River Bank Protection of Meghna Bridge

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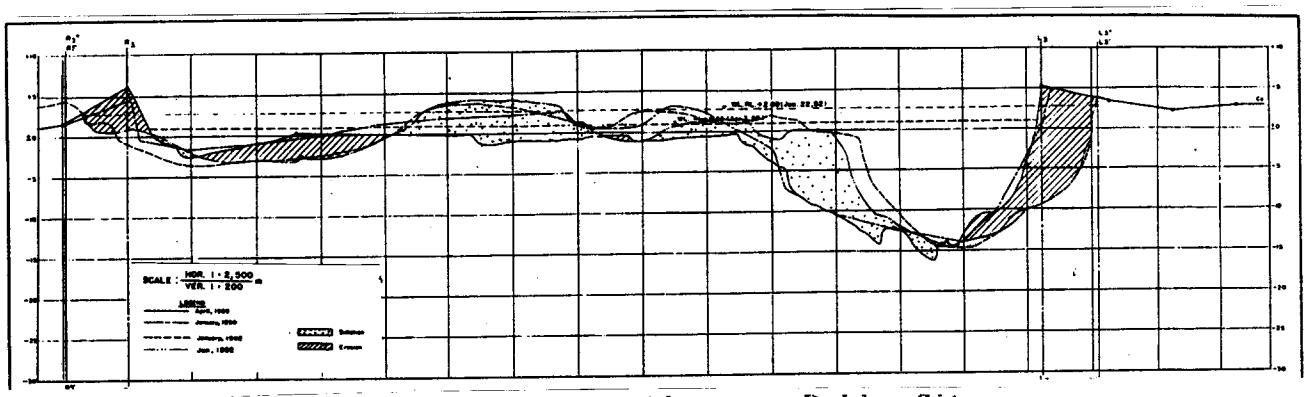
ABSTRACT : A river bank protection work was under taken to overcome the severe erosion problem threatening the Meghna bridge on a major national highway connecting the capital Dhaka with the main port city of Chittagong. The Meghna river system is complex with shifting banks and great scour depths. The design of the protective work comprised of regrading the eroded bank to stable slope placing geotetile and stone rip-rap. This project was first of it's kind in bangladesh and was executed using mostly local equipment and expertise.

INTRODUCTION

Bangladesh is a land of mighty rivers. These rivers are primarily of meandering and braided nature. The bed and bank of these rivers are highly erodible. Bangladesh is expected to have major bank protection and river training works in connection with it's flood control and water resource development activity under Flood Action Plan. River bank protection works similar to one reported in this paper is expected to give some basis for future bank protection and river training works in Bangladesh. Meghna bridge is one of the major bridges along the most important national highway of Bangladesh connecting capital city of Dhaka and the main port at Chittagong. The bridge across Meghna river, is located at 25 km south east of Dhaka city.

RIVER MORPHOLOGY, HYDROLOGY AND HYDRAULICS

Meghna river is one of the 3 major rivers following through Bangladesh and discharging in the Bay of Bengal. Like all other major rivers, Meghna river system is complex and intensely meandering with constant re-lignment of it's shore lines. Topography of the river bank basin, is shown in the form of a typical



Sketch 1 River Cross-section near Bridge Site.

cross-section of the river near the bridge site in sketch no 1. Sketch 2 shows typical profiles of scour pattern near the bridge site. The sketch shows gradual shifting of the south bank due to scour between the period of Dec. 1988 and June 1992.

Discharge : An average of annual discharge recorded at an observation point in the vicinity of the bridge show a value of 13000 to 14000 m^3/Sec.

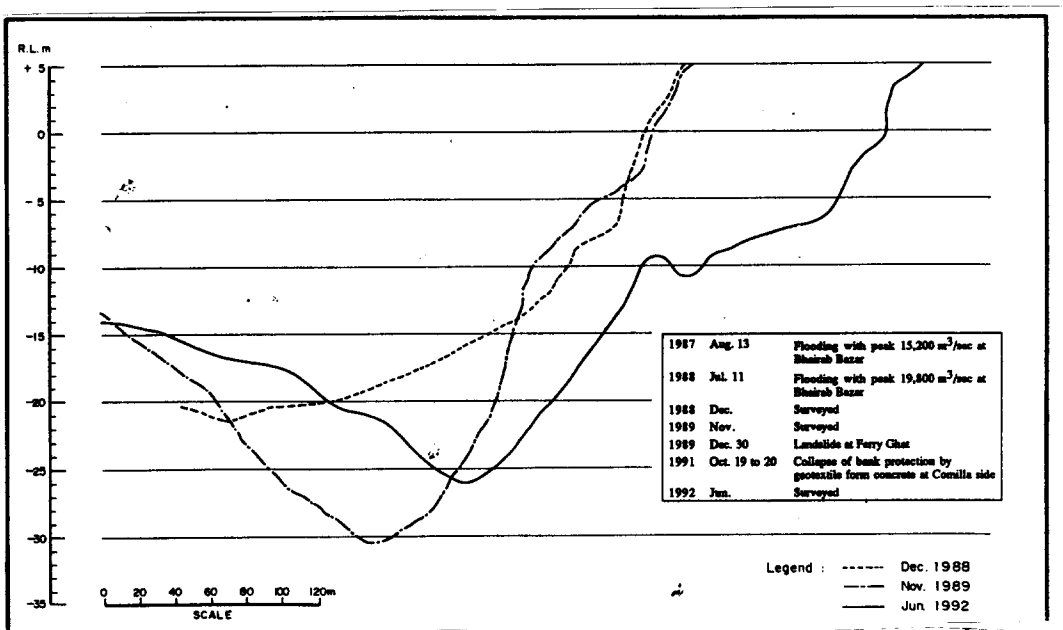
Index of variance :

$$\sqrt{d84/d16} = 1.33 \sim 6.07$$

(average 2.56)

Specific gravity: Gs=2.56.2.78
(average 2.73)

As for the samples taken on the river bank, 60% are smaller than d=0.075mm. It is assumed that the wash load is considerably contaminated.



Sketch 2 Profile of deepest scour section near Bridge Site.

Velocity : Maximum flow velocity recorded at the bridge site is 1.6 m/sec.

GEOTECHNICAL CONDITION

River bank is mainly composed of fine sand and silt.

Over all grain size distribution of the deposit of river bank and river bed is shown below :
Maximum size : dm=0.2 . 0.3mm
Medium size : d50=0.021 0.192mm
(average 0.096mm)

AIM AND SCOPE OF THE PROJECT

Project consists of construction of bank protection revetment along 700m of the southern bank. the aim is to protect the bank from further erosion threateningthe bridge.

DESIGN OF PROTECTIVE WORK

The design is based on :
Reconstruction/ regarding of river bank to adopted slope of 1:3 (1V:3H).

Placing Geotextile filter sheet on the bank slope both above and below water.

Placing stone as revetment on the geotextile below L.W.L.

Constructing falling apron with stones beyond geotextile limit.

Placing stone filled gabions from L.W.L. to top level of the bank.

Selection of slope gradient : Gradient of the river slope was selected based on the hydrological data and soil stability analysis. The soil parameters used for the stability check is shown below :

Soil Layer	Thick-ness(m)	Yt	N-Value (N)	Internal Friction Angle 0
Earthfill	-	1.80	-	30
Rubble, Crushed Gravel, Tile	-	2.00	-	37.5
River Bed :				
Layer #1	9.5	1.80	15	32 ^{0}
Layer #2	8.0	1.80	18	33 ^{0}
Layer #3	9.5	1.80	30	36.5 ^{0}
Layer #4	--	1.80	50	41.0 ^{0}

Water flow velocity : Maximum recorded water flow velocity of 1.6 m/s and furbilent flow condition was considered for the design.

Armour stone size : Based on the design parameter, the range of stone size for the primary and secondary armours were adopted as 200 mm to 400 mm and 80 mm to 200 mm respectively.

Geotextile properties : Under water placement of geotextile exposed the geotextile to very high stress during installation. Therefore a double layer of geotextile stiched together was used. The geotextile used was Polyfelt TS 600 having following properties :
Type : Needle punched, contineous filament, non-woven, mechanically bonded.
Mass : 200 gm/m^2
Tensile strength : 13 kN/m
Permeability : 250 l/m^{2}s
Effective opening size : 110 μ

Revetment : Design of revetment was done for following conditions :

Revetment above L.W.L. : This part of revetment was hand placedover the geotextile. Therefore, thickness of the revetment was limited to 750 mm.
Revetment from L.W.L. to falling apron :
This part of the revetment consisted of primary armours and secondary armous.
Total thickness of the revetment was 1250mm.
Falling apron : No geotextile was used under the falling to facilitate free adjustment of the rip-rap under scour condition. Stone size used in the falling apron was same as that of the primary armour placed over geotextile. Stone quantity was determined on the basis of maximum probable scour depth assuming a slope of 1:2.

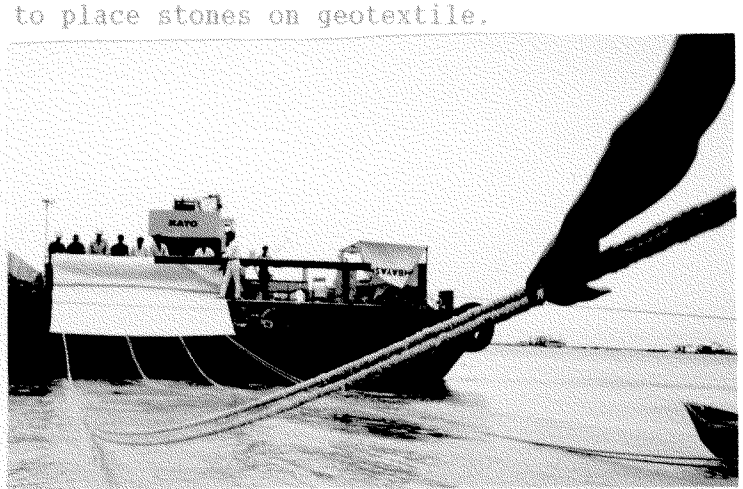
EXECUTION OF WORK

The work was carried out utilising mostly locally available resources and equipment.

The work was carried out in the period of June to August 1993. During the later part of the execution period, severe weather condition and strong currents were encountered.

METHOD OF GEOTEXTILE FILTER SHEET INSTALLATION

Geotextile filter sheets were cut to predetermined lengths. M.S. bars were attached across the widths of the geotextile sheet at 2m C/C to act as stiffener during under-water installation. Rerolled geotextile was mounted on a barge with one end anchored at river bank. Geotextile was then released by backward movement of the barge and was sunk by placing stone on the laid geotextile. Country boat and small self-propelled flat-top barges were used to place stones on geotextile.



Anchoring Geotextile on River Bank

Importment operations during geotextile placement which needed carefull attention were anchoring and manoeuvering of the barge used for placing of the geotextile and control of the boats (or flat top barges) used for placing the rip-rap. Alignment of geotextile during installation was monitored from the shore using conventional survey equipment. Control check were carried regularly by divers to monitor the actual under-water placement.

CONCLUSION AND REMARKS

It is one of the 1st work of this type in Bangladesh.

Experience of under-water installation of geotextile and revetment to such water depth (in excess of 20m) will be useful for future project in Bangladesh and else where.

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REFERENCES

1. Geotextile Engineering Manual 1984, FHWA, Washington D.C.
2. Koerner, R.M. 1990, Designing with Geosysthetics, Second edition. Prentice- Hall, New Jersy.
3. Basic Design Study Report 1992 JICA (Japan), Ministry of Communication, (Bangladesh).
4. Neill, C.R. 1973, Guide to Bridge hydraulics, Road & Transportation Association of Canada, University of Toranto Press.
5. Garg, S.K., 1989, Irrigation Engineering and Hydraulic Structures, Eighth Eidition, Khanna Publishers, Delhi.