International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

An Analysis Management by Mike 21 Modelling at Rolak 70 Retention Pool in Jombang Regency, East Java Province, Indonesia

Markhaban Siswanto[1], Erni Yulianti[2], Sutanto Hidayat[3], Grace Citra Dewi[4]
[1] Faculty of Engineering, University of Darul Ulum, Jombang, Indonesia
[2,3] Post Graduate Program of Civil Engineering, National Institute of Technology, Malang, Indonesia
[4] School of Business and Management, Ciputra University, Surabaya, Indonesia

ABSTRACT: Some areas in Indonesia have high level of sedimentation problems that able to cause flooding, and one apparent solution is to build a retention pool. Sedimentation is deposition of material into the reservoir or dam due to environmental damage or erosion occurs in the river basin area. Sedimentation becomes the main factor in constructing the Rolak 70 Retention Pool, as an important component in controlling floods on the Konto River when the water discharge exceeds the maximum limit. From geography perspective, the modelling location is in waters located between 112° 11' 22.85" South Latitude and 7° 38' 42.23" East Longitude. The model area has northern boundary at the tip of Rolak 70 pool, while western boundary at the outlet of Rolak 70 pool. The lowest water depth value is located in upstream area of Konto River at coordinates of 112°11'27.81" South Latitude and 7°38'49.27" East longitude.
Weight of soil sample taken from the research site was ± 1000 grams at each point, and the result of sediment sample test performed at the Soil Mechanics Laboratory of Civil Engineering Department, Sultan Agung University, Semarang showed that the research area is dominated by sand, followed by mud and gravel. There were several tests conducted include grain size analysis, hydrometer analysis, and specific gravity analysis to determine the D50 of the sediment. In the study area, several sampling points were taken, started from upstream area of the river in front of Rolak 70 building to the Rolak 70 Retention Pool. For this purpose, a MIKE 21 software modelling was used to determine distribution and lines of sedimentation in the study area. As visible from changes found in bed level morphology that occurred in Rolak 70 Retention Pool by cross section extraction, it can be seen that the largest change occurred in analysis for line 1 and the smallest bed level changes occurred in the analysis for line 6. Then, the result revealed that sedimentation tends to occur at large locations in upstream area of Rolak 70 Retention Pool, while the smallest sedimentation potential will happen at the downstream area of Rolak 70 Retention Pool. These results can be caused by changes of speed from the river flow which tends to decrease towards the end of Rolak 70 Retention Pool. So, the river flow has no more energy to carry heavy amount of sediments originating from the upstream area of the Konto River. By the existence of this retention pool, the need for rice field irrigation will not be disturbed by sediment deposits. In addition, the Rolak 70 Retention Pool can be used as temporary storage for material from Mount Kelud eruption where these materials can be utilized as building material or other useful purposes.

KEYWORDS: Analysis management, Jombang Regency, Rolak 70 Retention Pool, Mike 21 Software, Sedimentation line.

INTRODUCTION

Rolak 70 Retention Pool is located in Bugasurkedaleman Village, Gudo, Jombang. The name of Rolak 70 derived from numbers of sluice gates in the dam of which there are 70 sluice gates. A retention pond is pool or reservoir to collect rainwater for certain period of time. Its function is to cut the peak of the floods that occur in water bodies or in rivers (Pristianto, 2018)

From the beginning since the first built, Rolak 70 Retention Pool carried out important function as the main regulator of water discharge from Konto River, especially to the direction of Jombang area. All sluice gates have function to divide the water flow of Konto River towards retention ponds when floods come, and also to collect sediment. Geographical condition of Konto River is prone to flooding since the upstream area has two large mountains; Argowayang-Anjasmoro Mountain in Malang Regency and Kelud Mountain in Kediri Regency, therefore it requires a water sharing building. Then, at the time Konto River experienced a maximum water discharge (when the dam was still functioning) water would be divided to flow into the left side of Rolak 70 where would be collected first in this building, so that, not all overflowing water of this region went into Jombang Region, then, it became a balance water distribution and useful for irrigating rice fields around Gudo district of Jombang Regency. (Apriyanto, 2018)

As time goes by, the condition of Rolak 70 Retention Pool is in worrisome state where almost all sluice gates are damaged and its connecting bridge is disappeared. The entire water sluice gates were covered in piles of wood and other plants waste. As a result, Rolak 70 causes flooding in the Perak and Bandar Kedungmulyo areas in almost every year. Problem of sedimentation still becomes main cause of critical condition of retention pool and prone or easily broken. In addition, heavy current into the pool brought large amount of sediment. (Apriyanto, 2018).

Sedimentation is a process of rock material deposition which has been transported by water or wind power, this process occurs in two stages; the first stage happens during erosion where the water carrying rocks flows into rivers, lakes and finally reaches the sea. Whereas the next stage happens when the transport strength is reduced or exhausted and the rock is deposited in the water flow area. These are also called as sediment transport (Rifardi, 2012).

This location was selected as research material since it has large amount of sedimentation within Rolak 70 rentention pool. This problem is interesting to be used as research material and get an aim to analyze sedimentation in the Rolak 70 Retention Pool. This research will employ Korinofaction tool for Sedimentation testing with a *Shaking Table* method. This equipment research is located in the Soil Mechanics Laboratory, Faculty of Engineering, UNISSULA, previously has been used to analyze factors that influence the occurrence of liquefaction in silty sand and silt soil. Korinofaction tool can also be used to carry out various researches related to geotechnical, hydraulics and structures.

So far, discussions related to Management Analysis of MIKE 21 Modelling at Rolak 70 Retention Pool in Jombang Regency of East Java Province, Indonesia have not been carried out much by researchers, therefore, the researchers postulate study problems of: (1) What are the result of identification and characteristics of sedimentation material found in Rolak 70 Retention Pool in Jombang Regency?, (2) What are the results of sedimentation test simulation to obtain suspended load parameters for the Rolak 70 Retention Pool with the Corinofaction 5.0 test tool?, (3) What is the result of sedimentation capital management by mapping regulatory line trapezoidal rule value for 70 Rolak retention pool of Jombang Regency?

LITERATURE REVIEW

A. Sedimentation

Sedimentation is a process of material deposition transported by water, wind, ice or glaciers in a basin. Estuary delta is a result and process of material deposition carried by river water while sand dunes in deserts and in coastal areas are the result of material deposition carried by the wind. Sedimentation can be divided into three types (Mulyanto, 2018) : 1) Water sedimentation, for example, occurs in river.

2) Wind sedimentation, called as Aeolian sedimentation. 3)
Glacier sedimentation.

Result of sedimentation are breccia rock and conglomerate rock which will be deposited near the source, while sandstone will be deposited further than breccia and conglomerate rocks, and clay will be deposited very far from the source.

There are several factors that able to cause a sedimentation process as explained below: 1) There is a source of sediment material; 2) There is a suitable sedimentary environment (land, transition zone, sea); 3) There is a transportation process of material resources that occurs via wind, ice and water; 4) There is a deposition occurs due to differences in current or forces; 5) There is a replacement and changes of recrystallization of the material; 6) A Diagenesis, the chemical and physical changes that occur during the deposition process; 7) Compaction is caused by the gravity of the sedimentary material which forces the volume of sediment layer to decrease; 8) Lithification is caused by continuous compactions to make the sediment hardens. (Febriyani, 2017)

Mananoma (2003) states the deposition process includes several processes of erosion, transportation, deposition, and compaction of the sediment itself. While on the earth surface, a lifting process begins by endogenous energy. By the uplift motion, rocks in the earth's crust will be partially lifted and then become relatively higher than other areas. The uplift process is also influenced by external factors of exogenous forces consisting of weathering, transportation and deposition. The sediment removal process is divided into three processes of:

1) Rainfall detachment is a process that able to move eroded soil particles that carried away with the surface runoff.
2) Overland flow is a process that able to lift sediment on the ground and then onto the grooves and so on until it finally enters the river.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

3) Sediment deposition occurs when the speed of flow that able to carry and transport sediment material has reached the deposition speed which is influenced by the size of particles sedimentation also the speed of the river flow.

According to Triatmodjo (2010), after material is transported, there will be a sedimentation process occur and makes the transportation strength weaken. Deposition process can be divided into two parts:

1) A geological sedimentation process is a normal soil erosion process which means the ongoing sedimentation process still within the permissible range, or the natural balance of the degradation and aggradation processes in the flattening process of earth's crust happens due to weathering process.
2) An accelerated sedimentation process is a deviant sedimentation process which took place in a fast period of time, destructive or detrimental and able to disrupt the natural balance or the sustainability of the environment. This negative impact mostly caused by land cultivation by human, such as incorrect farming method causes soil erosion and high level of sedimentation as presented in the example of sedimentation process in Figure 1 below:

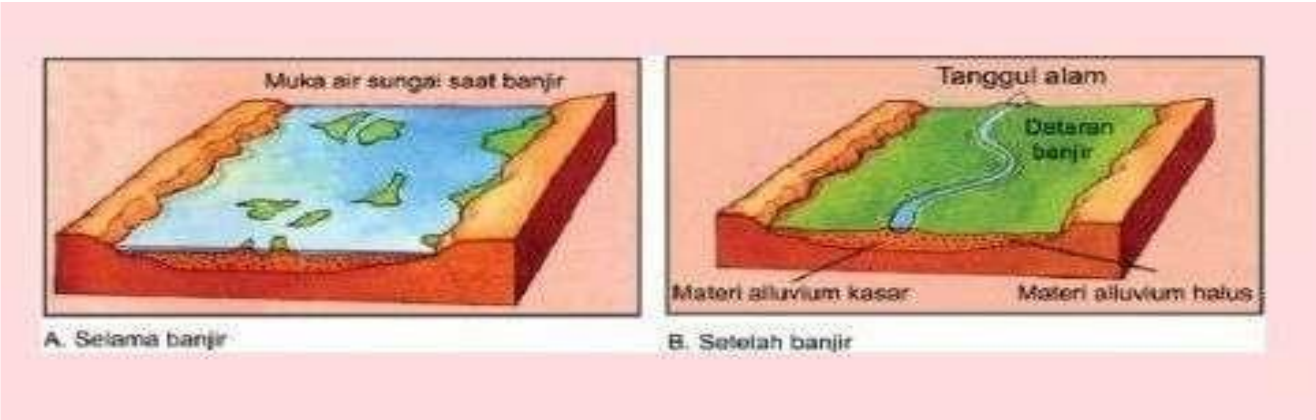


Figure 1. The river sedimentation process
Source: Triatmojo (2010)

B. Sediment Motion

There are two types of sediment motions:

1) Fluvial movement of the sediments is the force that make gravel grains on the surface of river bed to move, cosisting of components of gravitational force parallel to the force from the river bed also the shear force and lifting force which produced by the force of river water flow. (Prasetyo, 2015)
2) Sediment mass movement is water movement together with sediment masses in a very high concentration occur at the upstream of fast-flowing rivers on mountain or volcanic slopes. The motion of sediment masses is called as sediment shedding which usually happen in fast flowing river channels (torrents) that have slope greater than 150 (Prasetyo, 2015).

C. The Form and Size of Sediment Granular

The form and size of sediment granular are unlimited and diverse, where the flat shape particle has a smaller settling velocity and more difficult to transport when compare to round particle. Roundness is expressed as the ratio of diameter of a circle with the same area of grain projection in resting condition at a space on the largest space to the smallest diameter, or in other definition is stated as roundness is described as the ratio of the average radius of curvature of the tip of each grain to the radius of the largest circle. (Anasiru, 2006)

The sediment grain size is one prominent characteristic and widely used in the equation of sediment transport. The grain size is represented as below: (Hambali & Apriyanti, 2016)

1) Nominal diameter (d_n) is the diameter of a ball that has the same volume as the grain volume.
2) Fall velocity or fall diameter is the ball diameter with a specific gravity of 2.65 and has a standard falling speed.
3) Sediment diameter is the ball diameter that has weight and settling velocity of sediment grains in the same liquid and under the same condition.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

4) Sieve diameter, mostly used with sediment grain size measured by standard sieve for sediment grain diameter. This method is used to measure grains with diameter bigger than 0.0625 mm, according to the smallest sieve size.

Table 1. The classification of sediment granular size in accordance to AGU/American Geophysical Union

Diameter Range (mm)	Name
4096 – 2048	Very large boulders
2048 – 1024	Large boulders
1024 – 512	Medium boulders
512 – 256	Small boulders
256 – 128	Large cabbles
Diameter Range (mm)	**Name**
128 – 64	Small cabblers
64 – 32	Very coarse gravel
32 – 16	Coarse gravel
16 – 8	Medium gravel
8 – 4	Fine gravel
4 – 2	Very vine gravel
2 – 1	Very coarse sand
1 – 1/2	Coarse sand
1/2 – 1/4	Medium sand
1/4 – 1/8	Fine sand
1/8 – 1/16	Very fine sand
1/16 – 1/32	Coarse silt
1/32 – 1/64	Medium silt
1/64 – 1/128	Fine silt
1/128 – 1/256	Very fine silt
1/256 – 1/512	Coarse clay
1/512 – 1/1024	Medium clay
1/1024 – 1/2048	Fine clay
1/2048 – 1/4096	Very fine clay

D. The Sediment Transport

According to Mulyanto (2018) there are three types of sediment transports that occur in river channels:

1) Wash load or scrap load consists of silt and dust particles carried into rivers and remain floating until reaching the sea or other water bodies. This sediment type almost has no effect to the river properties although its amount is greater than other types, especially at the beginning of the rainy season. The sediment comes from weathering process of river basin area which mainly occurred during the previous dry season.
2) Suspended load or floating sediment mainly consists of floating fine sand within river flow since it transported by water flow turbulence. This type of sediment has little influence (not great) to the river properties, but when there is a change in flow speed, this sediment can change to a third type of transportation. Its driving force is the turbulence and speed of the river flow, in this matter is known as the lifting speed or pick up velocity. For certain grain sizes, if the lifting speed is exceeded,

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

the material will float. Conversely, if the speed of the river flow that transports it decrease below the lifting speed, the material will go down to the bottom of the flow.
3) Bed load is a basic transport where material with larger granular sizes will slide, roll, or rotate one on top of another on the river bed; where the movement will reach certain depth of the river layer and its driving force is the drag force from the river bed layer.

According to Wahyuni (2013), sediment transport rate is the amount of sediment measurement in an instant moment. When the water discharge does not change in rapid rate, only one measurement of sediment transport rate is sufficient to determine the average rate of water discharge in one day. In contrast, when the water discharge changes rapidly and the sediment rate is high, it requires several measurements to determine the average daily rate more thoroughly.

Erosion by water was explained by Foster and Meyer in their book entitled *Soil Erosion and Sedimentation by Water, An Overview* as stated that erosion occurrence covering the following processes: 1) Detachment or soil particles release as the result of impact of raindrops hitting the surface of the ground; 2) Transportation or soil particles drifting; 3) Deposition or settling particles that have been washed away.

According to Daulay, (2019) sediment particles are transported by water flow with one or a combination of transport mechanism consisted of: 1) Absorption (surface creep) is a process where sediment particles are moving in rolling or sliding motion over the river bed; 2) Saltation is a process where sediment particles are moving in jumping up and down motion on the river bed or sometimes stop and then leap again; 3) Suspension, is a process where sediment particles are moving by the support of surrounding fluids so they do not come into contact with the river bed.

The sediment load transported across a cross-section of river channel are made from three types of sediment loads: rinse load, drift/float load and bed load. The rinse load consists of very fine particles and colloids that deposits very slowly even in still water. Whereas the drift load and bed load sometimes are grouped together and known as base load because they are formed by particles found in base material and found in large quantities. Drift/float load defines as sediment which never positioning at the bottom of the river channel (by exclusion of rinse load) during the flowing condition (Komalig, 2008).

The size of sediment transported by water flow is determined by interaction of such factors like the size of sediment that enters the river or water channel, characteristics of the channel, the water discharge, and the physical characteristics of sediment particles, whereas the amount of sediments that enter the river also the water discharge amount are determined by climate factor, topography, geology, vegetation and farming practices in the water catchment area from which the sediment originates. In addition, the important characteristic of river in relation to the sediment matter are the river morphological form, roughness level of the river bed also the river slope. By interaction and each factor mentioned above will determine the amount and type of sediment as well as the speed from the sediment transport (Indra, 2012).

Based on sediment type and size of soil particles also the mineral composition of the parent material as its constructor, there are many types of sediments known as sand, clay, silt and others. While depending on the particle size, sediment is classified to be dissolved in the river (suspended sediment) or creeping along the river bed (bed load/base sediment). (Asdak, 2014) Furthermore, according to the size, sediments are divided into:

1) Clay with the particle size < 0,0039 mm
2) Dust with the particle size of 0,0039-0,0625 mm
3) Sand with the particle size of 0,0625-2,0 mm
4) Large Sand with the particle size of 2,0-64,0 mm

In line with the theories, according to Rezky (2017), sediment transport process can be explained by three processes of:

1) Rainfall detachment on sedimentary material found on the ground as a result of splash erosion that able to put soil particles in motion and be transported together with the overland flow or the surface runoff.
2) Overland flow which also lifts the sediment material that found on the ground surface which then washed into the grooves or rills and later went into the ditches and finally flow into the river.
3) Sediment deposition, a process occurs when flow velocity (pick up velocity) influenced by the size of sediment particles and the speed of flow.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

RESEARCH METHOD

A. Material and Tools of The Research Research Tools

Some of the research equipment's are available at the Soil Mechanics Laboratory and Hydraulics Laboratory, Faculty of Engineering, UNISSULA. Whereas the prototype in the research is a new research tool as a product of modification and improvement from previous tool. The following section will explain about equipment's used in the research:

1) Sieve. It is an equipment for testing the granular size of sediment samples (0.071-75 mm).

Figure 2. A Sieve shaker

2) Oven. The oven is used to accelerate the process of soil drying, where at first the soil that contains silt (before pounded and filtered) will be put into oven for 24 hours under a temperature of 160^0C for removing the water content.
3) Pounder. A tool for pounding the soil after it finished the baking process which is then filtered using a sieve.

Figure 3. A Pounder

4) Korinofaction 5.0. Korinofaction tool in this research was made as a modification of previous tool for carrying out sedimentation process. Image of the research tool is displayed below

Figure 4. A Korinofaction 5.0

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

5) Hydrometer measurement tool. A hydrometer is a piece of equipment used to measure relative density (or specific gravity) of a liquid, as stated into measuring ratio of liquid density to the water density. Most hydrometers are made of glass and consist of a cylindrical rod and a ball weighted with mercury to make it float in upright position. The way it works is based on the Archimedes principle, where a solid object suspended in a fluid (in this study, the solid object is soil) will be impacted with an upward force equal to the weigh of the displaced fluid. Thus, the lower the substance density, the further the hydrometer sinks.

Figure 5. A Hydrometer measurement tool

Material

Research material in this study were soil samples (made up by soil and water) from Rolak 70 Retention Pool in Jombang Regency. Soil in this study was taken from Rolak 70 Retention Pool in Jombang Regency. Water is one causal factor of sedimentation in which materials that become deposits could be in forms of dust, sand, soil and others. There are depositional environments whether in land, sea and transitional environments. While the movement of sediment material can be caused by water, wind, ice or glaciers. The water used in this study is fresh/plain water.

RESULT AND DISCUSSION

The following section explains five forms of city image; the path, edge, district, node and landmark whereas the 5 city elements as the creator of Pontianak City image are paths, edges, districts, nodes and landmark that will be put into explanation as follow:

A. Result of Suspended Load at Rolak 70 Retention Pool

Floating or suspended load are particles moving within a flow vortex that tend to continuously drift along with the flow, with size smaller than 0.1 mm. These loads are move along with the water flow and consist of fine sands which always supported by water and has less interaction with river bed since fine sands mostly pushed upwards by the flow turbulence.

The simulation of sedimentation process by the Korinofaction tool was held in five experiments at different times. To find out the value of floating/suspended load sediment, a hydrometer used in this study with the result value of the sedimentation testing simulation process by Korinofaction tool is presented in the following table 2.

Table 2. Hydrometer measurement result

Time (minutes)	Elevation Hydrometer (strip)				
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0	53	53	53	53	53
0.25	20	18	15	19	28
0.5	19	13	12	14	24
1	19	10	11	10	23
2	18	8	8	10	20

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

5	14	4	5	9	18
10	11	3	3	8	15
45	5	1	1	5	12
75	1	0	0	1	10
90	0	0	0	0	5
120	0	0	0	0	1

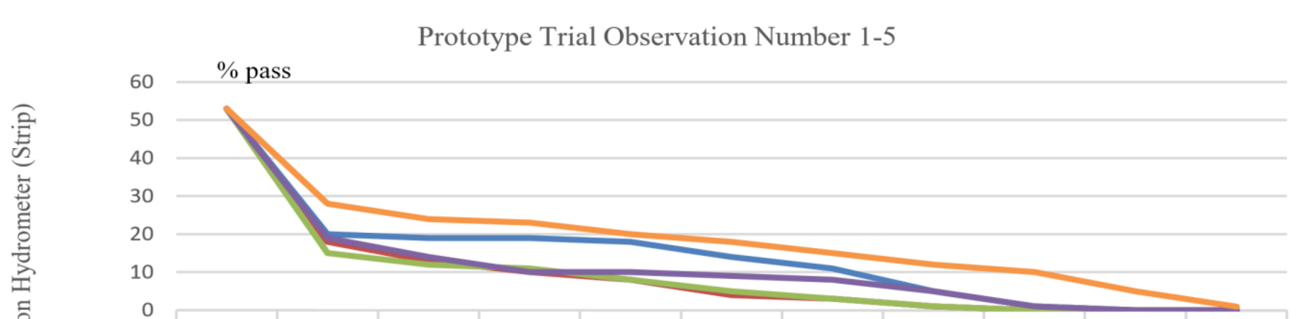
Apart from the water flow condition, next factor that causes the sediment transport to move and shift along the bottom of channels and drifting within the flow of channel and dam is the sediment's characteristic. To have a better understanding about the analysis of floating and base sediments, the writer put these sediments into a graph.

After the testing of soil samples conducted by a Korinofaction tool, next, the analysis of the floating sediment particles or suspended load was carried out and measured by a hydrometer through 5 (five) experiments. The graph of soil sample test using Korinofaction within 5 different experiments is presented in the following figure 6.

Figure 6 revealed a number of 0 was yielded in five trials of this study, meaning that zero number on the hydrometer or soil bulb indicates the floating sediment has completely settled.

Of the five samples, the highest immediate value of suspended load test is found in the shaking process at 1 minute condition where the sediment suspended load value reached 21 strips as displayed in the hydrometer which caused the water condition to be very cloudy (really dense). Then, the shaking took longer time and after 120 minutes it stopped and make the suspended load value decreases until it reached 0 strip. After the shaking process stopped, water became calmer over time and materials that originally floating during the shaking process were settled in the bottom side. So, the conclusion which can be drawn is the longer the shaking time or the longer the media shaken, the longer the time for suspended load to settle. It was caused by condition in the test where no retaining walls (like in the field) were employed, also from the flow velocity that occurred in the Korinofaction box.

This research only examines floating sediment (suspended load) because the limitation of the Korinofaction tool that using shaking table model where fine sand floating in the flow will be transported by the turbulence of the water flow, so material floats can be counted by a hydrometer. The researchers do not use bed load test since the material must have larger granular size to make it slides over one another at the base to reach a certain depth in the soil layer and produces a drag force from the base layer.



	0	0.25	0.5	1	2	5	10	45	75	90	120
Trial 1	53	20	19	19	18	14	11	5	1	0	0
Trial 2	53	18	13	10	8	4	3	1	0	0	0
Trial 3	53	15	12	11	8	5	3	1	0	0	0
Trial 4	53	19	14	10	10	9	8	5	1	0	0
Trial 5	53	28	24	23	20	18	15	12	10	5	1

Figure 6. Result analysis of suspended load trial 1-5 with hydrometer

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

B. Analysis of Morphological Change at The Base of Retention Pool

In the simulation of sediment transport, source of sediment was assumed only come from material carried away by river currents while other sediment sources such as those from bottom of the water are found due to the resuspension process. In the modelling process, there were six (6) lines created to analyze the change on morphological base water as shown in the following figures.

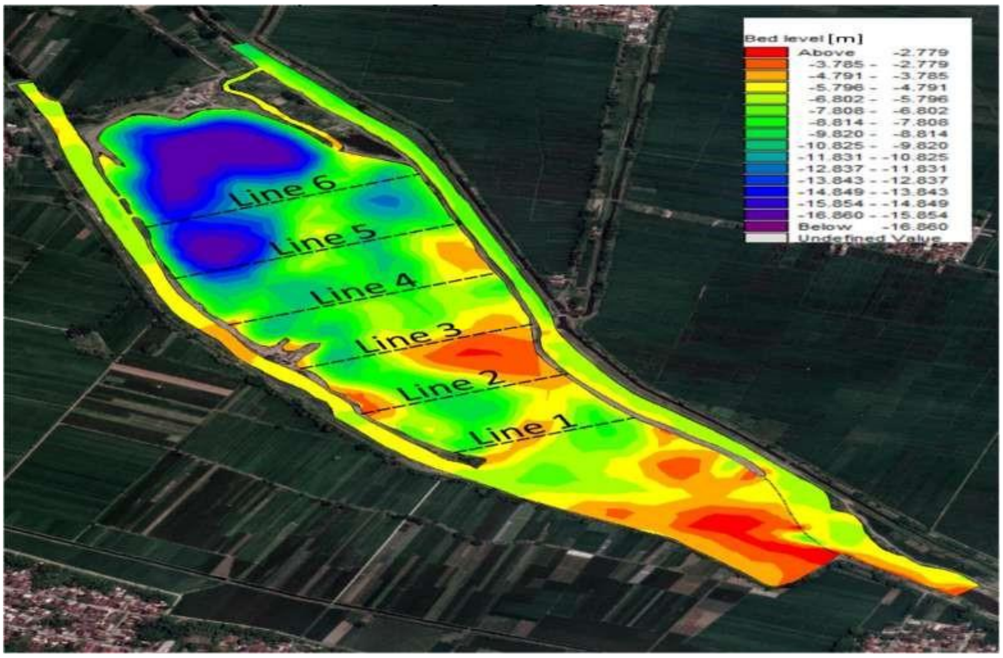


Figure 7. Lines of analysis on base morphological change at Rolak 70 pool

Table 3. Coordinates of modelling lines

Line	Initial Coordinates	Final Coordinates
1	x = 112.185926882 y = -7.6442760825	x = 112.1880603583 y = -7.643377521
2	x = 112.1848212247 y = -7.6432692572	x = 112.1872176959 y = -7.6422599227
3	x = 112.1840876111 y = -7.6421057386	x = 112.1868352021 y = -7.6409485368
4	x = 112.1832354658 y = -7.6409579089	x = 112.1864070514 y = -7.6396216845
5	x = 112.1825832552 y = -7.63975967	x = 112.1859486302 y = -7.6383422825
6	x = 112.1822407792 y = -7.6384314187	x = 112.185491046 y = -7.6370625122

 *Corresponding Author: Markhaban Siswanto

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

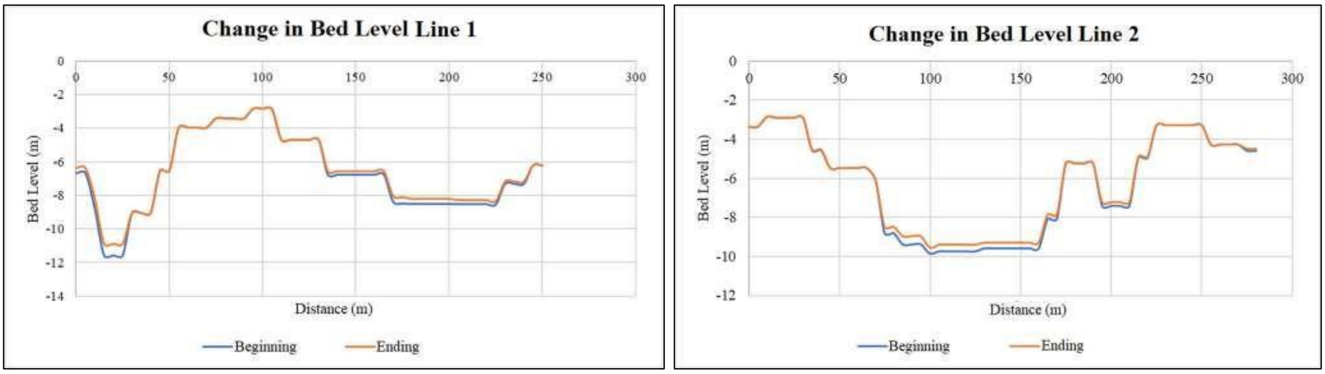


Figure 8. Change in bed level line 1 & 2

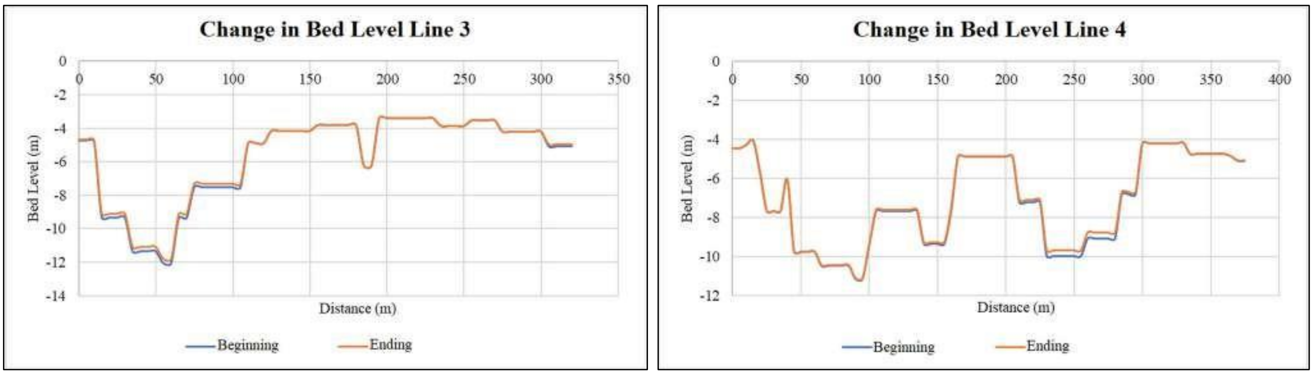


Figure 9. Change in bed level line 3 & 4

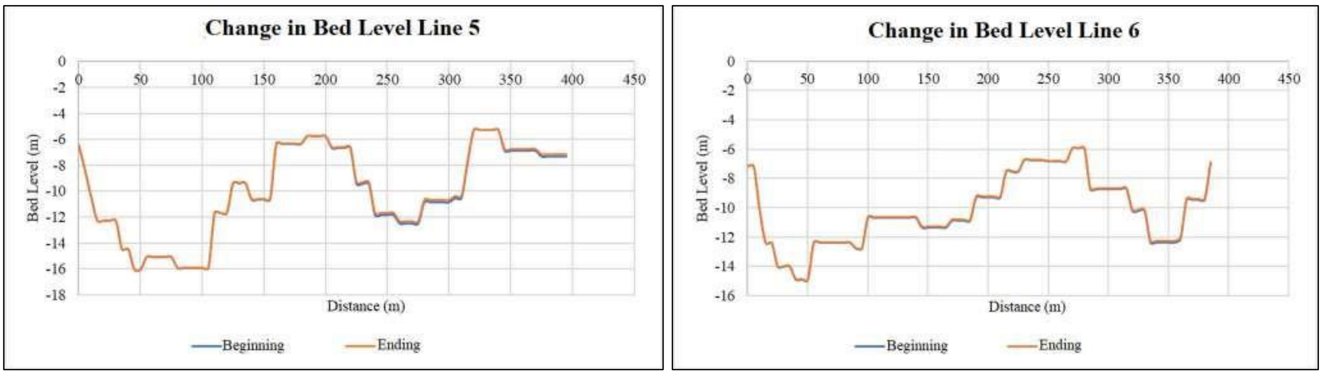


Figure 10. Change in bed level line 5 & 6

Figure 8 to 10 show changes in bed (base) level along line 1, line 2, line 3, line 4, line 5 and line 6. The largest elevation values from line 1 to line 6 are stated as: (a) the largest elevation change value for line 1 is 0.7116 m, (b) the largest elevation change value for line 2 is 0.4386 m, (c) the largest elevation change value for line 3 is 0.2698 m, (d) the largest elevation change value for line 4 is 0.2248 m, (e) the largest elevation change value for line 5 is 0.1859 and (f) the largest elevation change value for line 6 is 0.1102 m. From changes in bed level morphology at the Rolak 70 Retention Pool which extracted by a cross-section analysis, it is found that the largest change occurred in line 1 and the smallest change occurred in line 6. With these results, it shows that sedimentation has a tendency to occur at large locations in the upstream area of Rolak 70 Retention Pool and the smallest potential for sedimentation is in the downstream area of Rolak 70 Retention Pool which could be caused by changes in the speed of river flow that tends to decrease toward the far end of the Rolak 70 Retention Pool. Thus, the river flow has no more energy to carry sediments from

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

upstream area of Konto River. Therefore, the existence of Rolak 70 Retention Pool can be seen as an effective way to anticipate a river shallowing (silting) along the Konto River, so that, the irrigation need for rice farming will not be disturbed by sediment deposits. Furthermore, by the existence of Rolak 70 Retention Pool can be used as temporary storage for material retained from Mount Kelud eruption where it can be utilized as building materials or other useful purposes.
Volume of sediments in the research location was calculated to determine the capacity or how large the capacity of retention pool to sedimentation influences. Calculation to find value of sediment volume was carried out using the Surfer 17 software, and the calculation for finding value of sediment volume were made from the data of bed level change model that used as a reference in analyzing the cut and fill volume integration method to obtain sediment volume value (net volume). The result of these calculations is presented in the following table 4.

Table 4. Result calculation of sedimentation volume at Rolak 70 Retention Pool

Volumes	Volume of Sediment (m^3)
Total Volumes by:	
Trapezoidal rule:	32153.856518729
Simpson's rule:	31983.913568101
Simpson 3/8 rule:	32192.274112306
Cut & Fill Volumes	
Positive volume [Cut]:	32352.502318669
Negative volume [Fill]:	198.64579994
Net volume [Cut-Fill]:	32153.856518729

The shape of layout, depth influence, water current and building of Rolak 70 in the model resulted in condition differences of the base water profile at the research location. Difference in morphology condition at the bottom of the water is caused by accumulation of sediment transport that produces sedimentation (as obtained from the result calculation of sediment volume value in the Rolak 70 Retention Pool). In this study, the calculation to find sediment volume value for one month at Rolak 70 Retention Pool was done by applying the Trapezoidal Rule method with obtained value of 32,153,857 m^3, and by applying the Simpson's rule method with achieved value of 31,983,914 m^3 also by applying the Simpson's 3/8 rule method with achieved value of 32,192,274 m^3 within one month of the model simulation.
After obtaining water discharge data for 2022, the peak time of water discharge can be determined to be used as input for the simulation of sediment transport model in the Rolak 70 Retention Pool. The peak time of water discharge used in this experiment was the water current discharge occurred at February 2022 as stated to be **57,819 l/sec** because a heavy rain with highest intensity happened during that month and it brought potentiality to carry large amounts of sediment.
Furthermore, the Economic Volume Calculation for this research will be:
By Trent observation of 0.5 taken in January and another 0.5 taken in March, the predicted one-month trend is obtained at 0.4 %, thus, the estimation volume will be:

1.4 x 32,153.85 m^3 = 45,015.39 m^3

If the capacity of one Dam truck is 6 m^3, then, 45,015.39: 6 m^3 = 7502.565 Dam trucks. In which, if one truck with estimated HPS for Jombang Regency in 2024 equals to 600.000/number of trucks ready to go, it will yield:
600.000 x 7502,565 = Rp. 4.501.539.000 / year as contribution to Local Government Revenue (*Pendapatan Asli Daerah)* or contribution to local community.

= Rp. 4.501.539.000 / 365 = Rp. 12.332.983,56
= Rp. 12.333.000/day from a quality sand building material.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

C. Result of Curved Modelling Analysis of Storage at Rolak 70 Retention Pool

A reservoir capacity curve is a graph that connects inundation area with the storage volume to its elevation. In accordance to reservoir main function (to provide water storage), the main physical characteristic lies in its storage capacity. Capacity of regular shape reservoir can be calculated using calculation formula for finding volume of solid object. Under natural condition in the field, then reservoir capacity must be calculated using a topographic measurement. While the capacity curve is formed by measuring the area that enclosed by each contour line, and the cumulative of the area and elevation curve is the reservoir capacity curve. Capacity increase between two elevations is calculated by multiplying average area on the elevation by the difference between the two elevations. The accumulation of all increases at a certain elevation become the reservoir storage volume at that elevation.

In this study, the capacity curve model is based on 3D Triangulated Irregular Network (TIN). TIN is a form of vector-based digital geographic data built by triangulating a set of nodes. The connection points with a series of edges will form a triangular network. The surface of TIN can be created from vector data, raster data, and actual hydrometric or topographic data set.

Table 5. Curve capacity at Rolak 70 Retention Pool

No	Initial Elevation	H	Inundation Width		Storage Volume
	(m)	(m)	(m^2)	(Ha)	(m^3)
1	56	0.00	-	-	-
2	57	1.00	55,797.50	5.58	52,377.99
3	58	2.00	62,939.41	6.29	111,500.51
4	59	3.00	71,745.46	7.17	178,560.19
5	60	4.00	81,073.08	8.11	254,425.75
6	61	5.00	144,562.46	14.46	390,734.67
7	62	6.00	159,342.85	15.93	540,125.34
8	63	7.00	180,425.94	18.04	710,587.99
9	64	8.00	193,050.26	19.31	891,223.30
10	65	9.00	203,847.40	20.38	1,082,121.95
11	66	10.00	213,850.39	21.39	1,280,789.43

Source: *Data tabulation result, 2024*

CONCLUSION

The result of analysis and discussion as described in previous sub chapters of this study can be concluded as follows: 1) A Sieve Analysis test resulted a W (water content) value of 51.619%.

2) The Proctor test produced a wet unit weight or γ m value of 2.041 gr /cm^3 and a dry unit weight or γ d value of 1.346 gr / cm^3.
3) The Consolidation test produced an e (pore number) value of 0.934.
4) The Hydrometer test produced an n value (percentage of grains) of 0.483%.
5) The Direct Shear Test produced a c (cohesion) value of 0.081 and a Φ (soil shear angle) value of 42.45 ° 6) The soil composition test for the land resulted in 0.00% gravel, 0.95% sand, 96.64% silt and 2.42% clay.
7) For proctor testing γd (dry weight) max is 1,400 and Wopt (optimum water content) is 2.50%.
8) The sediment in the Rolak 70 Retention Pond soil laboratory is silt (a transition between clay and fine sand).
9) The specific gravity value of the sediment ( ) is 2.603 while the sediment water content (w) is 51.619%, the large permeability test is 1.091 x 10 -3, and the large consolidation value is 0.269 mm.
10) The regression result of sedimentation velocity y = f (t) is y = 72, 192-0.281x.

 *Corresponding Author: Markhaban Siswanto

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 09 September 2024
DOI: 10.47191/ijcsrr/V7-i9-63, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

Line Trapeziodal rule together with Korinofaction 5.0 research tool produce sedimentation observations within six lines of volume, area, as well as the monitoring time. Changes in bed level (baseline) along line 1, 2, 3, 4, 5, 6 are shown in the figure at previous sub chapter. The largest elevation change values are listed from line 1 with value of 0.7116 m, line 2 with value of 0.4386 m, line 3 with value of 0.2698 m, line 4 with value of 0.2248 m, line 5 with value of 0.1859 m and line 6 with value of 0.1102 m. Meanwhile, as seen from changes in bed level morphology at Rolak 70 Retention Pool as taken by cross section extraction, then it revealed that Rolak 70 building will be more effective as a buffer building and reservoir for cold lava eruption when it reaches its peak discharge to bring positive quality for the water quality for agricultural purpose.

The model applied in this study resulted in different conditions for the base water profil at the research location. Morphological differences are caused by the influence of sediment transport which accumulates and causes sedimentation. Based on the result obtained from calculating the sediment volume value in Rolak 70 Retention Pool, it is known that sediment volume for one month by applying the Trapezoidal rule method has value of 32,153,857 m^3, while by applying the Simpson's Rule method yieded value of 31,983,914 m^3 and by applying the Simpson's 3/8 Rule method yielded value of 32,192,274 m^3 within one month of the model simulation. Meanwhile, the volume measurement by Trapeziodal rule theory together with 3D Triangulated Irregular Network (TIN) also used to measure the Rolak 70 reservoir capacity based on research and as calculation source for 2023; which can be analyzed into mathematical formula as follow:

1,280,789.43 m^3 : 45,015.39 m^3 = 28.45 years (in full condition)

The capacity return period is 28.45 years (full of materials and within condition of no dredging or normalization project in Rolak 70 storages (12 Ha and 48 ha).

Further, by Trent observation of 0.5 taken in January and another 0.5 taken in March, the predicted one-month trend is obtained at 0.4 %, thus, the estimation volume will be:

1,4 x 32.153,85 m^3 = 45.015,39 m^3 (with the influence of ½ month of prior and after Q peak on March)

If the capacity of one Dam truck is 6 m^3, then, 45,015.39: 6 m^3 = 7502.565 Dam trucks.

One truck with estimated HPS for Jombang Regency in 2024 equals to 600.000/number of trucks ready to go. So, the economic value per calendar year and based on the peak discharge in the field:

600.000 x 7502,565 = Rp. 4.501.539.000 / year as contribution to Local Government Revenue (*Pendapatan Asli Daerah)* or contribution to local community.

= Rp. 4.501.539.000 / 365 = (in one year)

Per day income is Rp. 12.332.983.56 = Rp. 12.333.000/day from a quality sand building material.

REFERENCES

1. Anasiru, T. (2006). Angkutan Sedimen Pada Muara Sungai Palu. *Smartek*, 4(1), 25 – 33.
2. Apriyanto. (2018). Perbaikan Tanggul Rolak 70 oleh Dinas PUPR Jombang. Surabaya: Brantas River Regional Headquarters.
3. Asdak, C. (2014). Hidrologi dan pengelolaan daerah aliran sungai. Yogyakarta: Gadjah Mada University Press.
4. Febriyani, A. (2017). *Analisis sedimentasi yang terjadi sekitar Daerah Breakwater Pelabuhan Pulau Baai Bengkulu* [Undergraduated thesis, Faculty of Mathematics and Natural Sciences, Bengkulu University]. UNIB Library Repositary. http://repository.unib.ac.id/id/eprint/908
5. Hambali, R., Apriyanti, Y. (2016). Studi Kakteristik Sedimen Dan Laju Sedimentasi Sungai Daeng – Kabupaten Bangka Barat. *Fropil Journal*, 4(2), 165 – 174.
6. Indra, Z., Jasin, M. I., Binilang, A., & Mamoto, J. D. (2012). Analisis debit Sungai Munte dengan metode mock dan metode NRECA untuk kebutuhan pembangkit listrik tenaga air. *Statik*, 1(1), 34 – 38.
7. Komalig, M. (2008) *Analisa laju angkutan sedimen Sungai Sawangan pada titik kontrol Malendeng* [Unpublished undergraduated thesis] University of Sam Ratulangi Manado.
8. Mananoma, T., Legono, D., & Rahardjo, A. (2003). Fenomena Alamiah Erosi dan Sedimentasi Sungai Progo Hilir. *Jurnal Pengembangan dan Keairan*, 1(10), 1 – 70.

9. Mulyanto, H. R. (2018). Pengelolaan sedimen terpadu. Yogyakarta: Teknosain.
10. Prasetyo, D., & Dermawan, V. (2015) Study of sedimentation mitigation West Floodway Semarang City. *Jurnal Teknik Pengairan*, 6, 76 – 87.
11. Pristianto, H. (2018). Teori Aliran Sedimen Dalam Pipa. Surabaya: CV. Eureka Media Aksara. ISBN: 9786234876802
12. Rezky, N. (2017). *Analisis angkutan sedimen dasar pada saluran terbuka dengan variasi butiran sedimen* [Unpublished undergraduated thesis] University of Muhammadiyah Makassar.
13. Asrori, A., Rifardi, R., & Ghalib, M. (2016) Studi Transport Sedimen Lithogeneus di Perairan Muara Sungai Dumai Provinsi Riau. *Jurnal Online Mahasiswa Fakultas Perikanan dan Ilmu Kelautan Universitas Riau*, 3(2), 1-6.
14. Triatmodjo, B. (2010). Perencanaan bendungan. Yogyakarta: Beta Offset.
15. Wahyuni, S. E. (2013). Buku ajar kuliah irigasi. Semarang: Universitas Diponegoro.