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TECHNICAL REVIEW OF OPERATIONAL PATTERNS OF THE WEST FLOOD CHANNEL MOVEMENT (KBB) IN SEMARANG CITY

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Abstract- A based on the concept of the convenience of the West Flood Canal (KBB) river in Semarang City which is divided into five zones, so in 2019 work on the construction of the KBB Motion Weir was held. To optimize the operation of the Mobile Weir, it is necessary to analyze and simulate the operational pattern of the KBB Mobile Weir. The aim is to obtain procedures and patterns in the operation of mobile dams and the right and efficient opening and closing times during the rainy season and during sediment flashing. In this study, hydraulic analysis was used with the help of the HEC-RAS 4.1.0 program. to track flooding in the river channel using mathematical modeling in several scenarios. From this analysis, it can be seen how far the procedures and operational patterns of the West Flood Canal Movement Weir (KBB) are in accordance with several planned scenarios. The results of the study found that the simulation of the opening of 1 (one) door/span using Qmax 220.71 m3/second, as scenario I in the Standby/Ready condition. Simulation of opening 1 (one) door/span using Qmax 339.81 m3/second, according to scenario II during Standby II/Standby conditions. And scenario III for Saga III/Beware) requires 4 (four) door openings/span.

Keywords: Simulation, Procedure, Operational Pattern, Motion Weir, West Flood Canal, Semarang City KBB.

1. Introduction

The West Flood Canal River is an artificial floodway made by the Dutch East Indies government due to a fairly large flood in 1871. This channel is an alignment of the Garang river which was originally divided into 2 (two) branches, namely Kali Semarang and Kali Bulu Function from The West Flood Canal is intended to accelerate the release of flood discharge from upstream to the sea. In 2010 to 2014 the work of Normalization of Garang River and West Flood Canal was carried out with the concept of river comfort which was divided into five zones. In the third zone, a mobile weir is built which functions to raise water levels for the purpose of rowing competitions and for raw water needs, because in the third zone it is intended for water sports.

To optimize the operation of the weir, it is necessary to analyze the "Operational Pattern of the Weir Operational Analysis of the West Flood Canal of Semarang City" which will later be utilized in the operation of the weir.

2. Materials and Methods

In this study using hydraulics analysis with the help of the HEC-RAS 4.1.0 program. Hydraulics analysis is carried out to track flooding in river channels using mathematical modeling in several scenarios

- Scenario 1 Flood condition with Qmax 220.71 m3/s from Simongan Dam
- Scenario 2 Flood condition with Qmax 339.81 m3/s from Simongan Dam
- Scenario 3 Flood conditions with Qmax 786.86 m3/s from Simongan Dam

From the three scenarios, it will be simulated how many dam doors will be opened.

The data used in this study

a) Primary data from the measurement results of the Semarang City West Flood Canal is inputted complete with coordinates and elevation

b) Analysis of flow patterns using the fixed flow method using HEC-RAS 4.1.0 . software

c) The analyzed river flow is in the western flood canal river

d) Fixed flow hydraulic analysis using HEC-RAS 4.1.0 . software

In this study, the hydrological data used secondary data (Simongan Dam Runoff Data), namely the calculation of the discharge that passed through the Simongan Dam spillway. Calculation using the Q50 year return period used for planning the design/normalization of the West Flood Canal. Calculation of the discharge through the spillway using the equation

$$Q = CBH1.5 = 1.57 \times 64.6 \times (H)1.5 + 1.8\times 10.4 \times (H)1.5 \quad (1)$$

Where : Q = Discharge (m3/second)

C = Coefficient of discharge

B = Spill width (m)

H = Depth of spill

Table 1 Simongan Dam Runoff Discharge Data

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DISCHARGE OF SIMONGAN WEIR			
Elevation (m)	Height (H) from Crest Weir (m)	Discharge Simongan Weir (m3/sec)	Data Record
$Q = CBH^{1.5} = 1.57 \times 64.6 \times (H)^{1.5} + 1.8 \times 10.4 \times (H)^{1.5}$			
5.28	0.00	0.00	
5.38	0.10	3.80	
5.48	0.20	10.75	
5.58	0.30	19.74	
5.68	0.40	30.39	
5.78	0.50	42.48	
5.88	0.60	55.84	
5.98	0.70	70.36	
6.08	0.80	85.97	
6.18	0.90	102.58	
6.28	1.00	120.14	
6.38	1.10	138.61	
6.48	1.20	157.93	
6.58	1.30	178.08	
6.68	1.40	199.02	
6.78	1.50	220.71	
6.88	1.60	243.15	
6.98	1.70	266.30	
7.08	1.80	290.14	
7.18	1.90	314.65	8-Feb-09
7.28	2.00	339.81	
7.38	2.10	365.61	
7.48	**2.20**	**392.04**	**9-Nov-10**

DISCHARGE OF SIMONGAN WEIR			
Elevation (m)	Height (H) from Crest Weir (m)	Discharge Simongan Weir (m3/sec)	Data Record
$Q = CBH^{1.5} = 1.57 \times 64.6 \times (H)^{1.5} + 1.8 \times 10.4 \times (H)^{1.5}$			
7.58	2.30	419.07	
7.68	2.40	446.70	
7.78	2.50	474.90	
7.88	2.60	503.68	
7.98	2.70	533.02	
8.08	2.80	562.90	
8.18	2.90	593.32	
8.28	3.00	624.28	
8.38	3.10	655.75	
8.48	3.20	687.73	
8.58	3.30	720.22	
8.64	**3.36**	**740.00**	**Design**
8.68	3.40	753.21	
8.78	3.50	786.68	
Elevation of Crest of Weir = 5.28 m			
Elevation of Operating Deck (Existing) = 8.50 m			
Elevation of Operating Deck (Design) = 9.50 m			

The discharge used as input for the HEC-RAS program is the Simongan Dam runoff discharge, which is 220.71 m3/second (standby I), 339.81 m3/second (standby II) and 786.68 m3/second (standby III), then flow simulation can be carried out with the help of this device. HEC-RAS 4.0 (Hydraulic Engineering Center's-River Analysis System) software, which is a hydraulic model program designed to create flow simulations

The input data required in the hydraulic model program are:

A. River geometry data

- Long section
- Cross section (cross section)
- Coefficient of river roughness, n (Manning)

B. Unsteady flow data

- Flood hydrograph (flow hydrograph)
- Initial conditions
- Boundary conditions

From the results of the flow simulation, we can get the cross-sectional capacity of the West Flood Canal to determine the door/panel openings from number 1 to number 4, how many

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door/panel openings are needed, especially during a flood so that the impact of river flooding both upstream and downstream of the river is as small as possible

Weir Technical Data

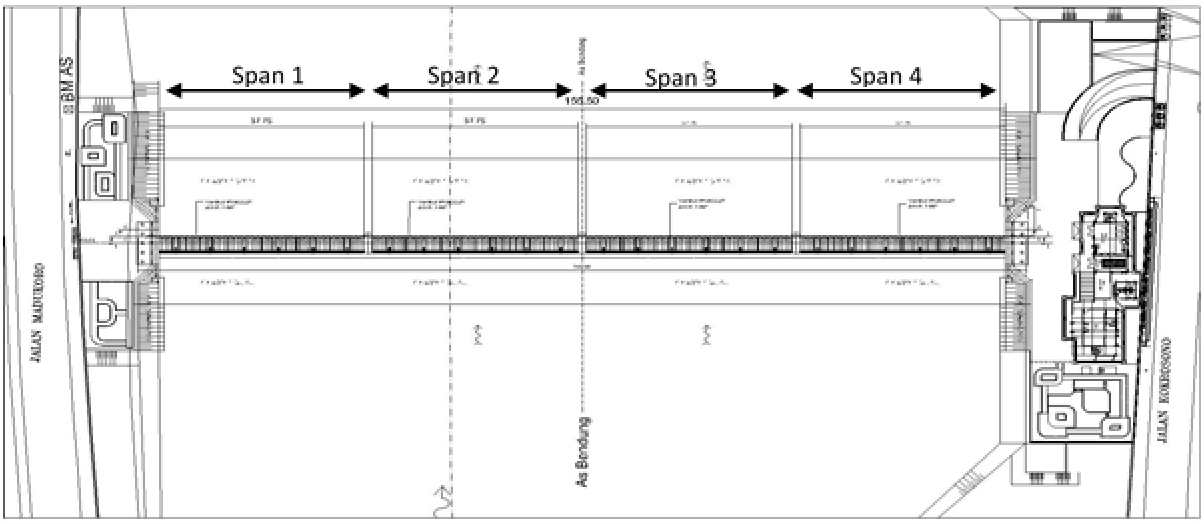
The West Flood Canal Movement Weir (KKB) has 4 (four) span panels, based on hydraulic analysis and tidal elevation, the weir crest elevation and surface floor elevation are as follows:

- Weir Lighthouse Elevation : + 1.5 mdpl
- Lower ground floor elevation : - 1.0 mdpl
- Maximum tide elevation : + 1.2 masl
- Embankment Surface Elevation : + 2.6 masl
- Weir Width: 155.50 consisting of

Span : 4 x 37.75 m = 149.40 m

Pillar : 3 x 1.50 m = 4.50 m

- Functions as a water reservoir with a capacity of 700,000 m3



Schematic Drawing of the West Flood Canal Motion Weir (KBB)

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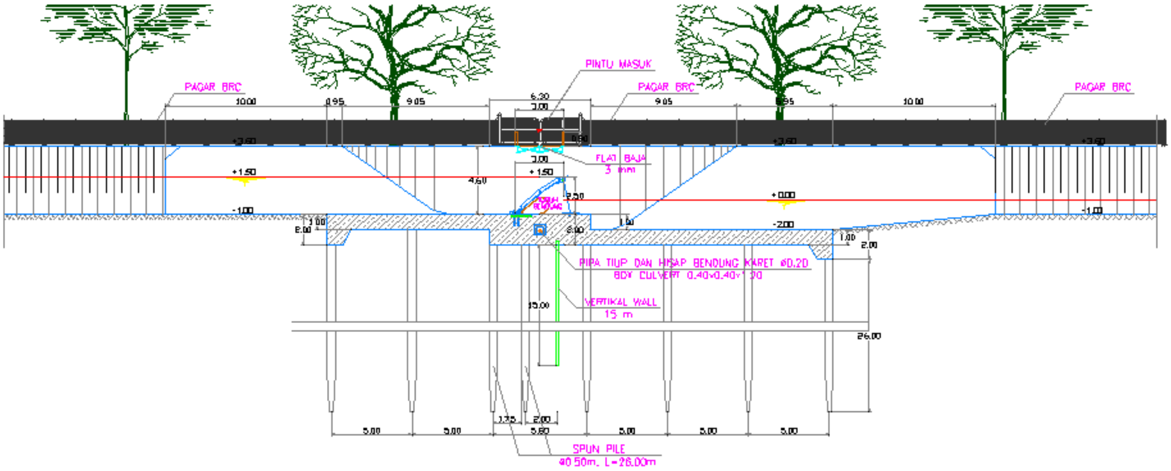
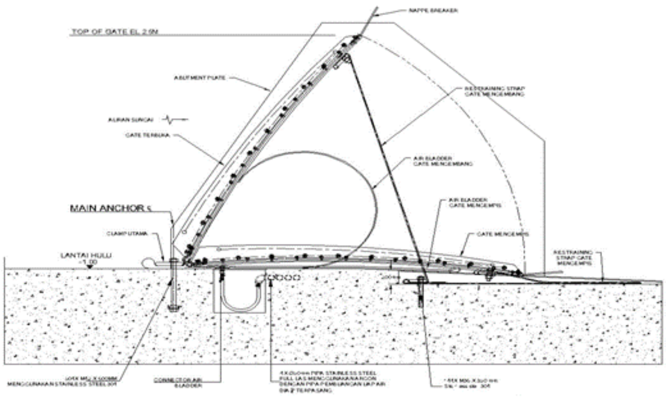


Figure of the Cross Section of the West Flood Canal Motion Weir (KBB



Picture of the Cross Section of the West Flood Canal (KBB) Motion Weir

3. Results and Discussion

From the operational side of the door opening of the West Flood Canal Motion Weir, the magnitude of the flood discharge warning condition to open the door is from the runoff discharge of the Simongan weir. The following is a recapitulation of the door openings of the Gerak Weir based on the Simongan weir runoff flood discharge which will be presented in 3 (three) scenarios, as follows:

Door opening simulation plan:

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1) Scenario 1 Flood conditions with Q max 220.71 m3/s from Simongan Weir, how many door openings are needed in the motion weir with the trial opening of doors/spans 1, 2, 3 and 4 until the required conditions are so that the water does not run off
2) Scenario 2 Flood conditions with Q max 339.81 m3/s from the Simongan Weir, how many door openings are needed in the motion weir with the trial opening of doors 1, 2, 3 and 4 until the required conditions are so that the water does not run off
3) Scenario 3 Flood conditions with a Q max of 786.86 m3/s from Simongan Weir, how many door openings are needed in the motion weir with the trial opening of doors 1, 2, 3 and 4 until the required conditions are so that the water does not run off

Flood Discharge Simongan Weir Runoff		**Number of Doors in Open**			**Weir Water Level Elevation**	**Upper Weir Water Level Elevation**
		Main	**Nafigasi**	**Aperture Height**		
Category	**m^3/detik**	**Unit**	**Unit**	**(m)**	**(m)**	**(m)**
Skenario 1 (Siap)	220.71	4	1	0	2.22	2.26
		4	1	2	-0.41	0.34
Skenario II (Siaga I)	339.81	4	1	0	2.46	2.52
		4	1	2	-0.22	0.79
		4	2	2	-0.22	0.79
Skenario III (Awas)	786.68	4	1	0	3.12	3.30
		4	1	2	2.49	2.82
		4	2	2	1.90	2.44
		4	3	2	1.35	2.21
		4	4	2	0.86	2.09

Table of Non-Door/Span Weir Motion Based on Overflow Discharge of Simongan Weir with Simulation Using HEC-RAS Software

4. Conclusion

Based on the analysis with the HEC-RAS software on the West Flood Canal Motion Weir that has been carried out with the formulation of the problem in this study,

1. The operation of the door/span must comply with the following operating regulations:
   - In the door/span operation method, the role of the door/span operator is needed in carrying out and understanding their duties and authorities properly. The door/span operator must obtain hydrological information, especially flood information about the rapid increase in flood discharge from the Simongan Dam.
   - Maximum spill height above the rubber weir threshold is 50 cm

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- The order of operation of the weir door (inflate / inflate)
  This process is carried out by closing doors 2 and 3 first and then closing doors 1 and 4. The purpose of the operation is so that river water can flow straight downstream, so as not to cause scouring on the river bank.
- Open the weir door (deflate / deflate)
  This process is carried out by opening door 1 and door 2 first and then proceeding to open doors 2 and 3. The purpose of opening the door carried out in this sequence is the same as the door closing process, namely so that the river water flow can flow straight downstream so as not to cause scour on the river. river bank.

2. Simulation of door openings using the HEC RAS program, with an experiment for each scenario, carried out with a 2.0 meter high door opening experiment.
   a) Scenario 1 (Siaga I/Ready), simulated door opening/span using Qmax 220.71 m3/second, with the result without door opening/span, water level elevation in the weir = 2.22 meters and water level elevation upstream of the weir = 2.26 meters, and results with a door opening/span as high as 2.0 meters, the water level at the motion dam = -0.41 meters elevation, upstream water level = 0.34 elevation. So in scenario I (Standby/Ready) it is enough with 1 (one) door opening/span.
   b) Scenario II (Siaga II/Siaga), simulation of door opening/span using Qmax 339.81 m3/second, with the result that without a door opening/span, water level elevation in the weir = 2.46 meters and water level elevation upstream of the weir = 2.52 meters, the results with an opening of 1 door/span as high as 2.0 meters, the water level in the mobile weir = -0.22 meters elevation, upstream water level = 0.79 meters elevation, the result with 2 doors/span openings as high as 2.0 meters water level in the motion dam = -0.22 meters elevation, water level upstream = 0.79 meters elevation. So in scenario II (Standby II/Standby) it is enough with 1 (one) door opening/span.
   c) Scenario III (Siaga III/Awas), simulation of door opening/span using Qmax 786.68 m3/second, with the result without door opening/span, water level elevation in the weir = 3.12 meters and water level elevation upstream of the weir = 3.30 meters, the results with an opening of 1 door/span as high as 2.0 meters, the water level in the mobile weir = 2.49 meters elevation, upstream water level = 2.82 meters elevation, the result with 2 door openings/span as high as 2.0 meters water level in the mobile weir = 1.90 meters elevation, water level upstream = 2.44 meters elevation, results with 3 door openings/span as high as 2.0 meters water level in the dam = 1.35 meters elevation, upstream water level = 2.21 meters elevation, and results with 4 doors/span openings as high as 2.0 meters water level at motion dam = 0.86 meters elevation, upstream water level = 2.09 meters elevation. So in scenario III (Siaga III/Awas) 4 (four) door/span openings are needed.
3. If there is a flood discharge above the planned discharge, the water will be controlled at the Jatibarang weir and the water will be released after the rain is over.

5. Suggestion

Based on the analysis of hydraulic calculations with simulations using the HEC-RAS software, which was carried out according to the problem formulation in this study, the following are suggested:

1. The need for periodic maintenance for the door/span so that the discharge issued is maintained and the output is maintained and so that the damage that occurs is known.
2. Sediment dredging and cleaning of floating waste that is upstream and downstream of the dam on a regular basis.
3. Operation and maintenance of inlet gates (flape gates) upstream from sedimentation and garbage.
4. The maintenance and care of the tools and equipment supporting the motion weir is carried out properly.
5. Maintenance and maintenance of the drenase door in the West Flood Canal

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