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## THE CHARACTERISTICS OF SEDIMENTATION PATTERN AND MORPHOLOGICAL CHANGE OF SIGELENG RIVER ESTUARY IN RANDUSANGA KULON VILLAGE BREBES DISTRICT

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### Abstract:

*Sigeleng River Estuary is located in Brebes Regency. The mouth of Sigeleng River Estuary suffering morphological change that caused by the sand spit that close the mouth of river estuary and creating deflection.*

*The results of characteristics test of the sediment from the estuary of Sigeleng River shows that the average density is 2.228 kg/l and the average particle diameter (D60) is 0.466 mm. On the other hand the largest result of total suspended solid test of the sediment samples is 1.58 mg/l. According to USDA, the soil texture in B location is Silt Loam and in A and C location are Sandy Loam. SED2D modeling that performed for 720 hours that assumed as 1 year shows a base elevation change that is 11,79%-30,20% in the river estuary mouth at the existing condition*

*Sediment cumulation that occurred around the mouth of the Sigeleng River Estuary within 5 years is 0.007 m - 2,560 m, while the depth of the Sigeleng River Estuary is only -3.00 m. Therefore, a treatment by dredging the sediment aroud the mouth of Sigeleng River Estuary is needed so that the river estuary is not closed.*

**Keywords:** River Estuary Morphology; Sedimentation; Sediment Characteristics.

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## 1. Introduction

### 1.1. Background

River estuary is a part of river downstream that directly connected to the beach. The problems of river estuary can be seen from the river mouth and river estuary itself. River mouth is the part of downstream that directly connected to the beach. River estuary is the part of a river that affected by the tides. River estuary serves as the river discharge exit to the sea especially when flooding. The river estuary that located in the end of the downstream causes the discharge flow in the estuary to be greater than the river in the upstream area.

The speed of water flow in the in the river estuary is often change. When the water flow enters the estuary there will be a change/transition in the speed of water flow. The water flow that enter the estuary will lose its energy so that it becomes slower. The slow flow of water causing sedimentation in the mouth of Sigeleng River Estuary. The mouth of Sigeleng River Estuary in Randusanga Kulon village suffering morphological change that caused by the sand spit that closes the mouth of river estuary, creating deflection that affects the Randusanga Kulon villagers.

The problem that occurs in Sigeleng River Estuary is needed to be studied to find out the sediment characteristics, the base elevation change, and to determine the right protective building that will be functioned as a safety construction around Sigeleng River Estuary in Randusanga Kulon Village. This research using a software with mathematical modeling called SMS (Surface Water Modeling System).

## **1.2. Problem Formulation**

The small river discharge factor gradually forms sand spit that change the river estuary morphology and forms sediment cumulation can be very dangerous if not seriously handled, if the river estuary is closed it will affected the Randusanga Kulon Villagers.

## **1.3. Research Objectives**

The objectives of this research are :

- a. Analyzing the characteristics of the base sediment and floating sediment in Sigeleng River Estuary in Randusanga Kulon Village.
- b. Determining which protective building that will be used as a safety construction around the river estuary.
- c. Analyzing morphological change that occurs in the Sigeleng River Estuary in Randusanga Kulon Village.

## **1.4. Problem Boundaries**

So that the research scope is not too wide, this research will be limited as follows :

- a. The research scope is the impact of sedimentation rate in Sigeleng River in Randusanga Kulon Village.
- b. The data that be used are a result of laboratory test of some base sediment and floating sediment samples from the Sigeleng River Estuary in Randusanga Kulon village.
- c. Sediment samples were taken from 3 location points along the river, from each point, 1 floating sediment sample and 1 base sediment sample were taken.
- d. The discharge data that be used were from the year of 2018, taking the maximum discharge ( $Q_{max}$ ) and the minimum discharge ( $Q_{min}$ ) data.
- e. The tidal data that be used were from the year of 2018 when the maximum discharge and minimum discharge occurred.
- f. Only determining and simulating protective building for the estuary and downstream of Sigeleng River in Randusangan Kulon Village without designing the building.

## **2. Materials and Methods**

### **2.1. Research Location**

The location of this research is Sigeleng River Estuary and the samples are collected from its watershed. Sediment samples are taken from 3 points that located 50-150 meters from the edge of sand spit.

### **2.2. Research Data**

#### 1) Sediment Data

Sediment data is the data that be used as a sample in Geotechnics Laboratory test to examine sediment characteristic. These sediment samples are directly taken from some certain sample location points. Sediment characteristic testing includes sediment density and grain analysis.

#### 2) Secondary Data

##### a) Discharge Data

Discharge data in this research were obtained from the Water Resources Management Center of Brebes Regency. The data that be used are from the year of 2018, taking the maximum and minimum discharge data of 2018. The maximum discharge is 1580,020 m<sup>3</sup>/s, while the minimum discharge is 21,744 m<sup>3</sup>/s.

##### b) Tidal Data

Tidal data are used as modeling material in SMS software. Tidal data were taken from the Meteorology Climatology and Geophysics Agency of Brebes Regency. The tidal data that be used are when the maximum and minimum discharge occurred.

#### 3) Bathymetry Map

Bathymetry Map was obtained from the Sigeleng River Management Agency in Brebes Regency. The bathymetry map was obtained in the form of a file with the .dwg format, so the bathymetry map must first be converted to .dxf before being used as the basis for geometric modeling.

### **2.3. Sampling Method**

Sediment samples were taken from 3 sample location points. From each location point 2 samples were taken, they are floating sediment and base sediment samples. The samples were taken using simple tools because of the limited tools and budget for this research. Base sediment samples were taken by using a bucket, whereas for floating sediment a bottle was used to take the samples.

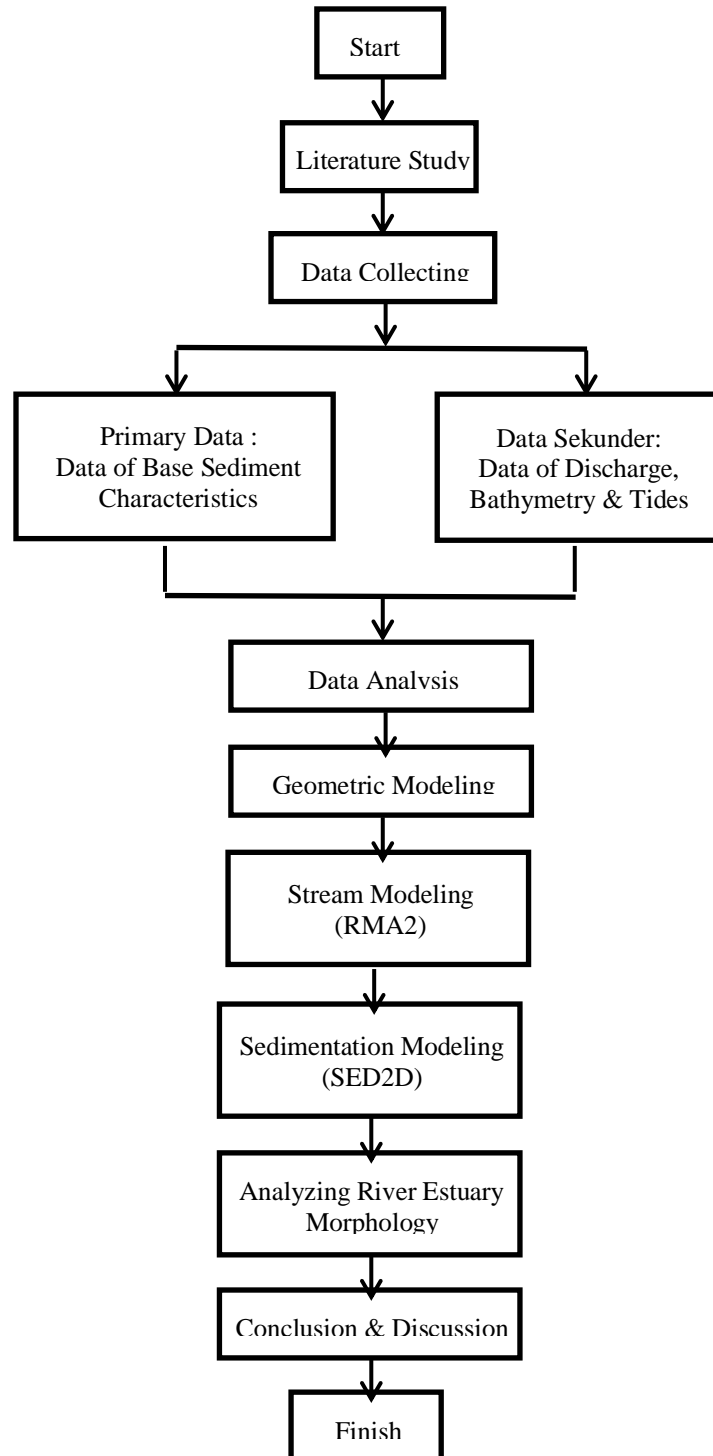
### **2.4. Laboratory Test Method**

#### a. Base Sediment

For base sediment, the test were performed in the Geotechnical Laboratory of Wijayakusuma University of Purwokerto with an estimated testing time for 2-3 weeks. The test that were performed including soil density test, soil particle analysis, and suspended solid test.

b. Floating Sediment

For floating sediment, the test were performed in the Chemical technic laboratory of Banyumas Regency with an estimated testing period for 1-2 weeks.



Picture 1: Research Flowchart

### 3. Results and Discussions

#### 3.1. Characteristic Test Result

##### 1. Base Sediment

- a. Soil Density Test : The Density Test used 3 base sediment samples, the result can be seen as follows :

Table 1: Density

Sample Code	Density
A	2,650
B	2,085
C	2,200
Average	2,312

- b. Analysis soil particle size – Hydrometer Analysis

Table 2: Hydrometer Analysis A Sample

Time (I) (minute)	Hydrometer Reading (R1)	Temperature ( °C)	Hydrometer Reading (R=R1+k)	L (table)	K (table)	D (mm)	P (%)
0,5	45	30	48,2	8,9	0,0122	0,052	75,28
1	38	30	41,2	10,1	0,0122	0,039	64,34
2	31	30	34,2	11,2	0,0122	0,029	53,41
5	23	30	26,2	12,5	0,0122	0,019	40,92
16	16	30	19,2	15,3	0,0122	0,012	29,99
30	0,5	30	3,7	16,1	0,0122	0,009	5,78
50	0	30	3,2	16,3	0,0122	0,007	5,00
250	0	30	3,2	16,3	0,0122	0,003	5,00

Table 3: Hydrometer Analysis B Sample

Time (I) (minute)	Hydrometer Reading (R1)	Temperature ( °C)	Hydrometer Reading (R=R1+k)	L (table)	K (table)	D (mm)	P (%)
0,5	30	27	32	11,4	0,0132	0,063	45,04
1	22	27	24	12,4	0,0132	0,046	33,78
2	19	27	21	13,2	0,0132	0,034	29,56
5	16	27	18	13,7	0,0132	0,022	25,33
16	12	27	14	14,3	0,0132	0,012	19,70
30	10	27	12	14,7	0,0132	0,009	16,89
50	9	27	11	14,8	0,0132	0,007	15,48
250	0	27	2	16,3	0,0132	0,003	2,81

Table 4: Hydrometer Analysis C Sample

Time (I) (minute)	Hydrometer Reading (R1)	Temperature ( °C)	Hydrometer Reading (R=R1+k)	L (table)	K (table)	D (mm)	P (%)
0,5	22	30	25,2	12,7	0,0128	0,065	36,86
1	15	30	18,2	13,8	0,0128	0,048	26,62
2	10	30	13,2	14,7	0,0128	0,035	19,31
5	7	30	10,2	15,2	0,0128	0,022	14,92
16	6	30	9,2	15,3	0,0128	0,013	13,46
30	4	30	7,2	15,6	0,0128	0,009	10,53
50	3	30	6,2	15,8	0,0128	0,007	9,07
250	0	30	3,2	16,3	0,0128	0,003	4,68

## c. Analysis of Soil Particle Size – Filter Analysis

Table 5: Filter Analysis

Filter Number	Particle Size (mm)	Weight of Particles that left on the Filter (gram)			Cumulative percentage of Particles that Passes the Filter (%)		
		A	B	C	A	B	C
10	2,000	0,000	0,000	0,000	100,000	100,000	100,000
16	1,190	1,040	0,180	0,000	96,061	99,635	100,000
30	0,590	2,700	0,300	0,620	85,833	99,027	97,849
50	0,297	3,800	6,450	2,250	71,439	85,955	90,042
100	0,149	5,600	30,970	16,250	50,227	23,186	33,657
200	0,075	2,300	2,110	9,050	41,515	18,910	2,255
	Pan	10,960	9,330	0,650	0,000	0,000	0,000
	Total	26,400	49,340	28,820			

## d. Moisture &amp; Soil Type

Table 6: Moisture &amp; Soil Type

Sample Code	Moisture (%)	Soil Type
A	56,170	Silt Loam
B	35,330	Sandy Loam
C	40,650	Sandy Loam

## e. Floating Sediment

Table 7: Test Result of Floating Sediment

No	Sample Code	TSS (mg TSS/L)	COD (mg /L O2)	Sludge Level (g/5ml)	BOD (DO <sub>0</sub> - DO <sub>5</sub> ) (mg/L)
1	1B	1,5	144	1,040	1,8
2	2B	0,5	16	1,038	2,2
3	3B	1,5	76	1,044	2,0

## f. Stream Pattern

Stream Pattern were obtained by comparing the great and small discharge of the Sigeleng River Estuary before and after the construction of jetty dan groundsill building as a safety construction in Sigeleng River Estuary.

Table 8: The Result of Stream Speed Modeling

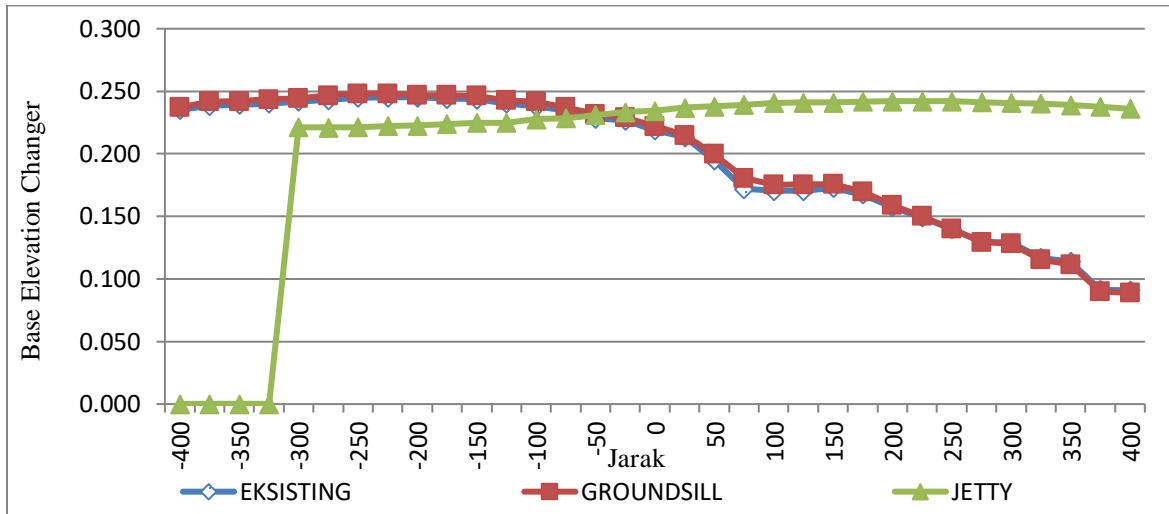
Location	Condition					
	Existing		Groundsill Planning		Jetty Planning	
	Great Discharge	Small Discharge	Great Discharge	Small Discharge	Great Discharge	Small Discharge
BM 6	0,848	0,040	0,920	0,042	0,869	0,041
BM 5	1,685	0,068	1,539	0,068	1,771	0,065
Groundsill Planning Point	0,816	0,035	0,815	0,040	0,815	0,036
BM 4 in Limbangan Village	0,782	0,037	0,859	0,039	0,833	0,041
BM 4 in Randusanga Village	0,661	0,036	0,733	0,037	0,569	0,038
BM 3 in Limbangan Village	1,341	0,057	1,354	0,057	1,240	0,058
BM 3 in Randusanga Village	1,060	0,056	1,031	0,056	1,035	0,054
BM 2	0,740	0,033	0,894	0,031	0,877	0,031
BM 1	0,002	0,000	0,001	0,000	0,337	0,015
River Estuary Mouth	0,627 - 0,976	0,023 - 0,039	0,549 - 0,684	0,028 - 0,037	0,198 - 0,351	0,015 - 0,030
Coastal Area	0,032 - 0,677	0,006 - 0,677	0,028 - 0,805	0,013 - 0,025	0,313 - 0,407	0,015 - 0,018

Note : Measurement meter/second (m/s)

## g. Sedimentation Pattern

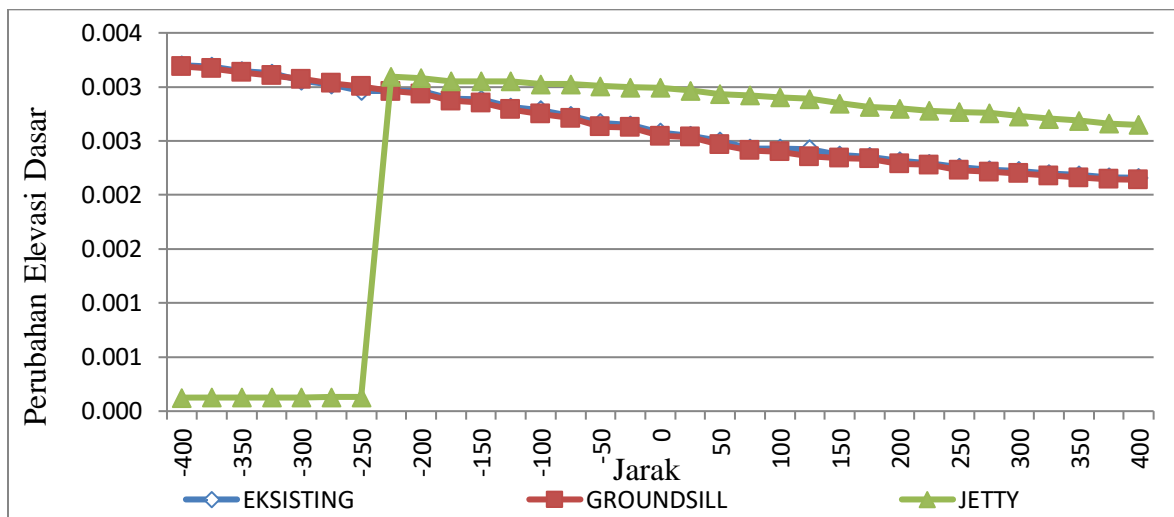
Outline elements that be used in stream pattern simulation were also used in sedimentation simulation. Sediment data that be used were material  $d_{60} = 0,492$  mm with

assumption that the sediment concentration is 0,015 kg/m<sup>3</sup>. The sediment poured to the Sigeleng River Estuary.



Picture 2: Graphic of Base Elevation Change in Sigeleng River Estuary during Great Discharge

After sediment concentration was poured into the great discharge of Sigeleng River Estuary for 720 hours or 30 days, the base elevation is change. because of the sediment distribution pattern for 720 hours or 360 days. The change in base elevation that occurred around river estuary mouth were obtained by pulling the crossing point of the river and the results are : in existing condition sediment accumulation that occurred is around 0,090 m – 0,245 m, in ground sill planning condition sediment accumulation that occurred is around 0,089 m – 0,248 m and in jetty planning condition sediment accumulation that occurred is around 0,242 m..

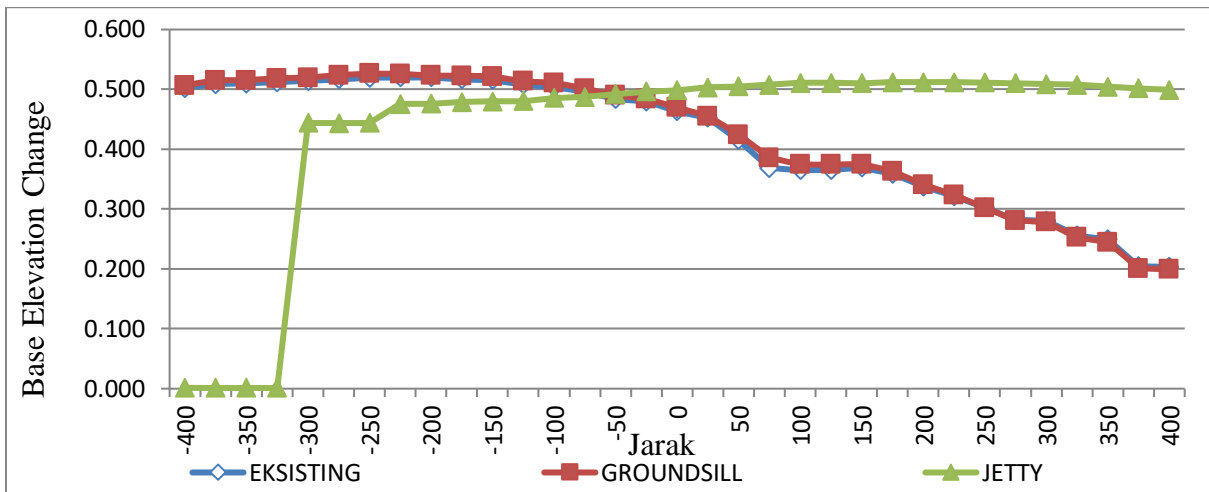


Picture 3: Graphic of Base Elevation Change in Sigeleng River Estuary during Small Discharge

After the distribution of sediment concentration during small discharge for 720 hours or 30 days in Sigeleng River Estuary, there were a change of base elevation that caused by sediment distribution pattern. The change of base elevation that occurred around the river estuary mouth were obtained by pulling the crossing point of the river, the results are : in existing condition



sediment accumulation that occurred is around 0,00216 m – 0,00320 m, in groundsill planning condition sediment accumulation that occurred is around 0,00214 m – 0,00319 m and in jetty planning condition sediment accumulation that occurred is around 0,00013 m – 0,00309 m.

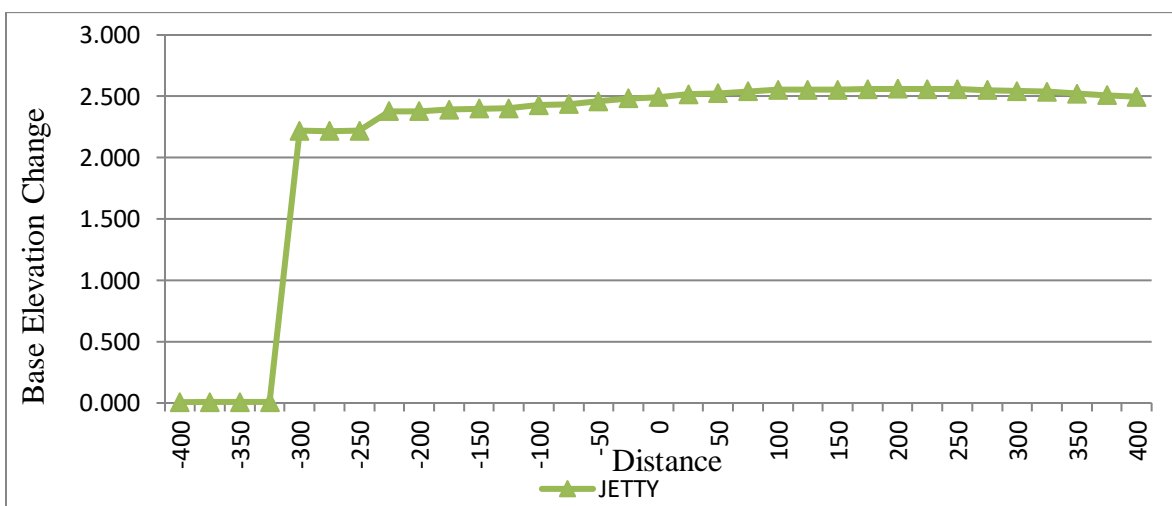


Picture 4: Graphic of Base Elevation Change of Sigeleng River Crossing Section

Base elevation change in 1 year, when great discharge occurred for 2 months and small discharge occurred for 10 months. The change in existing condition is 11,79% - 30,20%. When it was simulated with groundsill planning, it increased 0,35% from the existing condition so that the **decrease/change** of base elevation by using groundsill planning is 11,56% - 30,55%. When it was simulated with jetty planning, it decreased 0,47% from the existing condition so that by using jetty planning the elevation change in 1 year is 0,06% - 29,73%.

**h. Determining the Right Protection Building**

Based on the morphological change in Sigeleng River Estuary, with the presence of sand spit that closed the mouth of river estuary, protection building that be used in stream flow pattern simulation and sedimentation pattern simulation in the downstream of Sigeleng River is overflow type groundsill



Picture 7: Graphic of Base Elevation Change in Jetty Planning Condition

The results section should provide details of all of the experiments that are required to support the conclusions of the paper. The section may be divided into subsections, each with a concise subheading.

It is advised that this section be written in past tense. It is a good idea to rely on charts, graphs, and tables to present the information. This way, the author is not tempted to discuss any conclusions derived from the study. The charts, graphs, and table should be clearly labeled and should include captions that outline the results without drawing any conclusions. A description of statistical tests as it relates to the results should be included.

## **4. Conclusions & Recommendations**

### **4.1. Conclusion**

Based on the analysis, the research can be concluded as follows :

- a. The result of sediment characteristic test in Sigeleng River Estuary shows that the average density is 2,312, average grain diameter (D60) is 0,466 mm, whereas total suspended solid test biggest result is 1,58 mg/l. The type of soil in location A is silt loam, whereas in location B and C the type of soil are sandy loam.
- b. Stream pattern was simulated for 24 hours and the obtained result are : stream speed around Sigeleng River Estuary mouth during great discharge in existing condition is 0,627 m/s – 0,976 m/s, in groundsill planning condition is 0,549 m/s – 0,684 m/s, and in jetty planning condition is 0,198 m/s – 0,351 m/s.
- c. During small discharge the stream speed around Sigeleng River Estuary mouth in existing condition is 0,023 m/s – 0,039 m/s, in groundsill planning condition is 0,028 m/s – 0,037 m/s, and in jetty planning condition is 0,015 m/s – 0,020 m/s. When simulated using groundsill planning condition it increase 0,35%, therefore base elevation decrease when using groundsill planning condition is 11,56% - 30,55%. Base elevation change when using jetty planning condition decrease 0,47% from existing condition, therefore elevation change in 1 year is 0,06% - 29,73%.
- d. Based on the sedimentation pattern that has been modeled by considering base elevation change, the chosen protection building for river estuary safety is a long type jetty.

### **4.2. Recommendations**

After the research is done and to be useful for improvement in further research :

- a. Further research is needed **to/that** use discharge data that obtained from direct observation and measurement around Sigeleng River Estuary so that the research data is more accurate.
- b. The scope of this research is only the effect of Sigeleng River Estuary sedimentation rate, if a further research gonna be performed, sedimentation along the beach around Sigeleng River Estuary can be reviewed.
- c. A structural planning of a long type jetty building in the Sigeleng River Estuary is needed.

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