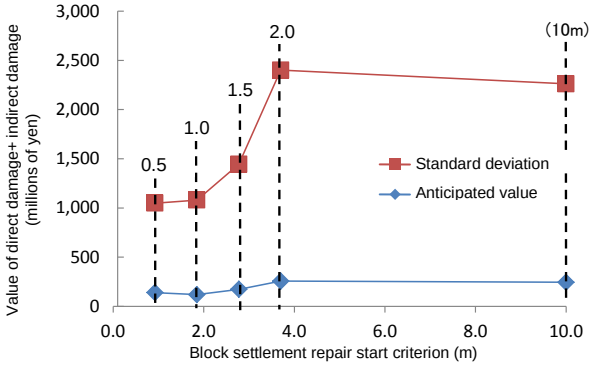


Figure 2. Relationship of Settlement Repair Start Criterion and Live Cycle Cost of a Caisson Type Breakwater Covered with Wave Dissipating Blocks



possibility of severe damage when a disaster occurs. These are limited study results, but they clearly show that at a wave dissipating block covered breakwater, diligently repairing settlement of blocks is a rational choice from the perspective of reducing total cost.

3. Conclusion

In the future, we will verify this model and improve it so it can used for practical work.

[Sources]
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