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Design of River Training Structures in a Tidal Channel

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ABSTRACT: Han river, a major river in south Korea, flows through Seoul metropolitan city and merges with the Imjin river before it flows into the Yellow Sea of Korean Peninsula. The reach of Munbal IC, which locates 30km far from the river mouth, has suffering from the serious scouring at right side of levees. The roads and fences on levees were fallen down due to the scouring. It was concluded that the river training structures at Munbal IC should be designed to satisfy two flows, flood flow and tidal boar flow. This study suggests serial spur dikes and vanes finally. The serial vanes were provided at two points, one is at the beginning point of the island and another is at the end point of the island. The vanes could change the flow path far from right levees and major flow could be developed along left channel of the island. The serial spur dikes were also provided at Munbal IC with right angle. The vanes and spur dikes will be constructed in two years and monitoring program will be performed.

Keywords: Spur dike, Tidal river, Stabilization, Levee erosion

1 INTRODUCTION

The reach of Munbal IC, which locates 30km far from the river mouth, has suffering from the serious scouring at right side of levees. The roads and fences on levees were fallen down due to the scouring. Island in the river is developed near the Munbal IC for the last couple of decades so the river divided by two paths. Bank line intruded more than 60m so levee protection with large boulder was provided around Munbal IC in early of 2000 but to fail again. In this study the reasons of scouring were studied and the river training structures with spur dikes and vanes were designed with numerical simulation and physical hydraulic model.

2 CAUSES OF LEVEE EROSION

2.1 *Geomorphological Conditions*

Han river, a major river in south Korea, flows through Seoul metropolitan city and merges with the Imjin river before it flows into the Yellow Sea of Korean Peninsula. The total length of the river is about 514km and the design flood flow rate is about 37,000m3/s. The width of the lower river ranges from 1km to 2km and the average depth is about 7m to 10m. [1, 2] Pedestrian walkways and levee protection with hard structures are well developed along the river. Tidal effects are very strong at the mouth of the river due to the high difference between the rise and fall of the tide. The adverse flow velocity is about 3m/s when the river subject to tide effects.

2.2 *Suspected Causes*

The bed materials of the lower river consist with silt-sand. The mean diameter of the bed material is less than 0.02mm. It was found that the scouring was caused by both flood flow and tidal flow. The river bends to right with 110 degree angle at Junryu station which is 5km upstream from Munbal IC. The flood flow from upstream hits left levees at Junryu station and deflected to the right side. The flood flow goes through right channel of the middle island and hits right levees at Munbal IC. The upstream ward tidal boar turns to the right with almost 90 degree at the intersection with Imjin river and hits right side of levees at Munbal IC.

3 HYDRAULIC MODELLING

The width of Han river around Munbal IC is about 1500m with deepest depth of 14m. Sand bar in the middle of the river exists with 2m depth at design flood 37000 cms(200year frequency). To keep the minimum depth with 2cm in model [3], 1:100 vertical scale was adopted. Allowable distorted ratio (G) between horizontal and vertical scale is depend on many conditions. [4]

3.1 *Distortion Ratio considering Top Width(T) and Depth(y)*

In according to Kobus() G should be less or equal to 10% of (T/y). Therefore, G≤10 at deepest point and G≤5 at the average depth point.

3.2 *Distortion Ratio considering Relative Roughness(k/y)*

In according to [3] The relation between relative roughness and distortion ratio is (k/y)=1/G3. And in according to [4] roughness height can be estimated with k=26/(d901/6). Since the d90 of bed material is 0.06mm, G≤6.7 and G≤6.2 at deepest point and average depth point, relatively.

3.3 *Scale Limitation in Hydraulic Rough Range*

In according to [3] the relationship between horizontal scale(Lr) and distorted ratio(G) is G=(0.2/(k/y))1/3. Therefore, G≤4 at deepest point and G≤3.6 at the average depth point.

Finally, the value of 4 was adopted as distortion ratio. The adopted horizontal and vertical scale was 1:400 and 1:100, respectively. Fig. 1 shows river model overview from left upstream. Fig. 2 shows placement of adjusted roughness blocks. Spur dikes arrangement and dimensions are shown in Fig. 3.

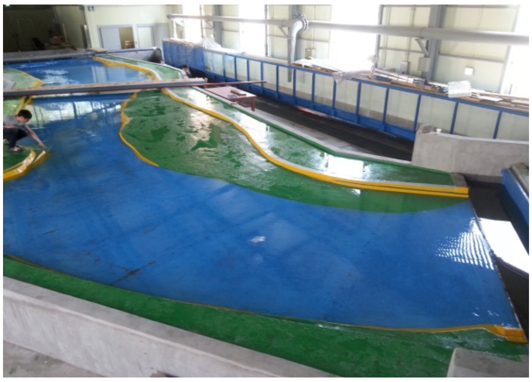

Figure 1. River Model Birdview from Upstream.

Figure 2. Roughness Adjustment with Block Placement.

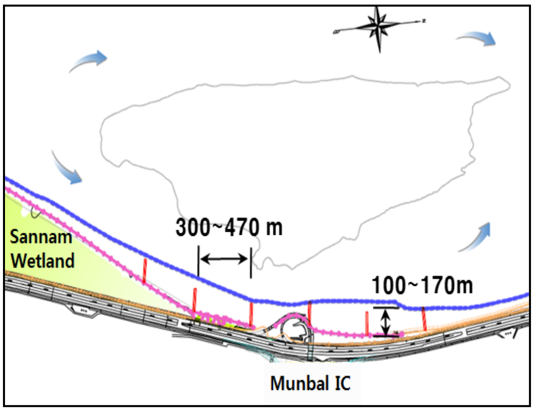

Figure 3. Spur-Dike Arrangement and Dimensions.

4 RESULTS AND CONCLUSIONS

It was found that the scouring was caused by both flood flow and tidal flow. The river bends to right with 110 degree angle at Junryu station which is 5km upstream from Munbal IC. The flood flow from upstream hits left levees at Junryu station and deflected to the right side. The flood flow goes through right channel of the middle island and hits right levees at Munbal IC. The upstream ward tidal boar turns to the right with almost 90 degree at the intersection with Injin river and hits right side of levees at Munbal IC.

It was concluded that the river training structures at Munbal IC should be designed to satisfy two flows, flood flow and tidal boar flow. This study suggests serial spur dikes and vanes finally. The serial vanes were provided at two points, one is at the beginning point of the island and another is at the end point of the island. The vanes could change the flow path far from right levees and major flow could be developed along left channel of the island. The serial spur dikes were also provided at Munbal IC with right angle. The vanes and spur dikes will be constructed in two years and monitoring program will be performed.

ACKNOWLEDGMENT

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