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Hydrology and Earth System Sciences Discussions

Interactive comment on "A flume experiment on the effect of constriction shape on the formation of forced pools" *by* D. M. Thompson and C. R. McCarrick

PA Carling (Referee)

p.a.carling@soton.ac.uk

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This paper is interesting in that it attempts to provide a systematic evaluation of bank-attached obstacle shape to downstream scour hole profiles. These kind of controlled experiments, which are relatively simple, are to be encouraged as they provide considerable insight into the effects of forced scour of pools and the consequent development of associated riffles.

However I do have some reservations. There are abundant publications on the effects of scour and deposition around isolated obstacles in the main flow, of varying shape. This literature chiefly relates to bridge piers of varying configuration that pierce the

water surface. In addition there is a literature concerning the design of dykes including those normal to the bank line and those which are angled relative to the bank line. This literature provides considerable insight as to the effects that might be expected before these experiments were designed but it is not cited or used apparently.

One key point is that the flow parallel face of the obstacle influences the over-all drag and consequently the downstream scour. In this respect the x-axis of the obstacles has to be the same for all configurations if comparisons are to be made. Thus in Fig. 2 there is the problem that the x-axes are not equal and so strictly speaking the effects will vary depending on the different x-axes lengths as well as the difference in shape more generally. The authors could have addressed this by more careful experimental design and indeed they note that the x-axis length is a factor on page 1959 line 17 in the literature review. Figures 1 and 2 need a caption note to the effect that they are plan views.

It is assumed on page 1951 line 8 that the same nominal water depth was maintained for all the runs although I don't think this is specified. The relative depth of inundation is a significant factor in the length of downstream scour around obstacles such that these results reflect the particular relative submergence of these experiments. This is not a criticism of these test runs but the observation serves to indicate that it will be difficult to isolate any generalities as to scour configuration due to fluctuating natural flow levels around natural objects. It is stated that the selected shapes were chosen to mimic those shapes most found in nature but it is not evident what those shapes are. Rather natural obstacles in rivers can have highly variable geometries including frequent examples of fully submerged conditions. In the later case the scour patterns are significantly different from non-submerged cases.

As with the engineering literature on obstacle effects an attempt could have been made to non-dimensionalize the obstacle shapes and relate these parameters to non-dimensional flow parameters such as the Reynolds number which is known to influence (along with the re-entrant geometry) the length of flow-separation bubbles and

reattachment criteria and consequently the scour parameter response. The authors should seek to do this to make the results more generic and thus transferable.

It is not clear why the eddy fence could not be isolated in the flume runs. Simple dye tracing and photography can do this effectively.

I add a couple of references below which deal with cognate phenomena.

Carling, P.A. (l989) Hydrodynamic models of boulder berm deposition. Geomorphology, 2, 319 340.

Carling, P.A., Hoffmann, M., Blatter, A.S. and Dittrich, A. (2002) Drag of emergent and submerged regular obstacles in turbulent flow above bedrock surface. In: Rock Scour due to Falling High-Velocity Jets Editors A.J. Schleiss and E. Bollaert, Swets and Zeitlinger/Balkema, Lausanne.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 1945, 2010.