NEED FOR UPDATING CODES ON RIVER TRAINING/SCOUR

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Extended Abstract

For the design of hydraulic structures and river training works e.g. bridges, barrages, culverts., groynes, guide bunds, revetments etc., a number of codes are referred to by the planners and designers. BIS, IRC and RDSO codes are being followed in the water resources sector, road sector and railway sector respectively. These Indian codes/guidelines are treated almost like bible and the designers have hardly any freedom to deviate from the provisions made in the codes. Although the codes are being reviewed and updated from time to time, there is very little change since majority of the members in the formulation of the codes/guidelines are from field and they are highly conservative. Very little of the recent developments in the subject percolate to the revised codes e,g. IRC-5(1994), IRC-78 (1985), IRC: SP-13 used for hydraulic deign of bridges .and culverts. IRC-89(1997), IS: 6966, part-1 (1989), IS-8408(1994), IS-10751(1994), IS-14262(1995) related to design of river training works have similar deficiencies. Fundamental changes in many of these codes/guidelines are needed in view of the recent developments in the disciplines like hydrology, hydraulic engineering, river mechanics and sediment transport. For example, in the scour computations in bridge piers and abutments, all the Indian codes prescribe use of Lacey/Inglis theory. In a case study by the author (Mazumder, 2006), it is observed that by Lacey/Inglis theory, scour is overestimated and the error varies from 5% to 255%. In all the mathematical models, scour is computed in a rational manner by dividing scour into three parts, namely, general scour, constriction scour and local scour; whereas no such divisions are made in the IRC method where maximum scour depth is determined simply by multiplying Lacey's regime depth with a factors of 2 in case of piers and 1.27 in case of abutments with protected approach irrespective of geometry and alignment of piers and abutments, non-uniformity of foundation materials, time required for equilibrium scour depth etc.. Similar factors, varying from 1.25 to 2.75 are used in determining maximum scour depths in different sections of guide bunds and other river training works. In all scientific methods, localised scour due to flow contraction and obstructions are computed with respect to bed level resulting in maximum scour profile as a curved surface when the bed profile is curved. As per codal provisions, however, maximum scour profile will be horizontal irrespective of the nature of bed profile since maximum scour depth is measured below HFL which is horizontal. The factor of safeties used in determining maximum scour depths is nothing but factors of ignorance. In the paper "Training River near Hydraulic Structures" (Mazumder, 2005), author has pointed out several deficiencies in IRC/BIS codes related to hydraulic design of bridges, barrages, river training works etc.A large amount of public money is being spent for the construction of bridges and their foundations (cost of which is about 50% of the total cost), scour protection and river training works. We should, therefore, endeavor to economise the cost through updating the relevant codes by introducing more scientific and rational approach for computation as in other developed countries. Unless the gap between research and practice is narrowed down through regular updating of the codes, education and research has little significance and empiricism will continue to be followed.

Understanding of river morphology and river mechanics (Garde and Raju-2000) is essentially needed for efficient planning, design, construction and maintenance of river training and scour protection and for formulation of the relevant codes accordingly. Some important aspects e.g. plan form, meandering , stability of a river and its response to hydraulic structures etc.have been discussed in a paper by the author (Maumder-2004). It is often

noticed that the river training measures and scour protection works are carried out in a hurry without pr**oper** understanding of river behaviour and collection of sufficient data needed for hydraulic analysis and design, which often result in their failure and wastage of money. Case histories of few such failures of river training measures (e.g. Kosi & Farakka barrages and some bridges) have been discussed elsewhere (Mazumder-2004). Although our codes have detailed descriptions of different types of river training measures, methodology of their construction and maintenance etc., there is a need for improving the codes for the proper investigation, planning and efficient & economic design. Codes need updating in several aspects as briefly mentioned underneath.

Scouring: Existing method of scour estimation in hydraulic structures and river training works based on Lacey's theory should be replaced by more scientific method e.g HEC/ IAHR method. Lacey's method does not distinguish between live bed and clear water conditions. The maximum scoured depth of flow predicted by Lacey goes on increasing with increase in discharge whereas scour is maximum at a critical flow corresponding to threshold condition of bed motion and it decreases thereafter with further increase in flow.

Pitcing: Apart from weight of individual stones, the shape and gradation of stones are also important in resisting drag due to stream flow. AASTHO, AUSTOROAD recommend extra weight due to turbulence, flow curvature etc. Empirical equations of Spring/Gales may be replaced by scientific principles for computation of thickness of Pitcing. Use of Gabions/Geo bags/geo tubes etc. in place of pitching should be encouraged. Codes have very little information about them.

Launching Apron: Under water launching is never uniform especially where the bed is stratified and floods of different magnitudes occur after the launching apron is laid. This will obviously help in winnowing of base materials underneath and undermining of the protection works. Cut-off walls or sheet piling are more effective in toe protection .

Filter: Use of geo-synthetics/ geo- bags/ geo-tubes/Geo-jute in place of conventional graded filters of crushed stones and sands are found to be more effective and should be given adequate coverage in the codes.

Shape and Length of Guide Bunds: Guide bunds are transition structures connecting the bridge with flood plain of a river. The conventional straight (or parallel) guide bunds, as recommended by Bell (1918), have an upstream sharp head abruptly ending within the flood plane. It causes high flow concentration near the head of guide bund and causes deep scour at the head often resulting in damage to the guide bund. Elliptical guide bund with proper ratio between major and minor axes is a better hydraulic design (Lagasse, et al. -1995) .

Levees: Levees constructed within the flood plain of a river (as in Kosi River) causes loss of flood plain/valley storage causing backwater and usually a rise in normal HFL. Stream power per unit weight per unit width (QS_0) is reduced considerably due to backwater resulting in deposition of sediments within the khadir bounded by the levees. Guidelines for planning and design of levees (IS:12094:2000) do not even mention of backwater computations needed for fixing top level of levees, leave apart computational methods. Code should also prescribe the necessity and design procedure for embankment sluices essential for country side drainage.

Groynes: IS: 8408:1994 provides guideline for planning and design of groynes in alluvial rivers- both permeable and impermeable types. The length, spacing and protective arrangements described in the IS code, however, are applicable for solid impermeable type spurs in a straight channel only. Very little information is available for permeable spur design.

Use of Other Techniques: Many other non conventionasl methods e.g. Use of Vanes in controlling scour/silting in meandering bends, scour retarders in controlling pier scour, dredging to control growth of bedbars, flow diversion etc. should also be covered in the codes.

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