

Structural and Hydro-technical Schemes for Flood Defenses

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Abstract. Area flooding is the main parameter necessary to achieve hydro technical defense schemes. This can be determined based on calculations performed in various programs. Of the many measures to limit the risk of flooding were chosen for comparison hydrotechnical for protection against floods schemes: embankment and building a polder area. Finally it is noted that structural measures are widely promoted because of the benefits arising from economically and ecologically necessary but complementary structural measures are the only high efficiency in cases with high abundant torrential floods. Today hydro technical schemes are a techno-economic and environmental compromise with fluctuating boundaries, making the decision to be very heavy, plus taking into consideration the temporal variability and the aspect of economy and nature. The optimal solution is specific to each river basin and establishing its methods are different, many of which are listed in this paper.

Introduction

There was hardly a year in which a river is not affected by a form of leakage, either „flood”, whether „high waters”. Both during high waters and at the flood, high flow rates and levels, and their duration depend on the overall physical and geographical conditions that generate outflow with respect to morphometric factors (surface and catchment topography, geological structure, soil, and the afforestation rate etc.) and climatic factors which in certain periods of the year plays a significant role. Both waters, especially floods exceed the limit of minor bed, causing overflows and flooding, a characteristic phenomenon of the climate of our country.

Flood is the phenomenon of land cover with a layer of stagnant or moving water that through its size and duration causes human victims and destruction. Floods can be foreseen, except instantaneous, which manifests like a dam breaking. Thus, this type of the event is usually preceded by prevention intervals. Depending on their magnitude, floods can destroy buildings, bridges and crops; can kill humans, livestock and wildlife. Floods are some of the natural phenomenon that deeply marked and marks the development of human society, being the most geographically widespread disasters around the world and also the largest producer of damage and human casualties. At the same time, floods were the causative factor and the catalyst for big changes in the approach to this phenomenon, from accepting flooding as a freak of nature to man trying to resist nature through approaches such as the fight against floods, to the flood defense [1].

Floods produced in recent years and the consequences that have followed have led, due to an increase in social responsibility, to a new approach of flood risk management the awareness and involvement of human communities have a vital role in avoiding loss of lives and reduce damage [2, 3, 4].

This approach is now almost general, is the one that opened the way to meet future challenges by introducing new concepts such as „more room for rivers” or „living with floods” and, especially, by assimilating the concept of sustainable development in flood risk management.

Flood risk management is the application of policies, procedures and practices aiming to identify risks, analyze and evaluate them, treating, monitoring and evaluation in order to reduce their risk so that human communities, all citizens can live and work and to meet the needs and aspirations of a sustainable physical and social environment.

Flood risk is characterized by the nature and probability of production, receptor exposure (number of people and goods), susceptibility to flooding receptors and their value resulting implicitly as to reduce the risk should be acted upon these features of his.

Intervention measures shall be done in a uniform manner based on the plans of defense against floods, dangerous meteorological phenomena, hydro construction accidents and accidental pollution, which is developed by counties, cities, and by users of potential water pollutants and objectives that may be affected by such events or accidents and at basin level [6].

Development of flood protection plans, ice and accidental pollution, identification, monitoring, stakeholder notification, warning the population, evaluation, limiting the removal or mitigation of risk factors will be made taking into account the mayor, management plans of the territory and restricting the construction regime in flooded areas, the application of design measures that allow buildings and other civil or industrial withstand rising sea levels and their speed, achieving structural protection measures, including the bridges and culverts [7].

Materials and Experimental Procedure

In this paper were chosen for comparison two of the many measures to limit the risk of flooding hydro-technical flood defense schemes: embankment and building a polder, analyzed for unit Jiu - Bechet, Rovinari non-permanent accumulation and for non-permanent accumulation Novaci (Scărița affluent).

The graphs were made using the software program HEC-RAS. The U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) is software that allows performing one-dimensional steady and unsteady flow river hydraulics calculations, sediment transport-mobile bed modeling, and water temperature analysis. The HEC-RAS software supersedes the HEC-2 river hydraulics package. The HEC-RAS software is a significant advancement over HEC-2 in terms of both hydraulic engineering and computer science. This software is a product of the Corps' Civil Works System Wide Water Resources Research Program (SWWRP). The first version of HEC-RAS (version 1.0) was released in July of 1995. Since that time there have been several major releases of this software package, including different versions. The HEC-RAS software was developed at the Hydrologic Engineering Center (HEC), which is a division of the Institute for Water Resources (IWR), U.S. Army Corps of Engineers [5].

Rovinari is a town in Gorj County, Oltenia, Romania. Is mining town, with the economic base of coal mining (surface and underground) and production of electricity in the city power plant, one of the first in Europe in size. Rovinari non-permanent accumulation is of particular importance, given the need to protect the downstream villages and objectives, being designed both for flood control and for protection of coal pits. Rovinari non-permanent accumulation is situated on the middle of the river Jiu immediately exiting the gorge region and Carpathian hills. The accumulation consists of natural depression at south of the city Rovinari and 15 km downstream from the city of Târgu-Jiu (Fig. 2.).

Embankment works on the river Jiu, upstream from the non-permanent Rovinari are hydrotechnical constructions placed on both sides of the watercourse and are designed for flood defense of localities, agricultural lands and coal pits of Rovinari area.

Novaci is a city in the Gorj county, Oltenia, Romania. Gilort is an affluent of the Jiu and in the upper course that exit from Parâng (Novaci) has a typical mountain valley with steep slopes over 65%, with a river network density 0.6-0.7 km/km².

Bechet is a city in Dolj County, Oltenia, Romania. It is located in the south of the county, one of the two Danubian ports of Dolj County, with Calafat.

Results and Discussions

Regarding impoundment hydro technical scheme for the protection of the unit Jiu-Bechet, flood defense of this unit was made in the early 1960s. Hydro technical scheme is typical of areas from Danube valley and consists of a simple embankment and drainage system necessary to discharges water from the inside (Fig. 1).

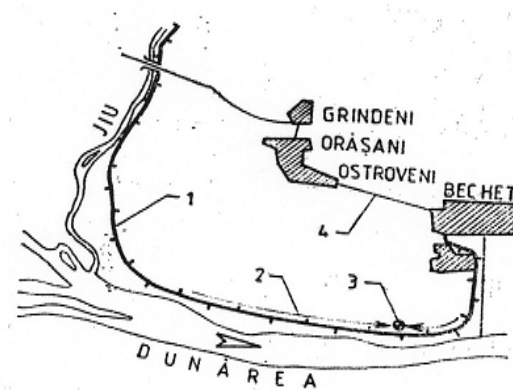


Fig. 1 Impoundment hydrotechnical scheme for the protection of unit Jiu - Bechet against floods

In Fig. 1 is shown embanked unit of Jiu-Bechet consisting of:

- 1 - levee protection;
- 2 - drainage channels;
- 3 - pumping station;
- 4 - road at the limit high of the terrace.

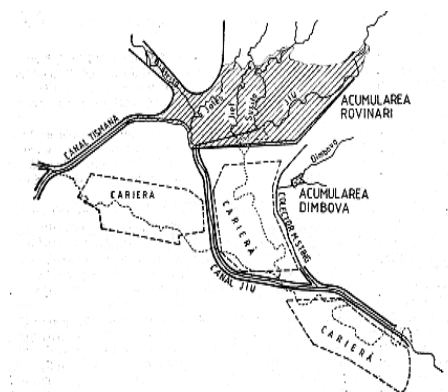


Fig. 2 Rovinari non-permanent accumulation

Flooding area is the main parameter necessary to achieve defense hydro-technical schemes. This can be determined based on calculations performed in various programs.

According to calculations performed with HEC-RAS software in the unimproved variant results flooding limits (the flow rate $Q = 230 \text{ m}^3/\text{s}$, with the probability of exceeding 5%) as shown in Fig. 3.

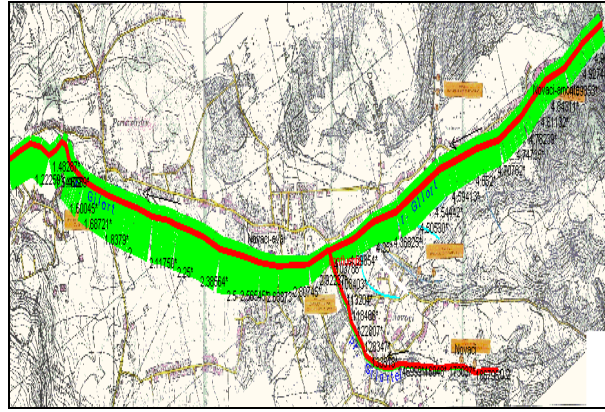


Fig. 3 Flooding limits for unimproved variant

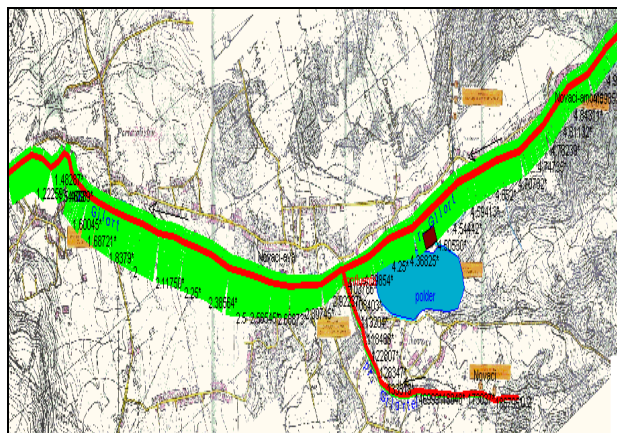


Fig.4 Hydro-technical flood defense scheme for the Novaci town

Fig. 4 shows the hydro-technical scheme for flood defense in Novaci for non-permanent accumulation in the variant with polder on Scărița affluent. It is noted that the flooding, in this variant, is lower than in the unimproved variant.

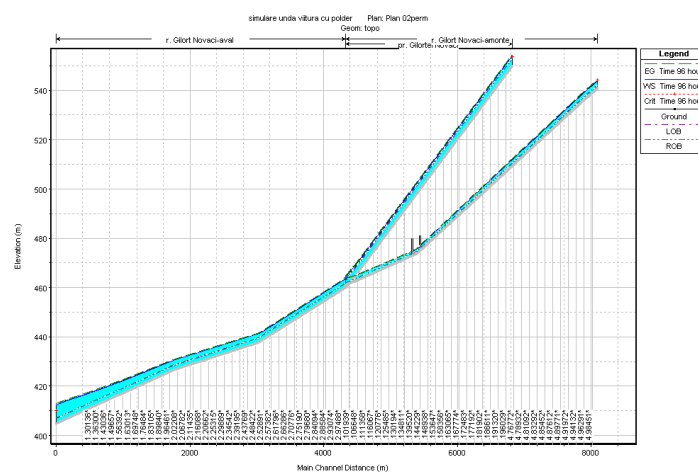


Fig.5 Longitudinal profile in polder version on Scărița affluent

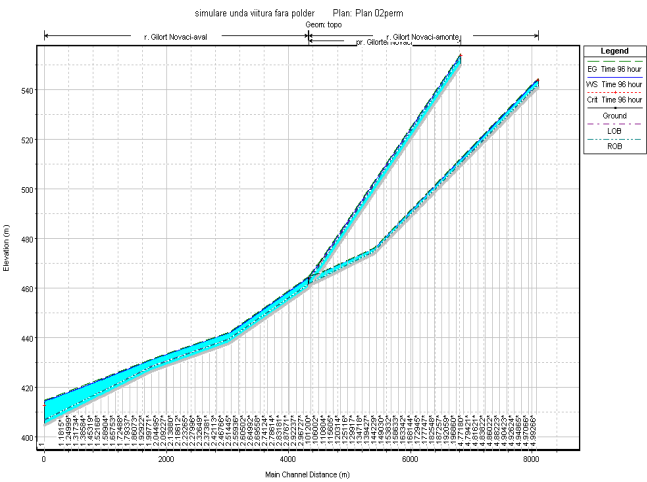


Fig. 6 Longitudinal profile in the variant unimproved regime

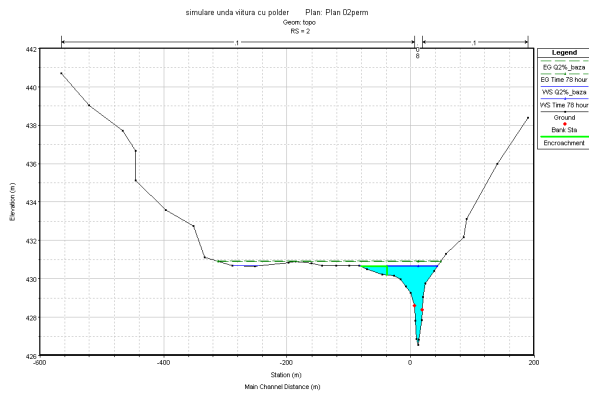


Fig. 7 Cross-section mode in polder variant on Scărița affluent

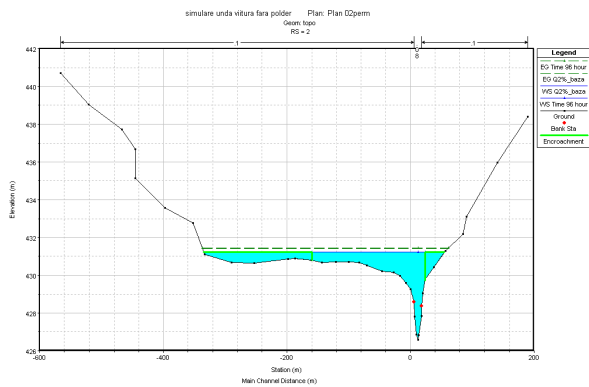


Fig. 8 Cross-section mode in the unimproved variant

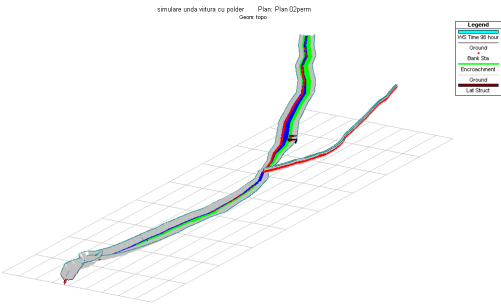
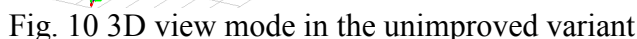


Fig.9. 3D view in polder version, on Scărița affluent



Of the many measures to limit the risk of flooding were chosen for comparison hydro-technical flood defense schemes: embankment and building a polder.

Economic efficiency of the works is good for hydro-technics defense scheme in polder version on Scărița affluent, in the idea that it is desired to decrease the risk for the entire area downstream polder conducted with large investments. A solution with lower investment but higher specific cost is impoundment of affected area (viable areas affected).

Hydro-technical schemes are a techno-economic and environmental compromise with fluctuating boundaries, making the decision to be very difficult, plus the temporal variability and the aspect of economy and nature.

The optimal solution is specific to each river basin and methods of its establishment are different.

- [1] R. Ristic, S. Kostadinov, B. Abolmasov, S. Dragicevic, G. Trivan, B. Radic, M. Trifunovic, Z. Radosavljevic, Torrential floods and town and country planning in Serbia. *Natural Hazards Earth System Sciences*, 12 (2012): 23- 35.
- [2] L.A. Lerner, Assessing global exposure to natural hazards: Progress and future trends, *Environmental Hazards*, 7 (2007): 10-19.
- T.P. Schmidt, S. Greiving, H. Kallio, M. Fleischhauer, J. Jarva, Economic risk maps of floods and earthquakes for European regions, *Quaternary International*, 150 (2006): 103-112.
- [4] T. Walczykiewicz, Priorytety decyzyjne w zakresie realizacji systemów ochrony przeciwpowodziowej, *Gospodarka Wodna*, 2 (2002): 61-64.
- [5] *** <http://www.hec.usace.army.mil/>. Accessed: 2014-02-23.
- [6] *** Government Decision no. 846 of 11.08.2010 approving the National Strategy for Flood Risk Management on medium and long term.
- [7] *** Directive 2007/60/CE of the European Parliament and of the Council on the assessment and management of flood risks. 2007.