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Interactive comment on "Effects of Y-type spillway lateral contraction ratios on debris flow patterns and scour features behind a check dam" *by* Huayong Chen et al.

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1. p.1, line 2 not sure, if "downriver of a check dam" would better describe the exact location of the scour. Answer: Thanks very much for the reviewer's com-ment. The phrase "behind a check dam" has been replaced by "downriver of a check dam" for better description of the exact scour loca-tion.

2. p.1, line 11 in cases where debris flow is used in a word composition (e.g. debris-flow pattern, debris-flow nappe) I learned, that there is a hyphen between debris and flow Please check the manuscript accordingly. Answer:A hyphen was added between debris and flow in a sentence throughout the manuscript where "debris flow" was used as attributive.

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Discussion paper

3. p.2, line 29 more common is "initiation zone", not "formation region"; delete "by debris flow" at the end of the sentence, it's an unnecessary repetition. Answer: The wrong phrases in the sentence have been revised according to the reviewer's comments.

4. p.3, line 56/57 not really clear, what this sen-tence means. Do you mean that the proposed geometry of such spillways is something that should be used especcially for torrents with high sediment disposability? Answer: To avoid misunderstanding, the sentence has been modified in the manuscript.

5. p.3, line 58 "is" instead of "was". Answer: The word "was" has been replaced by "is" in this sentence.

6. p.8, line 165 are the values for the density of the debris-flow densities measured values or assumptions? Both values seems to me more valid for hyperconcentrated flows. I would espect values in the order of 1700 - 1900 kg/mËĘ3. Answer: The flow densities were measured after de-bris-flow samples were taken. Frankly, as for debris flows the flow density in our experi-ments seems lower. The experimental analysis here is considered to be the preliminary achievements. The authors appreciate the re-viewer's valuable suggestions to carry out more experiments involving debris-flow den-sities in the order of 1700 - 1900 kg/mËĘ3 in the future.

7. #1: indicate flow direction and exchange the word "behind" with "downriver of". Answer: The word "behind" has been replaced by "downriver of".

8. #2a: Sabo dam is never use in the text. Use check dam or replace check dam with sabo dam in the text. Answer: The word "Sabo dam" has been replaced by "check dam".

9. #5: desribe it as "debris-flow hydrograph". If your LRF gave you min, max and mean values, you could perhaps explain the outliers. And: this hydrograph does not really show a typicall steep front of a debris flow. It looks more like a hyperconcentraded

flood. Again: add infor-mation on the sampling rate of the device. Answer: The caption of Figure 5 was changed to "de-bris-flow hydrograph". The information on the sampling rate of the device was added in line 90, page 5.

10. #6: add an arrow to show flow directions. Very small images. Perhaps increase contrast. Answer: An arrow in each figure was added to show debris-flow directions in Fig.6.

11. Scaling effects are not discussed. Please add a section to explain how the results of the ex-periments can be use in real dimensions. What is the Froude number of your experiments? Answer: The scaling effects are discussed in the re-vised vision in lines 207-215, page 11. The Froude number in our experiment ranged from 1.14 to 1.16. It meant that the debris flows in the experiments were supercritical flow (in lines91-92, page 5).

12. I miss a sensitivity study on different de-bris-flow mixtures (e.g. higher densities, water content variations) Answer: The variation of debris-flow density (dif-ferent debris-flow mixtures) on scour depth was added in lines 135-141, page 7.

13. I miss information on the LRF. What is the sampling rate (in Hz) of the device? How are splashing effects handled? Answer: The information on the LRF was given in lines 89-90, page 5 and the sampling rate (Frequency) was added in line 90, page 5.

14. What would happen, if there is driftwood in-volved? Did you test that or what do you ex-pect in such a case? Answer: Debris flows with driftwood will speed up the blockage and jamming of a check dam. Provided that driftwood is involved in our experiments, the check dam will capture driftwood when it passed through the spill-way with debris flows. The subsequent de-bris flows will overflow from the check dam crest once the spillway is blocked by the driftwood, which will cause scour downriver of a check dam. The debris flows with driftwood was not considered in the current experiments, but definitely the reviewer has raised a very important question. The related experiments will be carried out to investigate the behaviour of debris flows with driftwood and its

scour feature in the future.

15. Can you say something about abrasion rates and the expected life time of such structures? Answer: Abrasion occurs due to the interaction be-tween solid particles in debris flows and the boundary of hydraulic structures. For a spill-way with curved bottom, the reaction of cen-trifugal force exerting on spillway bottom enhance the interaction between the solid par-ticles and the bottom (a component of the reaction force has the same direction as the gravitational force of debris flows near the outlet of the spillway). Although abrasion phenomenon is common, it is difficult to quantify the abrasion rate during an episode of debris flows. Abrasion may be one of the factors lead to the damage of spillway with lateral contrac-tion. However, some methods can be taken to mitigate the abrasion damage of such struc-tures by using anti-abrasion materials, or add the protecting layer. The check dam with lat-eral contracted spillway, like other check dams, the expected life time mainly depends on the debris-flow scales, flow velocity, particle concentration, etc.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-189/nhess-2016-189-AC1-supplement.pdf

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