Advanced Engineering Days

aed.mersin.edu.tr

Advantages of slit-check dams in practice and investigation of bed slope effect

Mehmet Cihan Aydın*[1], H. Seda Aytemur [2], Ali Emre Ulu [3]

[1]*Bitlis Eren Univ., Engineering and Architecture Faculty, Department of Civil Engineering, Bitlis, Turkey, mcaydin@gmail.com*
[2]*State Hydraulic Works 17th Regional Directorate, Van, Turkey, aytemurseda@gmail.com*
[3]*Bitlis Eren Univ., Engineering and Architecture Faculty, Department of Civil Engineering, Bitlis, Turkey, aliemreulu@gmail.com*

Cite this study: Aydin, M.C., Aytemur, H.S. & Ulu, A.E. (2021). Application and Advantages of Slit Check Dams. 1st Advanced engineering Days, 32-34

Keywords
Slit-check dam
Flood control
River flow
Hydraulic structures

ABSTRACT

There are many types of check dams, which are flood control structures. Slit check dams, which is one of them, are especially preferred in rugged and high rainfall areas such as the Black Sea region of Turkey. The purpose of these dams is to hold back the large floating and drifting materials brought by the stream rather than preventing the floodwaters. Especially in the Black Sea region, the flood events that occurred in 2021 highlighted the necessity and importance of these structures. Branch logs and coarse stone materials brought by the rivers during the flood blocked narrow sections such as bridges and culverts in the settlements, causing the flood to damage larger areas. If these materials had been kept at the upstream of the settlements by using slit check dams, loss of life and property could have been prevented significantly. In this study, a general evaluation of slit check dams was made and their characteristics were discussed with examples in practice. Additionally, bed slope effects on the flow pattern downstream of slit-check dams were investigated by an experimental test.

Introduction

Check dams are effective hydraulic structures for flood control. Li et al [1] stated that check dams can be classified as closed-check dam and open-check dam, based on the literature [2-3]. Although closed check dams do not allow sediment passage and tend to fill up, open check dams allow sediment passage. While closed check dams do not allow sediment to pass through and tend to fill up, open check dams allow fine sediment to pass and only coarse materials are retained. For this reason, it is pointed out that these dams can maintain their efficiency for a much longer time [4-5].

Especially in recent years, researchers, such as Li et al. [1] focused the debris and sediment flows in slit and slot-check dams. However, there are not many studies on the hydraulics characteristics of such structures. Apart from flood times, these structures also have regulating and energy dissipating effects on normal flows. For this reason, it is important to examine the hydraulic performance of slit-check dams in clear water flow conditions. In this study, application examples of slit-check dams are presented and their hydraulic performances are discussed.

Slit Check Dams

In some cases, classical check-dams are insufficient to help maintain the natural balance in river basins. If fine material is required in the downstream part, permeable check dam can be preferred in these areas (in cases such as scouring in the downstream, etc.). Slit-check dams can be made with horizontal and vertical openings to filter coarse material. The downstream part is protected by using slit-check dams, as the coarse material will clog the water structures such as the bridge and culvert in the downstream. Especially in the years 2020-2021, the flood damages that occurred in the Black Sea region of Turkey were mostly caused by such reasons (Figure 1).

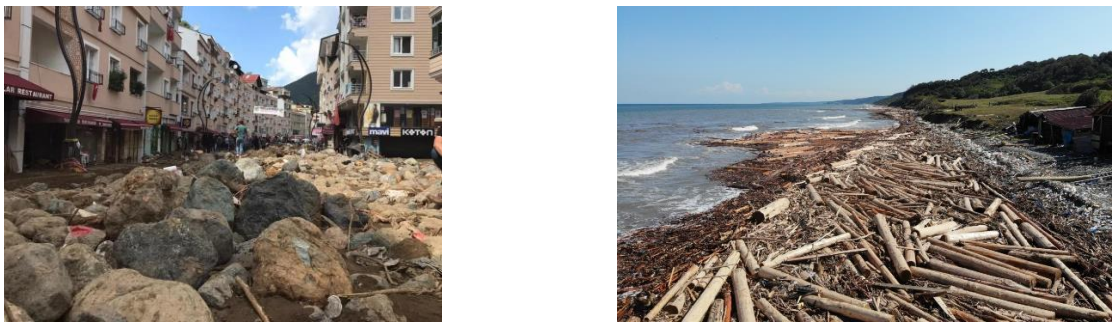


Figure 1. Images after the flood disaster in a) Giresun [6] and b) Sinop [7]

Slit-check dams built in forested and landslide areas such as the Black Sea protect the area from such damages by preventing the passage of tree pieces or large rock pieces downstream. Dynamic analyzes due to impact should be performed before these slid-check dams are constructed. In order to continue their functions in the next floods, the slid-check must be cleaned as they fill. Since there is no need for a fish passage, it does not prevent fish passages, thus the ecosystem is protected. It reduces the flow velocity during the flood and reduces the flood effect. It also has a regulatory effect thanks to its side walls. Slit-check dams constructed in different types are given in Figure 1.6(a-f).

(a) (b) (c)

Figure 2. Some slit-check dams species that: a) hold the woody overflow and regulate of flood water, b) regulate the bed load and adjust the amount of floodwater, c) to hold coarse sediment and break energy, [8].

Material and Method

Some experimental runs carried out for determination of slit-check dams with certain channel slope and relative slit rate. The experimental setup was illustrated in Fig. 3. Some pictures of the experiments study were given in Figs. 3.

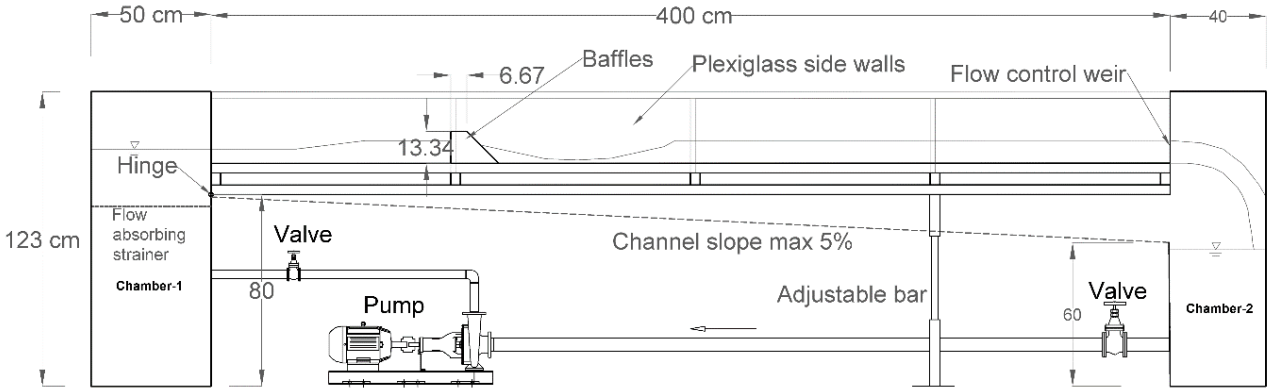
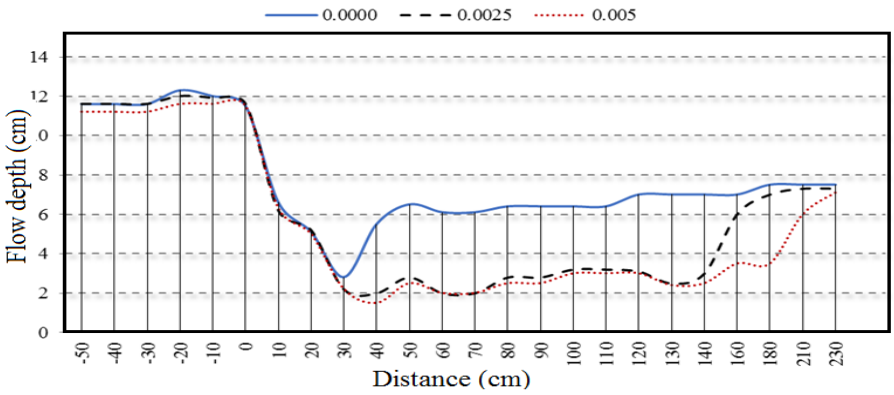


Figure 3. Experimental setup

Results

In this study, the effect of slit-check dams on free-surface flow profiles was investigated for different channel slopes. The graph in Fig. 5 shows the water surface profiles in three different channel slopes (J=0, 0.0025 and 0.005) for maximum discharge and t/s=1.0. The graphs show that as the channel slope increases, the length of the hydraulic jump also increases. The hydraulic jump after the check dam is to play an important role in energy

dissipation of the flow. However, this is the subject of a different study. Comprehensive results on the subject will be presented in further studies.



Conclusion

Slit-check dams are important protection structures, especially in rivers with high slopes and coarse solids transport. These structures also have a role in regulating the stream flow in normal times, apart from the solids transport. For the design of an effective slit-check dams, it is necessary to know the hydraulic behavior at different bed slopes as well as its type and dimensions. In this study, it has been observed that different channel bed slopes have a significant effect on the hydraulic jump occurring on the water surface. More comprehensive studies on the subject are in progress and will be presented in further studies.

Acknowledgement

This study has been derived from Aytemur's [9] master thesis.

Funding:

This study was supported by Scientific Research Projects Department of Bitlis Eren University, which Project Number BEBAP-2020-002.

Author contributions:

M. Cihan Aydın: Organization, Methodology, written **H. Seda Aytemur:** Data curation, Writing-Original draft preparation, experiments. **A. Emre Ulu**: Experiments and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

[1] Li, S., You, Y., Chen, X., Liu, J., & Chen, J. (2019) Regulation effectiveness of a window-check dam on debris flows. Engineering Geology, 253: 205–213.
[2] Armanini, A., Dellagiacoma, F., Ferrai, L. (1991) From the check dam to the development of functional check dams. Fluvial Hydraul. Mt. Regions 37, 331–344.
[3] Chen, X.Q., Cui, P., You, Y., Chen, J.G., Li, D.J. (2015) Engineering measures for debris flow hazard mitigation in the Wenchuan earthquake area. Eng. Geol. 194, 73–85.
[4] Chanson, H., 2004. Sabo check dams-Mountain protection systems in Japan. Int. J. River Basin Manag. 2 (4), 301–307.
[5] Choi, S.K., Lee, J.M., Kwon, T.H., 2017. Effect of slit-type barrier on characteristics of water-dominant debris flows: small-scale physical modeling. Landslides 1–12.
[6] Haberglobal (2020). https://haberglobal.com.tr/gundem/kare-kare-giresun-daki-sel-felaketi-otomobiller-agac-dallarina-takildi-camur-balcik-tavanlara-dayandi-64901. Date of access: 01.12.2021.
[7] IHA (2021). https://www.iha.com.tr/haber-karadeniz-tomruk-deniz-oldu-964248/ , Date of access: 01.12.2021.
[8] Çelik, H.E., Selek, B., Dağdeviren, M., Demir, E., Biroğlu, İ. (2017). Havza Islah Önlemleri Kapsamında Yeni Bir Uygulama, Süzücü (Geçirgen) Tersip Bentleri.
[9] Aytemur, H.S. (2021). Geçirimli Tersip Bentlerinin Hidrolik Analizi, Bitlis Eren Üniversitesi ve Dicle Üniversitesi, Lisansüstü Enstitüsü, Yüksek Lisans Tezi.