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LETTER

Discussion on live-bed local scour around vertical-wall abutments By A.K. Barbhuiya and M.H. Mazumder pub. In ISH J. of Hyd. Engg., Vol. 20, No. 3, p.339–351

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The paper being discussed is Barbhuiya and Mazumder (2014).

Most of the research study on bridge scour in India and abroad is on scour in bridge piers. This paper on scour in abutments is thus a good contribution made by the authors in bridge hydraulics and offers an insight into the scour mechanism which is similar to that in piers. Unfortunately, scour in bridges is still being computed in India by using IRC codes (IRC-5 1998; IRC-78 2000; IRC:SP-13 2004; IS:6966 1989) based on Lacey's regime theory (1930), although Lacey's regime theory has nothing to do with local scour in bridge piers and abutments which are governed by a large numbers of parameters not considered in Lacey's theory for prediction of regime widths and regime depths. The discussor in his papers (Mazumder and Dhiman 2014; Mazumder and Kumar 2006) has shown that scour computation using Lacey's theory always overpredicts scour depth in bridge piers compared to actual observed scour and scour predicted by scientific mathematical models developed by gifted research workers like Richardson and Davis (1995), Melville and Coleman (2000), Breussers and Randviki (1991), Kothyari et al. (1992), Dey (2005–2006) and others. Limitations of Lacey's theory in local scour prediction have been stated by the discussor elsewhere (Mazumder 2007).

Discussor would, however, like to bring to the notice of the authors some of the discrepancies as noted below:

(1) The statement made by the authors in the synopsis (6th line) and other places that "scour depth increases with the increase of sediment sizes" is not correct. In Table 3, for example, Melville values of scour depth for $V/Vc = 1.5$ and $L = 4$ are found to be constant at 0.080 m for d_{50} varying from 0.26 to 1.92 mm. Similarly, for $V/Vc = 1.5$ and $L = 12$, local scour depth is constant at 0.24 m for d_{50} varying from 0.26 to 1.92 mm. Lim and Cheng values for $V/Vc = 1.5$, and $L = 4$ and 12 are found to decrease with increase in sediment size. Same is the case for other values of L and V/Vc as well. Values measured/predicted by authors, however, show an increase in local scour depth with an increase in size (d_{50}) as per their Equation (5). This discrepancy in authors' results and others are probably due to the following facts:

(a) depths of scour as measured by the authors are the sum of contraction and local scour. If the contraction scour due to reduction in waterway (by an amount L) is deducted, it will give the actual local scour which will probably show that local scour depth decreases with increase in size of bed material in coarse form in the range $L/d_{50} < 25$ and remains constant in fine bed material in the range $L/d_{50} > 25$, as found by Mellville and Coleman (2000) and others.

(b) As mentioned by the authors under Sections 2 and 3 of the paper, it was difficult to maintain pre-scour bed level due to passage of bed forms (ripples and dunes). For attaining steady bed forms, the sediment fed should be at the same rate at which the sediments are transported under live-bed conditions. The paper does not indicate how sediments were fed and at what rate.

(c) Heights of bed forms under steady state increase with increase in sediment size (Julien and Klaassen 1995; Van Rijn 1984). The authors measured the scour depth when the bed forms go out the scour hole, i.e. at the trough of the bed form which will give a higher scour depth with an increase in the sediment size. Melville and others measured the actual continuous scour profile in the scour hole and added $h_d/2$ as the extra scour depth (due to bed forms passing through scour hole), where h_d gives the height of bed form.

According to Melville, sediments can be classified as fine and coarse depending on L/d_{50}-values. For $L/d_{50} > 25$, sediments are classified as fine and. With above classification, it is found that the experiments performed by authors fall in both fine and coarse grades. In the fine range, K_d-values may remain constant but in the coarse range, it should decrease with size.

In the light of above, Equation (5) and Figure 7 may be reviewed.

(2) Since σ_g has a dominant effect on scour, the same should have been included in Table 3 for clarity.

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(3) Equation (6) ($d_{se} = 5.25\ l^{0.67} d_{50}^{0.28}\ K_\sigma\ K_\theta$) suggested by the authors for computing local scour is dimensional, although Figures 2–5 are non-dimensional plots. Similar to other formulae (Froehlich, HEC-18, IAHR, etc.), the authors may develop a non-dimensional form of Equation (6) for the use of their results for the design purpose in the field. In Equation (6), d_{se} is in cm, L is in cm, d_{50} is in mm and in Table 3, it is in m unit. This is confusing.

(4) In Equation (3) by Melville and Coleman, K_h (=K_{yL}) are

$K_h = 2L$ for $L/h < 1$;
$K_h = 2(Lh)^{0.5}$ for $1 < h/L < 25$; and
$K_h = 10y$ for $L/h > .25$.

Thus, the statement made by the authors in p-8 that K_h may be taken as 1 is incorrect since flow shallowness affects scour depth and the scour depths found by Melville equation are to be corrected in Table 3.

(5) Figure 6 is a dimensional plot. Like other figures, it should also be a non-dimensional one.

(6) The authors should state how did they find the *Vc*-values? Local scour depth under live-bed condition is found to be about 10% lower than that at the threshold condition. This is in contradiction to the statement made by the authors under 3.1, namely "In all the experiments with uniform sediment, it is found that the live-bed maximum scour depth and threshold peak scour depth are almost same. However, from Figure 5, it is seen that for non-uniform sediment, the equilibrium scour depth increases with the increase of flow intensity even beyond the critical velocity".

References

Barbhuiya, A.K., and Mazumder, M.H. (2014). "Discussions on paper 'Live-bed local scour around vertical-wall abutments'." *ISH J. Hyd. Engg.*, 20(3), 339–351.

Breussers, H.N.C., and Randviki, A.J. (1991). *"Scouring", Chapter-5 "Scour at Bridge Piers"*, IAHR Hydraulic Structures Design Manual, A.A. Balkema Pub., Rotterdam.

Dey, S. (2005–2006). *Principal investigator of the research project "Determination of Scour Depth (for General Bed, Within Channel Contraction and at Bridge Piers) in Boulder-Bed Rivers Under High Stream Velocities (B-33)".* Sponsored by The Min. of Shipping, Road Transport and Highways, Govt. of India, Highway Research Record No. 33 (2005–06), IRC Highway Research Board, Indian Roads Congress.

IRC:5. (1998). *Standard specifications and code of practice for road bridges – Section-I*. Indian Roads Congress, New Delhi.

IRC:78. (2000). *Standard specifications and code of practice for road bridges, Section-VII*. Indian Roads Congress, New Delhi.

IRC:SP:13. (2004). *Guidelines for the design of small bridges and culverts*. Indian Roads Congress, New Delhi.

IS:6966. (1989). *Guidelines for hydraulic design of barrages and weirs, Part-I*. Bureau of Indian Standards, New Delhi.

Julien, P.Y., and Klaassen, G.J. (1995). "Sand dune geometry of large rivers during floods." *J. Hyd. Engg., ASCE.*, 121(9), 657–663.

Kothyari, U.C., Garde, R.J., and Ranga Raju, K.G. (1992). "Temporal variation of scour around bridge piers." *JHE, A.S.C.E.*, 118(8), 1091–1106.

Lacey, G. (1930). "Stable channels in alluvium." *Paper 4736, Proc. of Institution of Civil Engineers,* Vol. 229, William Clowes & Sons Ltd., London, UK, 259–292.

Mazumder, S.K., and Dhiman, R.K. (2014). "Local scour in bridge piers on coarse bed materials-observed and predicted by different methods." *J. Indian Roads Congress,* 74(4), 126–135.

Mazumder, S.K., and Kumar, Y.K. (2006). "Estimation of scour in bridge piers on alluvial non-cohesive soil by different methods." *IRC Highway Research Bulletin. Oct., 2006, presented in the 67th IRC Congress at Panchkula*, Haryana, during 17–21 Nov. 2006.

Mazumder, S.K. (2007). "Limitations of Lacey's theory for estimation of bridge scour." *Pub. in the Proc. of Hydraulics & Water Resources HYDRO2007 org. by Indian Society for Hydraulics and VSNIT at Surat*, 21–22 Dec., and Pub. By Elite Publishing House Pvt. Ltd., New Delhi, 328–336.

Melville, B.W., and Coleman, S.E. (2000). *Bridge scour*, Vol. I and II, Water Resources Publication, LLC, Highlands Ranch, CO.

Richardson, E.V., and Davis, S.R. (1995). "Evaluating Scour at Bridges." Report No. FHWAIP-90-017, Hydraulic Engineering Circular No. 18 (HEC-18), Third Edition, Office of Technology Applications, HTA-22, Federal Highway Administration, U.S. Department of Transportation, Washington, DC, USA.

Van Rijn, L.C. (1984). "Sediment transporet, Part-III: bed forms and alluvial roughness." *J. Hyd. Engg., ASCE*, 110(12), 1733–1754.