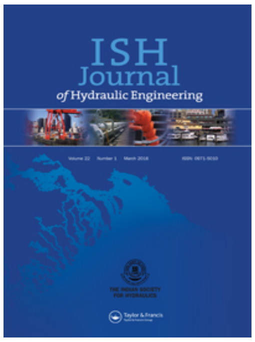

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Discussion of "River bank protection with porcupine systems: development of rational design methodology" by Mohammad Aamir and Nayan Sharma (2015)

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This paper is about the discussion of "Riverbank protection with Porcupine systems: development of rational design methodology"; Mohammad Aamir and Nayan Sharma (ISH Journal of Hydraulic Engineering, 8th Apr 2015, vol. 21, no. 3, pp. 317–332).

River training is necessary for making better use of river and river water. An untrained and uncontrolled river may bring devastation due to flooding, change in course, braiding, meandering, scouring of bed and banks, breaching of embankments, damages of hydraulic structures, roads and railways, etc. Spurs/groynes – both permeable and impermeable types – are constructed transverse to the river bank and extend from bank/embankment into the river either at right angle to the bank (fending spurs) or inclined downstream (attracting spurs) or inclined upstream (deflecting spurs) with the objective of diverting high velocity flow away from the river bank. They also help in dampening of flow and encourage silting of the bank. Unlike impermeable groynes made of earth and boulders, permeable spurs made of porcupines, wooden or bamboo piles, tetra hadrons, trees, etc. permit water to flow through their bodies and are helpful in bank protection due to flow dampening and energy dissipation due to production of microturbulence behind the spurs. They help in trapping of sediment and siltation near the bank, provided the river transports sediments in bed load and/or suspended load form. Further details about planning, layout, design, and maintenance of permeable and impermeable type spurs are covered in IRC:89 (1997) & IS 8408 (1994). CBIP (1989) in its publication "River Behavior, Management & Training" has covered in detail about planning and design methodology of different types of permeable and impermeable spurs including bamboo porcupines. In part VII of the publication "Flood Control Procedures and Practices in the United States," Central water Commission (CWC 1962), Sh. R.K. Jain has described in detail the use of pile spurs for Missisipi and Missouri river training. In its publication, "Handbook for Flood Protection, anti Erosion & River Training Works," CWC (2010) has given detailed guidelines for planning and design of RCC porcupine spur field. Scott Wilson (2007) used bamboo porcupines for protection/river training works in the Mahananda River Bridge on NH-31. After repeated failures of earthen spurs u/s and d/s of the Farakka barrage on the Ganga River, CWC used RCC porcupines to protect the erosion of left bank. It is reported that the porcupines were very effective and helped in siltation of the bank. A typical screen of RCC porcupine field used u/s of Farakka barrage is shown in Figure 1.

Presently, most of the river training measures are based on experience and physical model study. Considering the enormous cost of these measures, it is necessary that suitable design criteria should be developed for effectiveness and cost reduction. That way this paper is a good contribution in the area of river engineering. It is a basic study related to planning and design of RCC porcupine field for river bank protection. Authors have developed some indices (PFDI, PFSI, BDF, & PFLI) for finding the performance of the porcupines with different values of submergence, sediment concentration and hence fix up the length of retards, spacing, and density of the porcupines. Slope of the flume was so fixed as to ensure clear water flow conditions. Sediments of different concentrations were introduced at a section 0.5 m upstream of the porcupine field. Average and maximum values of BDF were found from measured depths of deposition of sediments (tables- 3, 4, 5, 6, & 7) in order to fix different dimensions of porcupine field for three different conditions, namely (i) erosion control, (ii) moderate reclaim, and (iii) heavy reclaim. Fig. A1 shows the velocity reduction with different numbers of models in a row. Fig. A2 shows the contour plots of sediment depositions. Design steps are stated under the clause 4.1. Discusser, however, wishes to get clarification on the following points:

(a) In Fig. 6, the length of retards is 0.5 m in a channel of 0.86 m, i.e. the porcupines intrude more than 50% of channel width. This is in violation with the maximum permissible encroachment from one-fifth to one-sixth of channel width.
(b) In Figs. 3 and 6, a maximum of 4 nos. of retards are shown for protecting 1.5 m length of channel. In Table 2, the Lr/Ls-values indicate that the retards are placed very close. Is the values given for a single screen? Where the length to be protected is very high, what will be the spacing between the screens?

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Figure 1. Showing one row of RCC porcupines used upstream of the Farakka Barrage.

(c) Why was the sediments introduced just 0.5 m ahead of the screen? There is no measurement of sediment concentration at different depths before and after the screen. With sediment size of 0.2281 mm, fall velocity (w_0) is found to be about 2.3 cm/s. With a mean velocity of 29 cm/s and depth of 10 cm, all the sediments are expected to deposit in a length of 1.25 m which is less than 1.5 m. So, there will be a little suspended sediment after the length of 1.5 m from the point of injection, i.e. 0.75 m away from the first retard. It may be one of the reasons that maximum value of BDF lies at a value of PFLF between 0.4 and 0.5 as shown in Figs. 10–17. This is contrary to the field situation and it appears that the subsequent screens will not be effective.

(d) Authors have not measured turbulent quantities which keep the sediments in suspension. It is the turbulence which helps in entrainment of sediments from bed. But the sediments in the bed, in the present case, are not entrained since $\tau_0 < \tau_c$, i.e. a fixed bed case. This is contrary to field situation when bed and bank materials move and the sediments are entrained by the flow.

(e) BDF – Values given in Table 3 for (i) Erosion Control, (ii) Moderate reclamation, and (iii) heavy reclamation appears to be arbitrarily fixed.

(f) Bamboo and wooden porcupines are to be driven and the bed is protected with mattress for stability. Although RCC porcupines are heavy, is it necessary to protect them against possible scour around the porcupines and their stability?

(g) One of the important parameters in the design of porcupine/pile spurs is permeability. Lagasse et al. (1995) mentioned that the permeability should not be less than 35% and not more than 50% for the effectiveness of permeable spurs. Authors have not mentioned anything regarding permeability defined as area of openings divided by the gross area of spurs measured normal to flow direction.

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