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# PILOT PROJECT FOR RIVERBANK PROTECTION ON THE MEKONG

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MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT, JAPAN  
MINISTRY OF COMMUNICATION, TRANSPORT, POST AND CONSTRUCTION, LAO PEOPLE'S DEMOCRATIC REPUBLIC  
INFRASTRUCTURE DEVELOPMENT INSTITUTE - Japan

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# Background

In the Lao People's Democratic Republic, public property and assets have rapidly become concentrated in the city of Vientiane, and hence there is an urgent need for protection against the threat of the Mekong River. Riverbank protection works with gabion boxes were actively carried out with foreign assistance in the 1990's, and yet some reaches suffered damage within a few years after completion, possibly due to inadequacy of the foundation and foot protection works. The Soda-mattress (Fascine-mattress) system was introduced and developed in Japan in the early years of the Meiji era (1868-1912), and was extensively used for groins and dyke-foot protection. Brushwood, twigs and stones are the principal materials of Soda-mattresses. These materials and relevant equipment are readily available locally within Laos, and so the Soda-mattress system could be a suitable and sustainable method of riverbank protection in Laos.



Notches formed around the foot of the riverbank at the pilot project site (March 2000)

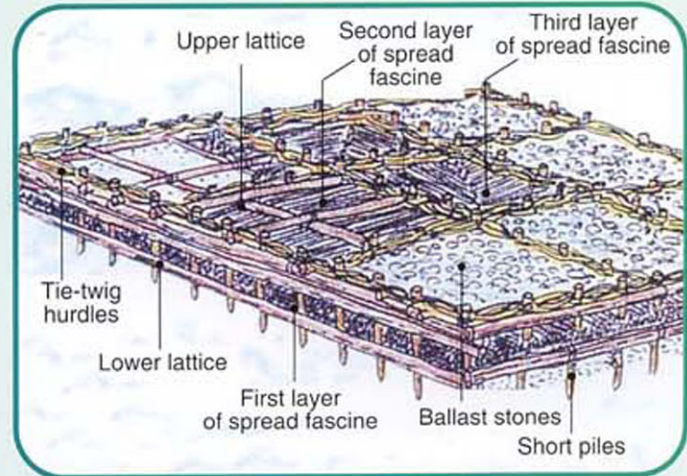




# Soda-mattress

## Distinctive Features of Soda-mattress



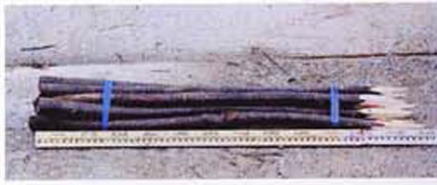

- Soda-mattresses are so flexible that they can change shape and follow the riverbed changes, and are thus effective for riverbank foot protection.
- Materials are readily available locally.
- Soda-mattresses can be fabricated in various sizes according to the site terrain.
- Since native plants and stones are used, Soda-mattresses do not contaminate the natural environment, and their highly porous structure creates habitats for small fish.



Soda-mattress

## Materials for Soda-mattress

The Soda-mattress is primarily assembled with brushwood and twigs of wild growth, and rubble stones. The main materials are 'Soda (Fascine brushwood)', 'Taisha (Tie-twigs)', 'Kogui (Short piles)' and 'Sekizai (Rubble stones)'. Their main features are summarized below.

Main materials	Soda (Fascine brushwood)	Taisha (Tie-twigs)
Properties and Dimensions	Hard and strong tree unit-bundles ø 200mm × L 2.7m	Flexible and tough trees, with small branches thoroughly pruned 25nos × ø 20 ~ 30mm × L 2.7m
Applied members	Upper and lower Lattices Spread matt layers	Shigarakaki fences (Tie-twig hurdles)
Typical Photos		
Main materials	Kogui (Short piles)	Sekizai (Rubble stones)
Properties and Dimensions	Light and strong trees ø 30 ~ 50mm × L 1.2m	Hard and heavy rocks ø 50 ~ 400mm
Applied members	Shigarakaki fence fixation, linking upper and lower Lattices	Weighting ballast
Typical Photos		

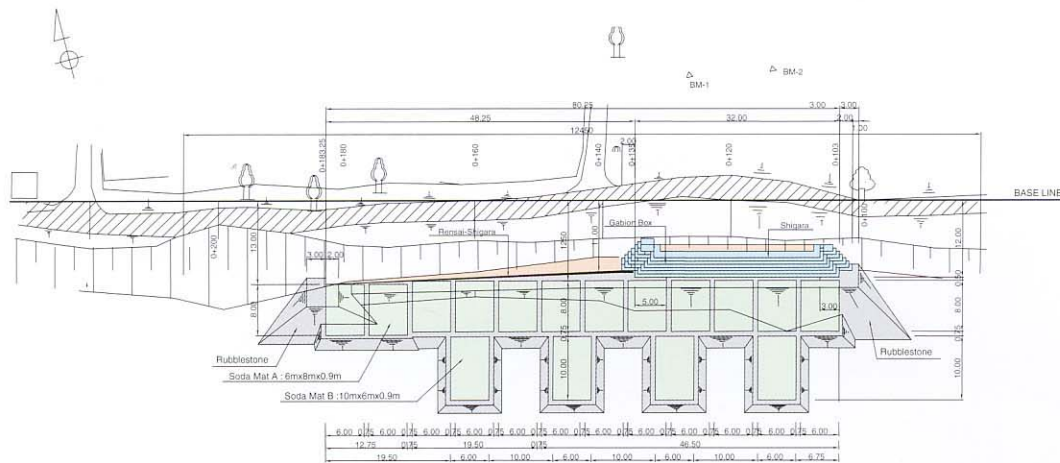


# DESIGN

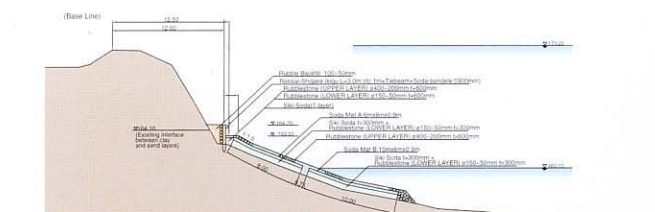


Panoramic View of the Pilot Project  
(March 2001)

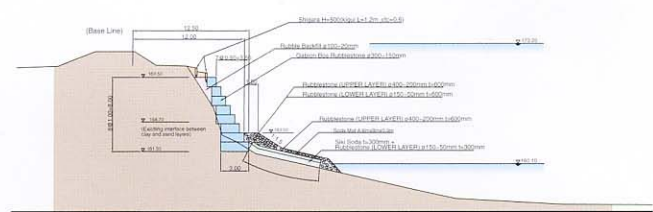
The stratum around the foot of the riverbank at the project site consists of loosely cemented silty-sand and gravel, and hence fine materials are steadily sucked out as a result of navigation waves, effusing groundwater, and running river water. The notches that have already formed will gradually develop and cause the upper solidified silty clay layer to collapse.



Project plan



Cross-sectional view at (0+160)



Cross-sectional view at (0+120)

Various structures are designed and integrated to overcome the problem.

- ① Rensai-shigara, to protect the bank-foot against notchformation due to exfoliation and scouring, and to prevent the collapse of the upper layer.
- ② Gabion-box, to protect the whole bank-slope against weathering, exfoliation, and scouring.
- ③ Foot-protection Soda-mattress, to protect the riverbed immediately in front of the Rensai-shigara and Gabion-box against scouring.
- ④ Groin Soda-mattress, to deflect the flow direction, to reduce the flow velocity, and thus to encourage sedimentation in the vicinity of the bank.



# CONSTRUCTION

## Collecting Soda Materials

Wood materials of good quality were collected from field habitats within a radius of 40km from the project site.

Rubble stones were transported to a temporary shipping yard by dump trucks from a quarry 40km distant.



Habitats of soda materials

## Bundling Fascine

'Rensai (Brushwood bundles)' of L=6.8m and 10.5m were bunched up by tie-twigs on the bundling frame at the temporary assembly yard, located 5km upstream of the site.



Quarry site

## Fabricating Soda-mattress

Soda-mattresses were fabricated under the guidance of a Japanese soda-specialist at the assembly yard.

The team of two Laotian staff and ten workers produced two sets of soda-mattress per day. However, they needed the soda-specialist's assistance a little longer for the Shigarakaki work, which requires advanced skills.



Fascine bundling



Framing lower lattice with bundled fascines



Spreading 3 layers of loose fascine



Linking upper and lower lattices



Half-driving of short piles



Shigarakaki  
(Hurling off with tie-twigs)



Assembled Soda-mattress units



## Installing Soda-mattress

The working yard behind the bank at the project site was severely restricted, making it inconvenient to stack the assembled Soda-mattresses, as well as to operate the relevant equipment.

The Soda-mattresses were installed afloat with a crawler crane, mounted on a floating-dock barge owned by the Vientiane Port Authority, and idly moored alone at the port. The Soda-mattresses were shipped on a material barge from the assembly yard, transported by water, and transshipped on the floating-dock barge at the site.

The groin Soda-mattresses were set in position while afloat, then submerged with H-shaped steel-frame weights, and then rubble stones were piled on top as ballast.

Alternative installation methods that do not require heavy equipment are also possible, such as fabricating and laying into the water at the locations by using either temporary wooden staging or lighter barges with mooring anchors, towing and installing with tugboats, and so forth. The method chosen will depend on the site conditions, that is, natural environment, ease of construction, construction cost and schedule.



Immediately after the pilot construction (March 2001)



Loading Soda-mattress onto the material barge



Final-driving of short piles immediately before the installation of Soda-mattress



Installing foot-protection Soda-mattress in position with a crawler crane, mounted on the floating-dock barge



Placing the H-shaped steel frame weight to submerge the groin Soda-mattress



Loading riprap onto the material barge with a backhoe



Riprapping



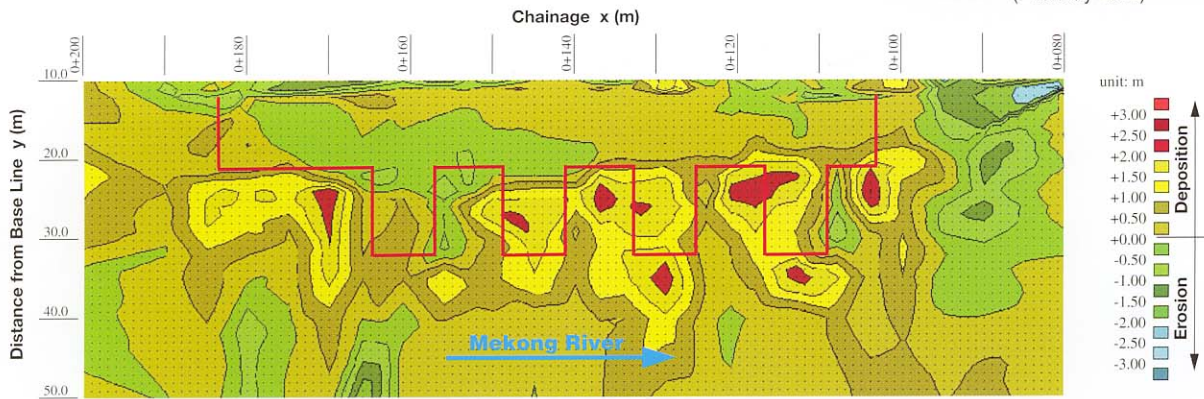
# MONITORING

To verify the effectiveness of the Soda-mattress, various surveys and measurements such as topographic survey, flow velocity measurement, river water level and groundwater level measurement, fish swarm sampling were periodically carried out in both the dry and flood seasons.

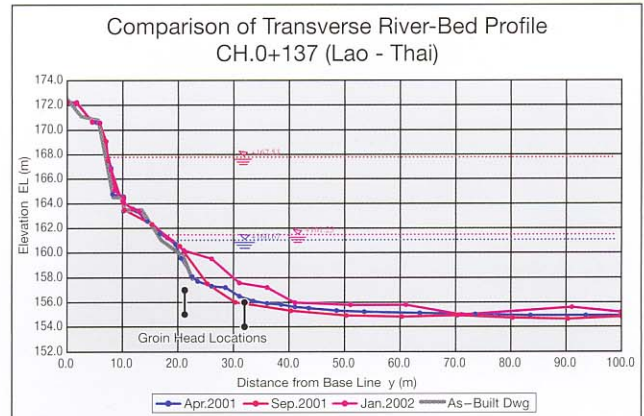
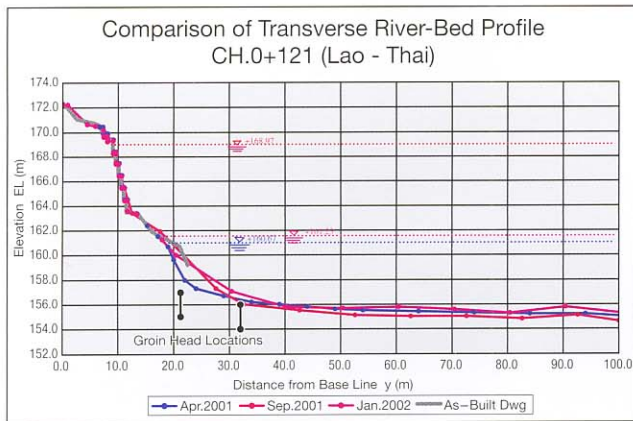
Sedimentation around the foot of the bank and between the groins, neither exfoliation nor collapse of the upper slope at the Rensai-shigara reach, reduction of velocity in the vicinity of the bank, and increase of fish swarm were clearly found eleven months after the pilot construction.



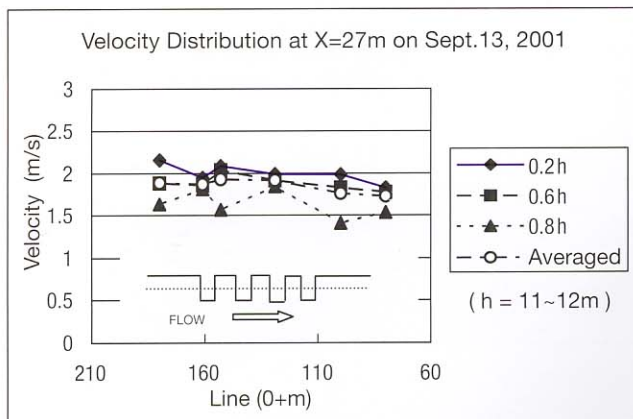
Eleven months after the pilot construction (February 2002)



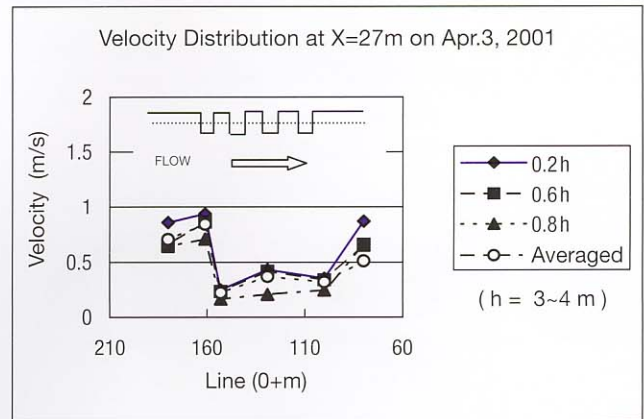
Riverbed Topography: Jan. 2002 vs. Apr. 2001



Riverbed Profile in the Vicinity of Left River Bank



River Flow Velocity Distribution in Flood Season



River Flow Velocity Distribution in Dry Season



*Children gather for fishing and swimming  
near to where the Soda-mattresses were installed.*

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**Pilot Project for Riverbank Protection on the Mekong  
(Soda-mattress System)  
INFRASTRUCTURE DEVELOPMENT INSTITUTE - Japan**

Headquarters: New Kojimachi Bldg., 5-3-23, Kojimachi,  
Chiyoda-ku, Tokyo 102-0083, Japan  
Tel: +81-3-3263-7920 Fax: +81-3-3230-4030  
Url: <http://www.idi.or.jp/> E-mail: [2bu06@idi.or.jp](mailto:2bu06@idi.or.jp)

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