Effect of Narrow Pass on Navigable Channel Characteristics in Braided Stream

○TIN TIN HTWE, Yuji HASEGAWA, Hiroshi TAKEBAYASHI, Masaharu FUJITA

1. INTRODUCTION

Rivers are very complex and dynamic. Braided channels are very unstable channels temporally and have a distinctive river morphology. Hence, bed deformation is very active and it is very difficult to control the bed geometry to keep the navigable flow depth. Fig.1 shows the braided streams with narrow pass sections of the Ayeyarwady River, Myanmar. Narrow pass sections can be formed often in braided rivers and are considered to affect the flow pattern and the navigable flow depth. In this study, braided streams formed in a channel with a stenosis (narrow pass) was reproduced experimentally and effects of narrow pass on navigable channel characteristics in braided stream are discussed.

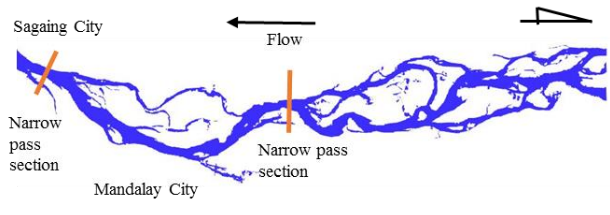

Fig.1. Channel configuration of the Ayeyarwady River

2. LABORATORY EXPERIMENT AND RESULTS

Flume experiments under steady flow condition, without narrow pass case and with narrow pass case were conducted. The rectangular straight open channel flume which is 20 m long and 50 cm wide is used. Two 10 cm x 10 cm timber posts are set at both sides of the flume at 9 m from downstream end as shown in Fig.2. The initial flume bed was filled smoothly with homogeneous anthracite, 0.65 mm in diameter and 1.45 in specific gravity. The same material is supplied from the upstream end in both cases so that the initial bed elevation at the upstream end might not be lowered. The hydraulic condition as shown in Table 1 is located in the formative region of braided streams (Takebayashi et al., 2001).

Bed elevation was measured with a laser instrument in the longitudinal direction of 10 cm interval at the target area (500-1300 cm from the downstream end). Measurements of the bed geometry were taken 6 hr later, where no change was noticed in the channel configurations.

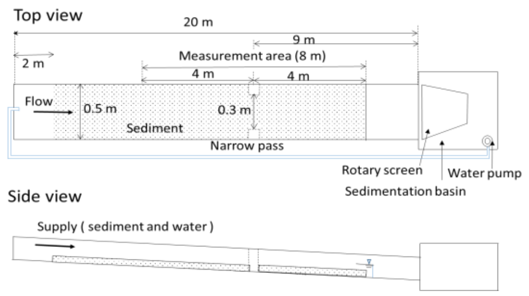

Fig.2. Outline of the experimental flume with narrow pass

Table 1 Hydraulic condition for experiments

Discharge (cm^3/s)	slope	B/d	h/d	τ_*
300	0.005	122.57	6.28	0.07

B: channel width, h: water depth, d: sediment size

The bed elevation contours for both cases after approaching an equilibrium condition of river bed are shown in Fig.3 and Fig.4, respectively. In without narrow pass case, erosion is more predominant. But the erosion depth did not increase with time and some bars are reformed. On the other hand, the deposition occurred in the channel then it was gradually transferred to the upstream. The deposition depth increase with time. Therefore, the depth of the flow becomes deeper and the spatial change in thalweg become lesser.

3. NUMERICAL ANALYSIS AND RESULTS

Horizontal two dimensional flow calculation was conducted to evaluate horizontal distribution of water depth in the experimental flume to clarify the effect of narrow pass on the navigational braided channel.

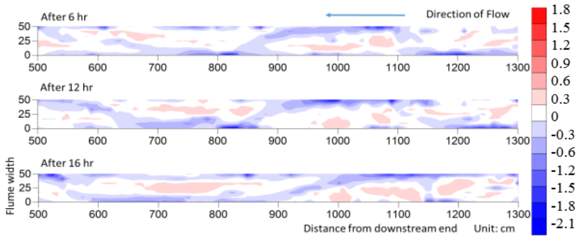

Fig.3. Bed elevation contour in without narrow pass case

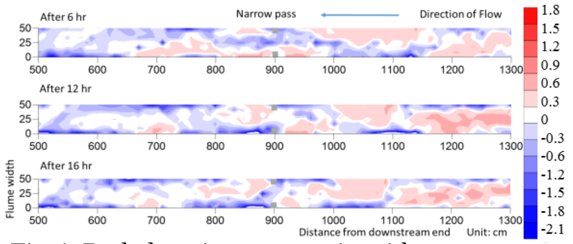

Fig.4. Bed elevation contour in with narrow pass

According to discharge hydrograph of the river, computation are performed under 3 different discharge condition with same initial river bed which is bed geometry after 6 hr from the experiment to check water depth in the small water discharge season.

The computed results on horizontal distribution of water depth and location of thalweg for both cases are shown in Fig.5 and Fig.6, respectively. Fig.7 shows longitudinal profile of water depth. In without narrow pass case, local scour occurred. So, the channel depth becomes deeper only in the local area. It can be seen that the river bed is eroded at 820 cm, 1070 cm and 1200 cm from the downstream end. The water depth becomes zero from 500 cm to 600 cm in the case of discharge (25 cm^3/s). On the other hand, the water depth is deeper than that in without narrow pass case.

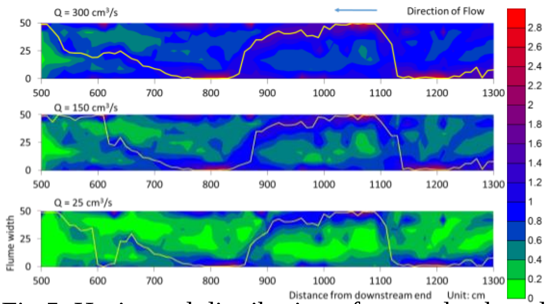

Fig.5. Horizontal distribution of water depth and location of thalweg in without narrow pass case

Therefore, the deep water depth could keep for navigation on braided channel and maintenance of fairway after some years.

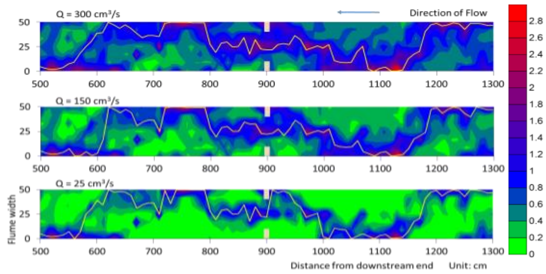

Fig.6. Horizontal distribution of water depth and location of thalweg in with narrow pass case

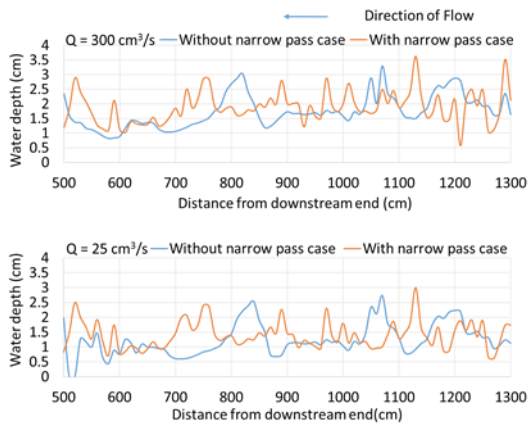

Fig.7. Longitudinal profile of water depth along thalweg

4. CONCLUSION

It is found that the deposition depth increses with time in with narrow pass case. Hence, the water discharge over the deposition areas decreases, because main flow shifted to the troughs. Sediment deposits around bars and the crest of bars on the water surface was protruded. The depth of the channel becomes deeper and the change in thalweg becomes lesser. Therefore, the deep water depth could keep for navigation and maintenance of the fairway after some years. It could be effectively reduced the dredging frequency as much as possible to keep the deep flow depth for the navigation due to the effect of narrow pass.

References:

(1)Takebayashi, H. (2005). River Configuration in Middle-Lower Reach of River Basin.

(2) Takebayashi, H, Egashira, S. and Okabe, T (2001). Stream formation process between confining banks of straight wide channels.