Application of Japanese Traditional Riverbank Protection Systems to Mekong River

Obayashi Corporation JSCE Member ○ SHISHIKURA Tomohiro
JICA (Formerly in Infrastructure Development Institute - Japan, IDI) KANO Toshiyuki
NIKKEN Consultants, Inc. JSCE Member KATO Yasuhiko

1. Introduction

Vientiane – the capital of Lao P. D. R. – is located along the middle reach of the Mekong River and has suffered continually from the threat of bank erosion. Many existing bank protection works with expensive gabion boxes had also been damaged and accordingly more effective and economical protection systems were desired. Under the circumstances, attention has increasingly been paid to Japanese traditional bank protection systems utilizing Fascine ("Soda"). Extensive studies then have been carried out since 1999 with regard to its application to the Mekong River and two pilot projects were implemented in sequence: the one by Infrastructure Development Institute - Japan (hereinafter abbreviated as IDI), followed by the other by Japan International Cooperation Agency (JICA). This paper outlines these 2 studies and touches upon some essential aspects.

2. Bank Erosion in Vientiane

The Mekong River has its width of about 800 m around Vientiane City – Nong Khai Reach, mean flow velocity being approximately 3 m/sec in the rainy season. The water level varies by about 10 m between the dry and the rainy seasons. The bank along this reach consists mainly of upper cohesive (non-erosive) layer and lower loose sandy-gravel (erosive) layer except at some locations. This suggests that the erosion mechanism here could be characterized by undermining of upper cohesive bank and subsequent mass failure as discrete events when a critical instability condition is met. Bank erosion continually hit densely populated Vientiane and the loss of properties, especially serious menace to the oil storage tanks at Ban Dongphosi station, was imminent. In 1990's, the local government executed protection works with foreign assistance. Several reaches however suffered damage within just a couple of years after completion, due possibly to inadequacy in foundation and foot protection. In addition, the gabion boxes used for these works were imported from Thailand and hence relatively expensive. Therefore more effective and economical protection systems were desired.

3. Traditional Riverbank Protection Methods by Fascine ("Soda") Mattress

Riverbank protection techniques applying fascine mattress were introduced by Dutch engineers, e.g. Johannis de Rijke, in the early years of Meiji era and were extensively used for groynes and dyke-foot protection. Fascine mattress has the following distinctive characteristics: i) It is so flexible that it can follow the riverbed topography, thus effective for bank-foot protection; ii) Material is readily available locally since brushwood, twigs and stones are the principal material; iii) It can be fabricated in various sizes according to the site terrain; and iv) it is environment friendly since native plants / stones are used. These suggest that the fascine mattress systems could suit the local conditions where long reach is to be protected and hence large amount of low-cost material should be readily available.

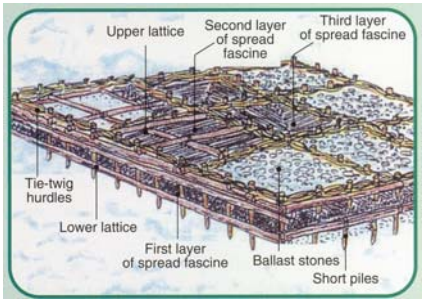

Fig.1 Fascine Mattress

4. Studies and Pilot Projects by IDI and JICA

The goal of a series of studies / pilot projects is to develop suitable and sustainable bank protection systems that, through technology transfer, could be implemented by the local government with her own budgets, materials and labour force.

Table-1 Bank Protection Options in IDI Study

Option	Slope (Bank) Protection	Foot Protection	Length
Option-1	Brush-woven Fence ("Rensai Shigara")	Fascine Mattress	48 m
Option-2	Gabion Box	Fascine Mattress	32 m

Keywords: Riverbank Protection, Fascine Mattress, Bank Erosion, Mekong River, Technology Transfer
Contact Address: Design Department No.2, Civil Engineering Technology Division, Obayashi Corporation
Shinagawa Intercity Tower B, 2-15-2 Konan, Minato-ku, Tokyo 108-8502, Japan, Tel: 81-(0)3-5769-1315

(1) The Pilot Project on Riverbank Protection on the Mekong (Soda-Mattress System) by IDI: IDI started her 3-year study in 1999. The first year was spent for field investigation, based on which several possibilities were successively planned and designed. The pilot protection works were executed in 2000 and subsequent 1 year was assigned for monitoring and evaluation. In principle 2 options shown in Table-1 were designed and implemented, both of which also include fascine mattress groynes.

(2) The Study on Mekong Riverbank Protection around Vientiane Municipality in the Lao People's Democratic Republic by JICA: JICA, in association with the Ministry of Communication, Transport, Post and Construction (MCTPC) of Lao P. D. R. and Vientiane City, has been carrying out further 4-year study. Having been started in 2001, field investigation was made and several options were studied in the first year. Then 3 pilot options (Table-2) were selected and executed at 3 different sites in the subsequent 1.5 years, followed by monitoring / evaluation period. The study ends up with the Master Plan development.

Table-2 Bank Protection Options in JICA Study

Option	Slope (Bank) Protection	Foot Protection	Length
Option-1	Cobble Stone with Willow Branch	Fascine Mattress	643 m
Option-2	Wooden Pile Groyne	Wooden Pile Groyne (+ Fascine Mattress)	240 m
Option-3	Cobble Stone with Willow Branch (lower half only)	Pile Fence (Log Hurdle) + Fascine Mattress	156 m

Fig.2 Fabrication under Supervision of Japanese Soda Expert (Left)

Fig.3 Installation of Fascine Mattress

Fig.4 Cobble Stone with Willow Branch

5. Construction

Fascine materials of good quality were collected from field habitats within 40 km distance from the sites. Rubble stones were transported from a quarry within 40 km distant. All the key activities such as bundling of fascine ("Rensai"), fabrication of fascine mattresses / brush woven fence and execution of cobble stone with willow branch work were made under the supervision of the study teams including a Japanese "Soda" expert. Remarkable contribution was also made by the local engineers having had a traineeship to Japan to master the fabrication skill prior to the start of works. For installation of mattresses and ripraps, locally available heavy equipment e. g. crawler cranes, floating dock barge etc. were utilized although alternatives without them may be possible. The method to be chosen will depend on site conditions, e.g. natural / social environment, ease of construction, cost and schedule.

6. Monitoring

The verification of the applied options is made through a series of monitoring consisting of site inspection, bed topographic survey, flow velocity / river water / groundwater level measurements, vegetation survey, fish swarm proving etc. The main findings are: i) no collapse of bank; ii) sedimentation at the foot of the bank and between groynes; iii) reduction in flow velocity in the vicinity of the bank; and iv) increase in fish swarm, providing local people with a better fishing spot.

7. Conclusion

The studies and pilot projects have been successfully completed. This as well as the results of subsequent monitoring demonstrates the applicability of Japanese traditional bank protection systems to the Mekong River though some issues are still monitored in a much longer sense. Following these studies and the Master Plan, MCTPC and Vientiane City are planning to execute, with their budget, their own bank protection works further downstream. This gives the authors utmost pleasure as the efforts devoted to these studies were towards the ultimate goal.

8. Acknowledgements

The authors gratefully acknowledge the efforts and cooperation for the studies, extended by the Hokuriku Soda Promotive Association and all of many people and parties concerned.