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THE RELATIONSHIP OF GROYNE PLACEMENT AT THE RIVER BEND WITH THE SEDIMENTATION ACCUMULATIONS

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ABSTRACT

A Good of groyne placement on the curve channel were the lower of flow water on near groyne. This condition will occur the sedimentation field. This research having a goal to development the relationship of groyne placement at the curve channel with sediment field accumulation occurred, so that this research will be done by modeling of groyne placement using mathematical modeling approach by finite different method. Research modeling has been simulation many case of groyne placement applied to the curve channel where the radius bend equal 40 m and 30 m. The research performed 288 times simulation to the many case of groyne placement on the river bend. Many case of groyne placement on the curve channel were combinations of two various of the radius bend, three various the groyne position and three various of groyne length. On each of them be simulated used 4 various of the flow velocities and 4 various of the sediment suspended concentrations. The resulting simulation many case of groyne placement will be analyzed bring in the relationship of the effect groyne placement at the curve channel to sediment accumulation occurred.

Keyword: groyne placement, mathematical modeling, sedimentation.

1. INTRODUCTION

The groyne placement problem, get researched by Suharjoko 2001 [1], Jungseok, 2005 [2], Heereveld (2006) [3], Prohaska (2007) [4], Duan (2006) [5], Zhang (2007) [6], Armani (2010) [7], Zhang, Mizutani and Nakagawa (2011) [8], Suharjoko 2012 [9], 2012[10] and 2014 [11].

On the issues of concerning the groyne placement, has been studied as follows; Suharjoko 1999 [1] and 2001 [2], had researches a good angle of grayne on a straight channel, Jungseok, 2005 [3], that research has carried out the distance between groyne used Numerical Modeling to single permeability Groyne on rectangular channel (CFD) Flow-3D Software. Suharjoko (2012) [10], had researched of the relationship of Groyne Placement at the Curve channel based on Flow analysis.

While Heereveld (2006) [4], built the groyne river with consider the contradictive assertions such as the reduction of the riverbed velocities and an increase fairway on the top. Duan 2006 [6], developed applications of numerical hydrodynamics modeling to get the sediment concentration distribution around groyne. The model has been applied in the field of case studies focusing on the confluence of Kankakee and Iroquois, Illinois, USA, to simulate suspended sediment concentration distribution around the groyne.

Zhang (2007) [7], this study investigates the flow and process of riverbed change at a river rehabilitation projects by using physical model and mathematical model. Prohaska (2007) [5], results showed that conservative methods to determine erosion and to control erosion around groyne. The analysis gives the effective value of the critical erosions hear stress to be smaller than the average value of the assent shear stress. Armanini, 2010 [8], doing analysis experiment results of research with physical models in problems of scouring and deposits around groyne.

The research mentioned has been applied to simulate the currents flow pattern around groyne and to get shown the distribution of sedimentation concentration on the groyne field. But there has been no research to get the relationship of the groyne placement on the curve channel with the Sediment accumulation be occurred. So that's this paper will be shown the relationship of the groyne placement on the curve channel parameters with the sedimentation field volume.

To get the relationship, be done 288 times simulation of the groyne placement case. Many case of groyne placement were combinations of *two* various of the radius bend, three various the groyne position and three various of groyne length. On each of them be simulated used 4 various of the flow velocities and 4 various of the sediment suspended concentrations.

The resulting simulation many case of groyne placement will be analyzed bring in the relationship of the effect groyne placement at the curve channel to the sedimentation accumulation be yielded on groyne field.

2. METHODS

A. The relationship of Groyne placement

The parameterswere caused of sediment accumulation around groyne field were Groyne position, groyne length, angle bend of the river, radius of curve channel, flow water, sediment concentrations.

The relationship of parameters there were caused sediment accumulation around groyne field shown in Figure-1 below:

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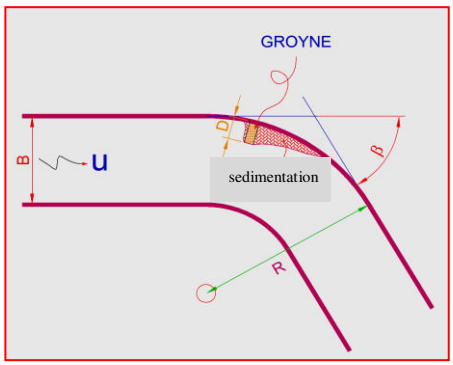

Figure-1. The parameters that influent to the sediment accumulation around groyne field.

a. Morphology factor

B : River with,
R : Radius Bend,
β : Angle Bend

b. Hydrology and hydrometry factor

u : Flow Velocities
h : Water depth
ρ : density of water
ν : Viscocty, degree of fluidity in a fluid

c. Suspended load

C: sediment concentration, mg/ltr
d_{50} grain diameter,
ρs Mass density of sediment,

d. Groyne placement factor

: Position of Groyne,
L : Lengt of Groyne,
α : in this recearch $\alpha = 90^0$

From the description above, the relationship between that's parameters can be expressed mathematically as follows;

$Vol = f(B, R, D, \beta, \alpha, u, h, \nu, C, d_{50}, \gamma, \rho, t)_{\text{Case, various}}$

To get this studied be expressed generality, be solved with non-dimensional analysis by Stepwise Method, Yuwono 1994 [12]. That was the parameters relationships become non-dimensional by elimination of each parameters stage by stage, yield non-dimension parameters relationship as follows:

$$\theta = \left(\frac{Vol}{h^3}, \frac{B}{h}, \frac{R}{h}, \frac{D}{h}, \frac{\rho_S}{\rho}, \frac{\upsilon}{uh}, \frac{gh}{u^2}, \frac{d_{50}}{h}, \frac{ut}{h}, \frac{C}{\rho}, tg\beta\right) \text{ or}$$

$$\theta = \left(\frac{Vol}{h^3}, \frac{B}{h}, \frac{R}{h}, \frac{D}{h}, \frac{\rho_S}{\rho}, \frac{\upsilon}{uh}, \frac{d_{50}}{h}, \frac{ut}{h}, \frac{C}{\rho}, Fr, tg\beta\right)$$

Where Fr. as Froude Number, that is $Fr = u/\sqrt{gh}$ from the non-dimension parameters relationship can be arranged model formulations of the sedimentation accumulation as follow:

$$\frac{Vol}{t} \approx \frac{BRD}{10000} \frac{C\upsilon}{\rho_S d_{50}^2} tg(\beta) Fr;$$

this relationship can be created the equations while put it value of C_{vol} as follow:

$$\frac{Vol}{t} = C_{vol} \frac{BRD}{10000} \frac{C\upsilon}{\rho_S d_{50}^2} tg(\beta) Fr \left(m^3/dt\right)$$

This equation can be rewrite

$$\frac{d(Vol)}{dt} = C_{vol} \frac{BRD}{10000} \frac{C\upsilon}{\rho_S d_{50}^2} tg(\beta) Fr \left(m^3/dt\right)$$

From this equation the important analysis is find out the value C_{vol}. To get on this study a simulation of the various cases is passed as proposed below.

To solved modeling groyne placement would be simulation many cases of groyne placement using mathematical modeling.

B. Mathematical models of hydrodinamics

The mathematical models of hydrodynamics in two dimensions on Horizontal Flow that were built of from the Conservation equations, continuity equations and sedimentation equations, numerical resolving with the characteristic compatible method by Triatmadja (1990) [11]. Numerical programming has been built by Suharjoko (1999) revised [1] by using the Visual Basic program and post-program be solve by the Surfer program, CorelDraw program, Auto CAD program and Excel program.

C. Case research be purposed

As previously described for the relationship of an effect groyne placement on the curve channel to the sediment accumulation around groyne field that occurs, will be analysis based on the result of simulation from any case and any various of flow parameters. The purposed of Case Research were carried out from combinations of various groyne placement, flows parameters and sedimentations parameters also the radius bend.

The research done 288 times simulation to the groyne placement on the river bend. The eighteen case had case code that were combinations of two various of the radius bend, three various the groyne position and three various of groyne length. On each of them be simulated used 4 various of the flow velocities and 4 various of the sediment suspended concentrations.

3. RESULTS AND DISCUSSIONS

A. Groyne Lengt's and placement

There are three variationspositions of groyne placement be purposed, that's thePosition-1 on the upstream arc bends, and Position-2in¼upstreamarccurves andPosition-3 in the middle of the arc bends. Every positions will be simulated tree various Lengt of Groyne (L), that's various-1 is L/B equal 1/5, various-2 is L/B equal 1/3 and various-3 is L/B equal ½.

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B. Various of times simulations

The groyne size L/B that's various-1 is *L/B* equal 1/5, various-2 is *L/B* equal 1/3 and various-3 is *L/B* equal ½. And groyne placement be purposed, there arePosition1 is on the upstream of the arc curve bend, Position 2in¼upstreamof the arc curve bend andPosition3 is in the middle of the arc curve bend.

Variations of velocity running are u=0.8 m/s, u=1.0 m/s, u=1.2 m/s and u=1.4 m/s, and variations of sediment concentration variations are C=25 mg/ltr, C=50 mg/ltr, C=75 mg/ltr and C=100 mg/ltr.

So that the time simulations is 3 x 3 x 4 x 4 = 144 times for the radius bend 30 m. and 144 times for the radius bend 40 m, all of them 288 times

C. Simulations result and analysis result

From any simulations be obtained the important parameters, which are the sediment accumulations occurred on groyne field. The 144 times simulation yield to any groyne layout case for the cahnnel on radius bend 30 m. be tabulating and calculating the *Vol/t, Fr* and C_{vol} using equation below as presented in Tables 1, 2 and 3 below, further the any data *Fr* and C_{vol} be analysis using the regression analysis method had solved the relationship of Fr. And C_{vol} for each value of groyne size L/B of any groyne positions.

$$Fr = u \Big/ \sqrt{gh}$$

$$C_{vol} = \frac{\frac{Vol}{t}}{\frac{BRL}{10000}\frac{C\upsilon}{\rho d_{50}^2} tg(\beta) Fr}$$

Then the result of the simulations is the relationship of the value Fr between C vol are had a result in Figure-3(a, b, c) for the cahnnel on radius bend 30 m.

Then, the review results of the simulations on the curve channel on radius bend is R=30 m, the relationship of the value Fr between Cvol are had a result in Figure-2(a, b, c).

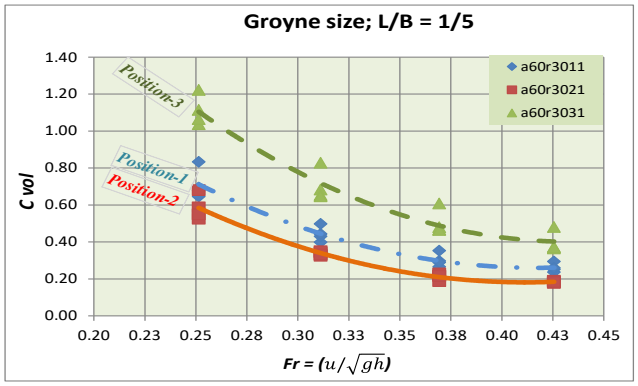

Figure-2(a). The relationship of the value Fr between Cvol of any positions for the groyne size L/B=1/5on the curve channel, radius bend is R=30 m.

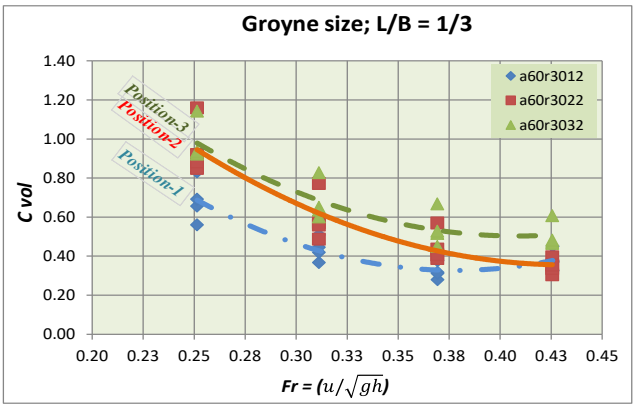

Figure-2(b). The relationship of the value Fr between Cvol of any positions for the groyne size L/B=1/3on the curve channel, radius bend is R=30 m.

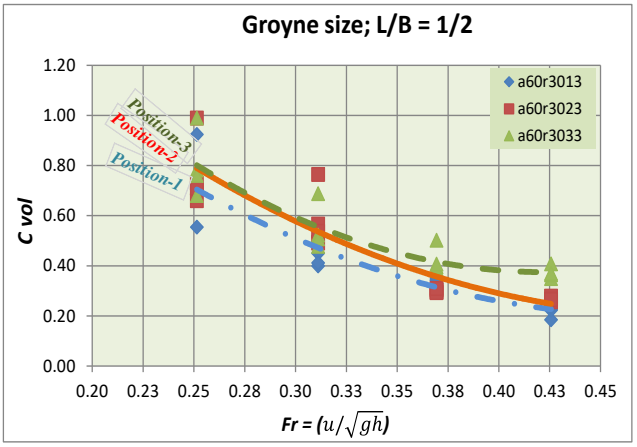

Figure-2(c). The relationship of the value Fr between Cvol of any positions for the groyne size L/B=1/2on the curve channel, radius bend is R=30 m.

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Table-1. Analysis of simulation results in case groyne number a60r30-1, with variations in velocity and sediment concentration variations for the groyne size L/B = 1/5 on the curve channel, who' s radius bend is R=30 m.

Groyne size; L/B = 1/5

Case Code	Data and simulation result											Data Analisis					
	α	r	B	L	h	$h_{manning}$	U	C sus	haur	vol	Vol/T	$\frac{BRD}{10000}$	$tg(\beta)$	$\frac{\nu}{d_{50}^2}\frac{C}{\rho}$	Fr	Vol/T	Cvol
Groyne Position-1																	
a60r3011	60	30	20	4	1.187	1.032	0.80	25	1	0.304	0.304	0.24	0.577	10.482	0.251	0.365	0.833
a60r3011	60	30	20	4	1.187	1.032	0.80	50	1	0.472	0.472	0.24	0.577	20.964	0.251	0.730	0.646
a60r3011	60	30	20	4	1.187	1.032	0.80	75	1	0.742	0.742	0.24	0.577	31.447	0.251	1.096	0.677
a60r3011	60	30	20	4	1.187	1.032	0.80	100	1	1.013	1.013	0.24	0.577	41.929	0.251	1.461	0.694
a60r3011	60	30	20	4	1.211	1.053	1.00	25	1	0.225	0.225	0.24	0.577	10.482	0.311	0.452	0.498
a60r3011	60	30	20	4	1.211	1.053	1.00	50	1	0.360	0.360	0.24	0.577	20.964	0.311	0.904	0.398
a60r3011	60	30	20	4	1.211	1.053	1.00	75	1	0.583	0.583	0.24	0.577	31.447	0.311	1.356	0.430
a60r3011	60	30	20	4	1.211	1.053	1.00	100	1	0.801	0.801	0.24	0.577	41.929	0.311	1.808	0.443
a60r3011	60	30	20	4	1.238	1.077	1.20	25	1	0.189	0.189	0.24	0.577	10.482	0.369	0.536	0.352
a60r3011	60	30	20	4	1.238	1.077	1.20	50	1	0.284	0.284	0.24	0.577	20.964	0.369	1.073	0.265
a60r3011	60	30	20	4	1.238	1.077	1.20	75	1	0.477	0.477	0.24	0.577	31.447	0.369	1.609	0.296
a60r3011	60	30	20	4	1.238	1.077	1.20	100	1	0.621	0.621	0.24	0.577	41.929	0.369	2.145	0.289
a60r3011	60	30	20	4	1.269	1.103	1.40	25	1	0.182	0.182	0.24	0.577	10.482	0.426	0.618	0.294
a60r3011	60	30	20	4	1.269	1.103	1.40	50	1	0.292	0.292	0.24	0.577	20.964	0.426	1.236	0.236
a60r3011	60	30	20	4	1.269	1.103	1.40	75	1	0.466	0.466	0.24	0.577	31.447	0.426	1.854	0.251
a60r3011	60	30	20	4	1.269	1.103	1.40	100	1	0.641	0.641	0.24	0.577	41.929	0.426	2.472	0.259
Groyne Position-2																	
a60r3021	60	30	20	4	1.187	1.032	0.80	25	1	0.248	0.248	0.24	0.577	10.482	0.251	0.365	0.680
a60r3021	60	30	20	4	1.187	1.032	0.80	50	1	0.383	0.383	0.24	0.577	20.964	0.251	0.730	0.525
a60r3021	60	30	20	4	1.187	1.032	0.80	75	1	0.643	0.643	0.24	0.577	31.447	0.251	1.096	0.587
a60r3021	60	30	20	4	1.187	1.032	0.80	100	1	0.803	0.803	0.24	0.577	41.929	0.251	1.461	0.550
a60r3021	60	30	20	4	1.211	1.053	1.00	25	1	0.155	0.155	0.24	0.577	10.482	0.311	0.452	0.343
a60r3021	60	30	20	4	1.211	1.053	1.00	50	1	0.293	0.293	0.24	0.577	20.964	0.311	0.904	0.325
a60r3021	60	30	20	4	1.211	1.053	1.00	75	1	0.473	0.473	0.24	0.577	31.447	0.311	1.356	0.349
a60r3021	60	30	20	4	1.211	1.053	1.00	100	1	0.599	0.599	0.24	0.577	41.929	0.311	1.808	0.332
a60r3021	60	30	20	4	1.238	1.077	1.20	25	1	0.101	0.101	0.24	0.577	10.482	0.369	0.536	0.188
a60r3021	60	30	20	4	1.238	1.077	1.20	50	1	0.247	0.247	0.24	0.577	20.964	0.369	1.073	0.230
a60r3021	60	30	20	4	1.238	1.077	1.20	75	1	0.351	0.351	0.24	0.577	31.447	0.369	1.609	0.218
a60r3021	60	30	20	4	1.238	1.077	1.20	100	1	0.463	0.463	0.24	0.577	41.929	0.369	2.145	0.216
a60r3021	60	30	20	4	1.269	1.103	1.40	25	1	0.110	0.110	0.24	0.577	10.482	0.426	0.618	0.178
a60r3021	60	30	20	4	1.269	1.103	1.40	50	1	0.234	0.234	0.24	0.577	20.964	0.426	1.236	0.189
a60r3021	60	30	20	4	1.269	1.103	1.40	75	1	0.340	0.340	0.24	0.577	31.447	0.426	1.854	0.183
a60r3021	60	30	20	4	1.269	1.103	1.40	100	1	0.452	0.452	0.24	0.577	41.929	0.426	2.472	0.183
Groyne Position-3																	
a60r3031	60	30	20	4	1.187	1.032	0.80	25	1	0.446	0.446	0.24	0.577	10.482	0.251	0.365	1.222
a60r3031	60	30	20	4	1.187	1.032	0.80	50	1	0.814	0.814	0.24	0.577	20.964	0.251	0.730	1.114
a60r3031	60	30	20	4	1.187	1.032	0.80	75	1	1.136	1.136	0.24	0.577	31.447	0.251	1.096	1.037
a60r3031	60	30	20	4	1.187	1.032	0.80	100	1	1.555	1.555	0.24	0.577	41.929	0.251	1.461	1.065
a60r3031	60	30	20	4	1.211	1.053	1.00	25	1	0.374	0.374	0.24	0.577	10.482	0.311	0.452	0.829
a60r3031	60	30	20	4	1.211	1.053	1.00	50	1	0.617	0.617	0.24	0.577	20.964	0.311	0.904	0.683
a60r3031	60	30	20	4	1.211	1.053	1.00	75	1	0.886	0.886	0.24	0.577	31.447	0.311	1.356	0.653
a60r3031	60	30	20	4	1.211	1.053	1.00	100	1	1.168	1.168	0.24	0.577	41.929	0.311	1.808	0.646
a60r3031	60	30	20	4	1.238	1.077	1.20	25	1	0.326	0.326	0.24	0.577	10.482	0.369	0.536	0.607
a60r3031	60	30	20	4	1.238	1.077	1.20	50	1	0.515	0.515	0.24	0.577	20.964	0.369	1.073	0.480
a60r3031	60	30	20	4	1.238	1.077	1.20	75	1	0.751	0.751	0.24	0.577	31.447	0.369	1.609	0.467
a60r3031	60	30	20	4	1.238	1.077	1.20	100	1	0.997	0.997	0.24	0.577	41.929	0.369	2.145	0.465
a60r3031	60	30	20	4	1.269	1.103	1.40	25	1	0.297	0.297	0.24	0.577	10.482	0.426	0.618	0.481
a60r3031	60	30	20	4	1.269	1.103	1.40	50	1	0.450	0.450	0.24	0.577	20.964	0.426	1.236	0.364
a60r3031	60	30	20	4	1.269	1.103	1.40	75	1	0.691	0.691	0.24	0.577	31.447	0.426	1.854	0.373
a60r3031	60	30	20	4	1.269	1.103	1.40	100	1	0.916	0.916	0.24	0.577	41.929	0.426	2.472	0.371

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Table-2. Analysis of simulation results in case groyne number a60r30-2, with variations in velocity and sediment concentration variations for the groyne size L/B = 1/3 on the curve channel, who' s radius bend is R=30 m.

Groyne size; L/B = 1/3

Case Code	Data and simulation result											Data Analisis					
	α	r	B	L	h	$h_{manning}$	U	C sus	haur	vol	Vol/T	$\frac{BRD}{10000}$	$tg(\beta)$	$\frac{v}{d_{50}^2}\frac{C}{\rho}$	Fr	Vol/T	Cvol
Groyne Position-1																	
a60r3012	60	30	20	6.67	1.187	1.032	0.80	25	1	0.506	0.506	0.40	0.577	10.482	0.251	0.609	0.831
a60r3012	60	30	20	6.67	1.187	1.032	0.80	50	1	0.682	0.682	0.40	0.577	20.964	0.251	1.217	0.560
a60r3012	60	30	20	6.67	1.187	1.032	0.80	75	1	1.199	1.199	0.40	0.577	31.447	0.251	1.826	0.657
a60r3012	60	30	20	6.67	1.187	1.032	0.80	100	1	1.683	1.683	0.40	0.577	41.929	0.251	2.435	0.691
a60r3012	60	30	20	6.67	1.211	1.053	1.00	25	1	0.383	0.383	0.40	0.577	10.482	0.311	0.753	0.509
a60r3012	60	30	20	6.67	1.211	1.053	1.00	50	1	0.553	0.553	0.40	0.577	20.964	0.311	1.506	0.367
a60r3012	60	30	20	6.67	1.211	1.053	1.00	75	1	0.947	0.947	0.40	0.577	31.447	0.311	2.260	0.419
a60r3012	60	30	20	6.67	1.211	1.053	1.00	100	1	1.343	1.343	0.40	0.577	41.929	0.311	3.013	0.446
a60r3012	60	30	20	6.67	1.237	1.076	1.20	25	1	0.337	0.337	0.40	0.577	10.482	0.369	0.894	0.376
a60r3012	60	30	20	6.67	1.237	1.076	1.20	50	1	0.500	0.500	0.40	0.577	20.964	0.369	1.788	0.280
a60r3012	60	30	20	6.67	1.237	1.076	1.20	75	1	0.850	0.850	0.40	0.577	31.447	0.369	2.682	0.317
a60r3012	60	30	20	6.67	1.237	1.076	1.20	100	1	1.114	1.114	0.40	0.577	41.929	0.369	3.577	0.312
a60r3012	60	30	20	6.67	1.268	1.102	1.40	25	1	0.464	0.464	0.40	0.577	10.482	0.426	1.031	0.451
a60r3012	60	30	20	6.67	1.268	1.102	1.40	50	1	0.671	0.671	0.40	0.577	20.964	0.426	2.061	0.326
a60r3012	60	30	20	6.67	1.268	1.102	1.40	75	1	1.143	1.143	0.40	0.577	31.447	0.426	3.092	0.370
a60r3012	60	30	20	6.67	1.268	1.102	1.40	100	1	1.548	1.548	0.40	0.577	41.929	0.426	4.123	0.375
Groyne Position-2																	
a60r3022	60	30	20	6.67	1.187	1.032	0.80	25	1	0.706	0.706	0.40	0.577	10.482	0.251	0.609	1.159
a60r3022	60	30	20	6.67	1.187	1.032	0.80	50	1	1.120	1.120	0.40	0.577	20.964	0.251	1.217	0.920
a60r3022	60	30	20	6.67	1.187	1.032	0.80	75	1	1.550	1.550	0.40	0.577	31.447	0.251	1.826	0.849
a60r3022	60	30	20	6.67	1.187	1.032	0.80	100	1	2.149	2.149	0.40	0.577	41.929	0.251	2.435	0.883
a60r3022	60	30	20	6.67	1.211	1.053	1.00	25	1	0.581	0.581	0.40	0.577	10.482	0.311	0.753	0.772
a60r3022	60	30	20	6.67	1.211	1.053	1.00	50	1	0.734	0.734	0.40	0.577	20.964	0.311	1.506	0.488
a60r3022	60	30	20	6.67	1.211	1.053	1.00	75	1	1.291	1.291	0.40	0.577	31.447	0.311	2.259	0.571
a60r3022	60	30	20	6.67	1.211	1.053	1.00	100	1	1.683	1.683	0.40	0.577	41.929	0.311	3.013	0.559
a60r3022	60	30	20	6.67	1.238	1.077	1.20	25	1	0.509	0.509	0.40	0.577	10.482	0.369	0.894	0.570
a60r3022	60	30	20	6.67	1.238	1.077	1.20	50	1	0.693	0.693	0.40	0.577	20.964	0.369	1.788	0.388
a60r3022	60	30	20	6.67	1.238	1.077	1.20	75	1	1.170	1.170	0.40	0.577	31.447	0.369	2.682	0.436
a60r3022	60	30	20	6.67	1.238	1.077	1.20	100	1	1.456	1.456	0.40	0.577	41.929	0.369	3.575	0.407
a60r3022	60	30	20	6.67	1.269	1.103	1.40	25	1	0.409	0.409	0.40	0.577	10.482	0.426	1.030	0.397
a60r3022	60	30	20	6.67	1.269	1.103	1.40	50	1	0.626	0.626	0.40	0.577	20.964	0.426	2.060	0.304
a60r3022	60	30	20	6.67	1.269	1.103	1.40	75	1	1.042	1.042	0.40	0.577	31.447	0.426	3.090	0.337
a60r3022	60	30	20	6.67	1.269	1.103	1.40	100	1	1.462	1.462	0.40	0.577	41.929	0.426	4.120	0.355
Groyne Position-3																	
a60r3032	60	30	20	6.66	1.187	1.032	0.80	25	1	0.695	0.695	0.40	0.577	10.482	0.251	0.608	1.143
a60r3032	60	30	20	6.66	1.187	1.032	0.80	50	1	1.121	1.121	0.40	0.577	20.964	0.251	1.216	0.922
a60r3032	60	30	20	6.66	1.187	1.032	0.80	75	1	1.688	1.688	0.40	0.577	31.447	0.251	1.824	0.926
a60r3032	60	30	20	6.66	1.187	1.032	0.80	100	1	2.277	2.277	0.40	0.577	41.929	0.251	2.432	0.936
a60r3032	60	30	20	6.66	1.211	1.053	1.00	25	1	0.623	0.623	0.40	0.577	10.482	0.311	0.752	0.828
a60r3032	60	30	20	6.66	1.211	1.053	1.00	50	1	0.904	0.904	0.40	0.577	20.964	0.311	1.505	0.600
a60r3032	60	30	20	6.66	1.211	1.053	1.00	75	1	1.467	1.467	0.40	0.577	31.447	0.311	2.257	0.650
a60r3032	60	30	20	6.66	1.211	1.053	1.00	100	1	1.912	1.912	0.40	0.577	41.929	0.311	3.010	0.635
a60r3032	60	30	20	6.66	1.238	1.077	1.20	25	1	0.596	0.596	0.40	0.577	10.482	0.369	0.893	0.667
a60r3032	60	30	20	6.66	1.238	1.077	1.20	50	1	0.803	0.803	0.40	0.577	20.964	0.369	1.786	0.450
a60r3032	60	30	20	6.66	1.238	1.077	1.20	75	1	1.382	1.382	0.40	0.577	31.447	0.369	2.679	0.516
a60r3032	60	30	20	6.66	1.238	1.077	1.20	100	1	1.886	1.886	0.40	0.577	41.929	0.369	3.572	0.528
a60r3032	60	30	20	6.66	1.269	1.103	1.40	25	1	0.625	0.625	0.40	0.577	10.482	0.426	1.029	0.607
a60r3032	60	30	20	6.66	1.269	1.103	1.40	50	1	0.970	0.970	0.40	0.577	20.964	0.426	2.058	0.471
a60r3032	60	30	20	6.66	1.269	1.103	1.40	75	1	1.436	1.436	0.40	0.577	31.447	0.426	3.087	0.465
a60r3032	60	30	20	6.66	1.269	1.103	1.40	100	1	1.982	1.982	0.40	0.577	41.929	0.426	4.116	0.481

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Table-3. Analysis of simulation results in case groyne number a60r30-*3*, with variations in velocity and sediment concentration variations for the groyne size L/B = ½ on the curve channel, who' s radius bend is R=30 m.

Groyne size; L/B = 1/2

Case Code	Data and simulation result											Data Analisis					
	α	r	B	L	h	$h_{manning}$	U	C sus	haur	vol	Vol/T	$\frac{BRD}{10000}$	$tg(\beta)$	$\frac{v}{d_{50}^2}\frac{C}{\rho}$	Fr	Vol/T	Cvol
Groyne Position-1																	
a60r3013	60	30	20	10	1.187	1.032	0.80	25	1	0.844	0.844	0.60	0.577	10.482	0.251	0.913	0.925
a60r3013	60	30	20	10	1.187	1.032	0.80	50	1	1.013	1.013	0.60	0.577	20.964	0.251	1.826	0.555
a60r3013	60	30	20	10	1.187	1.032	0.80	75	1	1.876	1.876	0.60	0.577	31.447	0.251	2.739	0.685
a60r3013	60	30	20	10	1.187	1.032	0.80	100	1	2.507	2.507	0.60	0.577	41.929	0.251	3.652	0.687
a60r3013	60	30	20	10	1.211	1.053	1.00	25	1	0.589	0.589	0.60	0.577	10.482	0.311	1.130	0.521
a60r3013	60	30	20	10	1.211	1.053	1.00	50	1	0.904	0.904	0.60	0.577	20.964	0.311	2.260	0.400
a60r3013	60	30	20	10	1.211	1.053	1.00	75	1	1.526	1.526	0.60	0.577	31.447	0.311	3.389	0.450
a60r3013	60	30	20	10	1.211	1.053	1.00	100	1	1.859	1.859	0.60	0.577	41.929	0.311	4.519	0.411
a60r3013	60	30	20	10	1.238	1.076	1.20	25	1	0.459	0.459	0.60	0.577	10.482	0.369	1.341	0.342
a60r3013	60	30	20	10	1.238	1.076	1.20	50	1	0.882	0.882	0.60	0.577	20.964	0.369	2.682	0.329
a60r3013	60	30	20	10	1.238	1.076	1.20	75	1	1.382	1.382	0.60	0.577	31.447	0.369	4.023	0.344
a60r3013	60	30	20	10	1.238	1.076	1.20	100	1	1.885	1.885	0.60	0.577	41.929	0.369	5.364	0.351
a60r3013	60	30	20	10	1.268	1.102	1.40	25	1	0.351	0.351	0.60	0.577	10.482	0.426	1.546	0.227
a60r3013	60	30	20	10	1.268	1.102	1.40	50	1	0.572	0.572	0.60	0.577	20.964	0.426	3.092	0.185
a60r3013	60	30	20	10	1.268	1.102	1.40	75	1	1.037	1.037	0.60	0.577	31.447	0.426	4.638	0.224
a60r3013	60	30	20	10	1.268	1.102	1.40	100	1	1.456	1.456	0.60	0.577	41.929	0.426	6.183	0.236
Groyne Position-2																	
a60r3023	60	30	20	10	1.187	1.032	0.80	25	1	0.904	0.904	0.60	0.577	10.482	0.251	0.913	0.990
a60r3023	60	30	20	10	1.187	1.032	0.80	50	1	1.206	1.206	0.60	0.577	20.964	0.251	1.826	0.660
a60r3023	60	30	20	10	1.187	1.032	0.80	75	1	1.996	1.996	0.60	0.577	31.447	0.251	2.739	0.729
a60r3023	60	30	20	10	1.187	1.032	0.80	100	1	2.592	2.592	0.60	0.577	41.929	0.251	3.652	0.710
a60r3023	60	30	20	10	1.211	1.053	1.00	25	1	0.864	0.864	0.60	0.577	10.482	0.311	1.130	0.765
a60r3023	60	30	20	10	1.211	1.053	1.00	50	1	1.111	1.111	0.60	0.577	20.964	0.311	2.260	0.492
a60r3023	60	30	20	10	1.211	1.053	1.00	75	1	1.921	1.921	0.60	0.577	31.447	0.311	3.389	0.567
a60r3023	60	30	20	10	1.211	1.053	1.00	100	1	2.428	2.428	0.60	0.577	41.929	0.311	4.519	0.537
a60r3023	60	30	20	10	1.237	1.076	1.20	25	1	0.409	0.409	0.60	0.577	10.482	0.369	1.341	0.305
a60r3023	60	30	20	10	1.237	1.076	1.20	50	1	0.796	0.796	0.60	0.577	20.964	0.369	2.682	0.297
a60r3023	60	30	20	10	1.237	1.076	1.20	75	1	1.179	1.179	0.60	0.577	31.447	0.369	4.024	0.293
a60r3023	60	30	20	10	1.237	1.076	1.20	100	1	1.665	1.665	0.60	0.577	41.929	0.369	5.365	0.310
a60r3023	60	30	20	10	1.268	1.102	1.40	25	1	0.432	0.432	0.60	0.577	10.482	0.426	1.546	0.279
a60r3023	60	30	20	10	1.268	1.102	1.40	50	1	0.794	0.794	0.60	0.577	20.964	0.426	3.092	0.257
a60r3023	60	30	20	10	1.268	1.102	1.40	75	1	1.242	1.242	0.60	0.577	31.447	0.426	4.638	0.268
a60r3023	60	30	20	10	1.268	1.102	1.40	100	1	1.642	1.642	0.60	0.577	41.929	0.426	6.183	0.265
Groyne Position-3																	
a60r3033	60	30	20	10	1.187	1.032	0.80	25	1	0.904	0.904	0.60	0.577	10.482	0.251	0.913	0.990
a60r3033	60	30	20	10	1.187	1.032	0.80	50	1	1.242	1.242	0.60	0.577	20.964	0.251	1.826	0.680
a60r3033	60	30	20	10	1.187	1.032	0.80	75	1	2.144	2.144	0.60	0.577	31.447	0.251	2.739	0.783
a60r3033	60	30	20	10	1.187	1.032	0.80	100	1	2.779	2.779	0.60	0.577	41.929	0.251	3.652	0.761
a60r3033	60	30	20	10	1.211	1.053	1.00	25	1	0.778	0.778	0.60	0.577	10.482	0.311	1.130	0.688
a60r3033	60	30	20	10	1.211	1.053	1.00	50	1	1.080	1.080	0.60	0.577	20.964	0.311	2.260	0.478
a60r3033	60	30	20	10	1.211	1.053	1.00	75	1	1.771	1.771	0.60	0.577	31.447	0.311	3.389	0.523
a60r3033	60	30	20	10	1.211	1.053	1.00	100	1	2.293	2.293	0.60	0.577	41.929	0.311	4.519	0.507
a60r3033	60	30	20	10	1.237	1.076	1.20	25	1	0.673	0.673	0.60	0.577	10.482	0.369	1.341	0.502
a60r3033	60	30	20	10	1.237	1.076	1.20	50	1	1.033	1.033	0.60	0.577	20.964	0.369	2.682	0.385
a60r3033	60	30	20	10	1.237	1.076	1.20	75	1	1.591	1.591	0.60	0.577	31.447	0.369	4.024	0.395
a60r3033	60	30	20	10	1.237	1.076	1.20	100	1	2.183	2.183	0.60	0.577	41.929	0.369	5.365	0.407
a60r3033	60	30	20	10	1.268	1.102	1.40	25	1	0.630	0.630	0.60	0.577	10.482	0.426	1.546	0.408
a60r3033	60	30	20	10	1.268	1.102	1.40	50	1	1.078	1.078	0.60	0.577	20.964	0.426	3.092	0.349
a60r3033	60	30	20	10	1.268	1.102	1.40	75	1	1.688	1.688	0.60	0.577	31.447	0.426	4.638	0.364
a60r3033	60	30	20	10	1.268	1.102	1.40	100	1	2.288	2.288	0.60	0.577	41.929	0.426	6.183	0.370

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In the same way, then the analysis of simulation results for the curve channel on radius bend is R=40 m, the relationship of the value Fr between Cvol had a result in Figure-3(a, b, c).

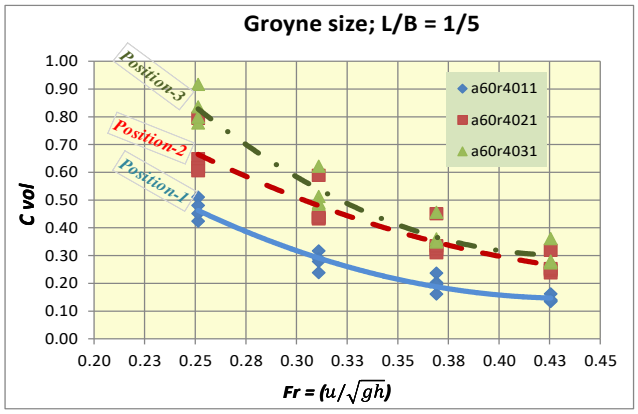

Figure-3(a). The relationship of the value Fr between Cvol of any positions for the groyne size L/B=1/5on the curve channel, radius bend is R=40 m.

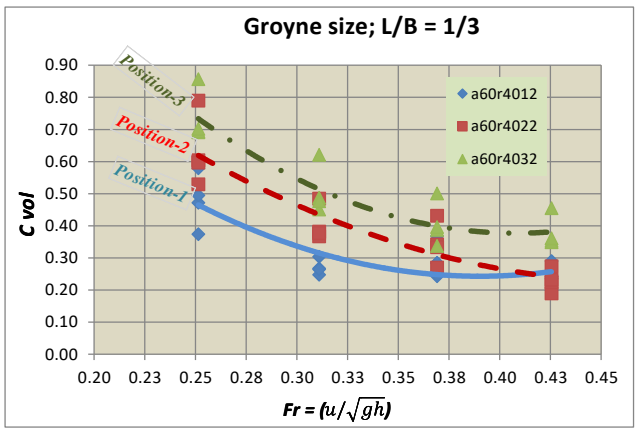

Figure-3(b). The relationship of the value Fr between Cvol of any positions for the groyne size L/B=1/3on the curve channel, radius bend is R=40 m

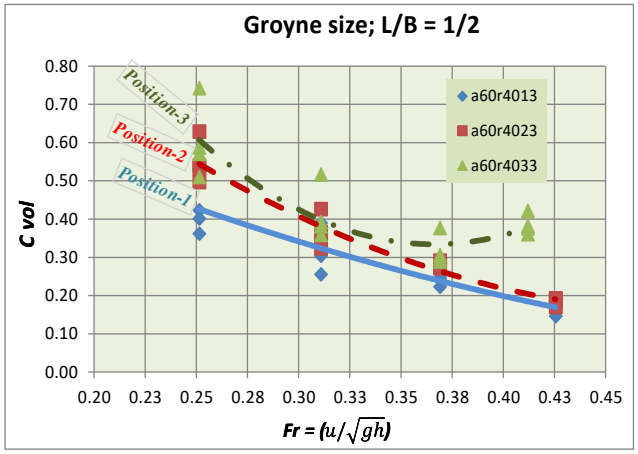

Figure-3(c). The relationship of the value Fr between Cvol of any positions for the groyne size L/B=1/2on the curve channel, who' s radius bend is R=40 m.

4. CONCLUSIONS

The relationship of groyne placement at the curve channel with sediment accumulation occurred, be solved with non-dimensional analysis by stepwise method yield as follow:

$$\frac{Vol}{t} = C_{vol}\frac{BRD}{10000}\frac{C\upsilon}{\rho_S d_{50}^2} tg(\beta) Fr \left(m^3/dt\right)$$

From this equation the important analysis is find out the value C_{vol}. To solve modelling groyne placement can be created would be simulation many case of groyne placement using mathematical modeling approach by finite different method. Research had applied to the curve channel where the radius bend equal 40m and 30 m. The research done 288 times simulation to the groyne placement on the riverbend. Many case of groyne placement on the curve channel were combinations of two various of the radius bend, three various the groyne position and three various of groyne length. On each of them be simulated used 4 various of the flow velocities and 4 various of the sediment suspended concentrations.

The results of simulations yield are the graphics relationship of the value Fr between Cvol of any positions for the groyne case.

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To enrich understanding of sedimentations on groyne field due to placement of groyne on the river bend, need more research to increase variety of groyne placement, angles and radius bend of river studies.

REFERENCES

[1] Suharjoko. 1999. Study on Numerical Modeling of Two-Dimentional Horizontal Flow special case Groyne on the River Estuary, Thesis for the degree of Master Science in Civil Engineering Program, Department of Engineering Science, Post-graduate Program, University Of Gajah Mada, Yogyakatra.

[2] Suharjoko. 2001. Numerical Modeling of Two-Dimentional Horizontal Flow on Groyne Field due to Groyne Placement on the River Straight, Recearches Report. Departemen of Recearch and Aplications, Institute of Technologie Sepuluh Nopember, Surabaya.

[3] Jungseok Ho, Hong Koo Yeo, Julie Coonrod and Won-Sik Ahn. 2005. Numerical modeling study for flow pattern changes induced by single groyne,

©2006-2018 Asian Research Publishing Network (ARPN). All rights reserved.

Seminario Internacional La Hidroinformática en la Gestión Integrada de los Recursos Hídricos, Universidad del Valle/Instituto Cinara Kutija, V. and Murray, M. G. 162.

[4] Heereveld, Zijlstra. 2006. River Groynes for the future innovative groyne design, EU Water Framework Directive, EU Habitats Directive.

[5] Prohaska Sandra. 2007. Thomas Jancke, Bernhard Westrich, Model Based Estimation Of Sediment Erosion In Groyne Fields Along The River Elbe, University of Stuttgart, Institute of Hydraulic Engineering, Stuttgart, Germany.

[6] Duan J.G., Nanda P. 2006. Two-dimensional depth-averaged model simulation of suspended sediment concentration distribution in a groyne field. Journal of Hydrology, Elsevier.

[7] Zhang Hao. 2007. Hajime Nakagawa, Yasunori Muto, Yosio Muramoto, *et al,* Morpho dynamics of Channel with Groins its Applications in River Restoration, Annual of Disas, Prev. Res. Inst. Kyoto Univ. No. 50 B.

[8] Armani A, M. Righety, Sartori F. 2010. Experimental Analysis of Fluvial Groyne, Proc, of River Flow, Brauschweig.

[9] Zhang Hao. 2011. Mizutani and Nakagawa, Impact of Grain Size Distribution on Bed Topography around a Groyne, 34th IAHR worl Congress - Balance and Uncertainty, ISBN 978-0-85825-868-6, Brisbane, Australia.

[10] Thacker, Ben H., Scott W. Doebling, Francois M. Hemez, Mark C. Anderson, Jason E. Pepin, Edward A. Rodriguez. LA-14167-MS, Issued. Concepts of Model Verification and Validation. Edited by Charmian Schaller, Approved for public release; IM-1. Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36, (October 2004).

[11] Triatmadja R. 1990. Numerical and physical studies of Shallow Water Wave with special reference to Lanslate generated Wave and the method of Characteristics. Department of Civil Engineering University of Strathclyde, Glasgow, United Kingdom.

[12] Nur Yuwono. 1994. Hydraulics Modeling, Central of University Association on Engineering Science. University Of Gajah Mada, Yogyakarta.