

STRUCTURAL MEASURES AGAINST FLOODING IN CLUJ AND DEJ HILLS

ALINA-DACIANA DUMITRA¹

ABSTRACT. – **Structural Measures Against Flooding in Cluj and Dej Hills.** The effects of hydrological phenomena of risk are generally adverse to the environment, generating a lot of damage. Thus the management activity of these phenomena and a planned activity to prevent and combat their negative effects is absolutely necessary. To mitigate the negative effects of hydrological phenomena of risk or reduce the risk, people have completed technical hydrological works to combat the destructive effects of water (flood protection works, to correct torrential formations and reforestation, works for soil erosion control and works to remove excess humidity). The main flood protection technical works existing in Cluj and Dej Hills are the embankments. Regarding these technical works we can mention that not all of them operate at designed parameters.

Keywords: *floods, structural measures, flood protection works.*

1. INTRODUCTION

For thousands of years, people have been attracted by riversides because these areas offered them benefits like drinking water, fertile soil and smooth terrain, ignoring the destructive force of water, minimizing it, or even taking a risk.

Also, for thousands of years people have made various hydraulic works to mitigate the negative effects of floods, or to reduce the risk of flooding. However, as proven by the whole experience of confrontation with floods, in spite of all the efforts, it turns out that the risk cannot be completely eliminated.

The study aims to assess the status of the existing flood defence works in Cluj and Dej Hills area. In the beginning we discuss about the types of measures which may be adopted against flooding. Further we consider the existing flood defense works in Cluj and Dej Hills, with special attention paid to the problem of the status of the existing flood defense works, explaining the causes of this situation. Then we listed some projects with proposals regarding flood defence works, and finally we briefly concluded with some of our own opinions about flood defence measures in Cluj and Dej Hills area.

2. TYPES OF DEFENCE MEASURES AGAINST FLOODS

First of all we have to mention that two types of measures may be adopted against floods: structural and non-structural.

¹ *Romanian Academy, Cluj-Napoca Branch, Cluj-Napoca, Romania, e-mail: alina_daciana@yahoo.com*

2. 1. Structural measures

According to Stănescu and Drobot (2002), structural measures can be classified as follows:

- Measures to reduce flood peak flow:
 - permanent bodies (accumulation) of water;
 - inpermanent bodies (accumulation) of water;
 - works of terracing and soil conservation on hillsides;
 - afforestation;
 - rehabilitation works, to ensure the natural attenuation of flood through the accumulation of water in the floodplain;
 - works of rainwater retention and delay of its flow, especially in urban areas;
 - water derivations;
- Measures to reduce the maximum levels in the bed of the river:
 - cleaning of riverbeds;
 - works of regularization of riverbeds;
- Measures to reduce flood duration:
 - drainage works;
- Measures to protect the goods and people from the flood plain:
 - river dykes and concrete dams.

2. 2. Non-structural measures

Non-structural measures are soft measures to prevent flooding and in case of flooding they include legislative and organisational measures.

The protection of the population against flooding only by engineering is an old concept. The reality unfortunately confirms this fact due to the high number of damages caused to the environment and the population.

Some of the inconvenients related to the construction of water projects against flooding are: the high cost of implementation and maintenance of these works, increasing vulnerability to the shelter offered by them, degradation of ecological balance, improper calculation of the parameters used in the design of older hydraulic works in the context of global climate change etc.

Of course, under certain conditions or in some territorial locations, some structural measures are absolutely necessary to limit the damage caused by flash floods or floods. They are, however, supported by non-structural measures, "soft-measures" in international specific literature.

There is a specific legislation in the European Union, regarding the defense against flooding including *laws and other normative acts*. In Romania one can enumerate: Law 107/1996-Water Law, amended and supplemented; Government Decree 447/2003-detailed rules concerning the drafting and content of natural risk maps; Government Emergency Decree 21/2004 relating to the national system of Emergency Management, approved with amendments and completions by Law No. 15/2005, etc.

Also, in Romania, the Ministerial Committee for Emergency Situations of the Ministry of Environment shall prepare the national strategy for defense against flooding.

The National Strategy for Flood Risk Management is the legislative framework for the preparation and adoption of specific measures relating to:

- the knowledge of the risk of flooding;
- monitoring the phenomenon of flooding;
- taking preventive measures;
- consideration of the risk of flooding in the territorial planning;
- preparation for emergencies;
- reconstruction;
- learning from the experience.

Organisational measures refer to the *organisation of the national system* for the management of emergency situations, the drawing up of *defence plans*, the development of specific collaborative *international projects* and *programmes*, or *educational activities*. *Educational activities* for the population include *simulation exercises* for defence against flooding, *public alert exercises*, *information campaigns* on flood risk management within local communities, or *lessons in schools* for children and young people (themed meetings) to develop a more aware and more responsible attitude in situations of risk, or in relationships between people.

The regional directorates of the “Romanian Waters” National Administration and the County Councils may be the beneficiaries of PHARE *programmes*, by carrying out contracts for the rehabilitation of flood-affected water projects, or for the reduction of the destructive effects of flooding. For example, in 2005, Cluj County Council has received the 371,420 euro, through PHARE/2005/017-690.01.03- “Measures against disasters caused by floods”, intended for the rehabilitation of bridges damaged by flooding in Cluj County.

3. MATERIALS AND METHODS

In order to identify the problems at the existing flood defense works in Cluj and Dej Hills presented in this article, we studied the existing bibliography about risks and particularly about hydrological risks. In addition to the international and national specific literature about risks, we also used the EU and Romanian legislative methodology (laws, decrees, directives) on flooding.

We completed this work with field observations, also shown by photos taken in Cluj and Dej Hills in September 2008.

We have to mention that this study is part of a more extensive research on “Hydrological risk phenomena in Cluj and Dej Hills and Almaş-Agrij Depression”. This study is based on topographic documents and hydrological data based on measurements obtained from hydrological stations, data and information from public and specialized institutions.

4. RESULTS AND DISCUSSIONS

4. 1. The existing flood defense works in Cluj and Dej Hills

In Cluj and Dej Hills, dykes and river bank consolidations have been achieved in larger number, followed by recalibrations and river bed correction works, while soil conservation works are less usual.

The *dykes (embankments)* are the most common works of defence against water overflows, seemingly one of the first man-made works. They are very useful in limiting the frequency of floods. Through the development of embankments parallel to the stream, a prevention of the water overflow is achieved as long as the maximum flood level is lower than the calculation level (fig.1). But dykes can create a false impression of safety and in the

case of major flooding the damage can be much higher than in their absence - by creating the effect of strangulation, or worse, by breaking them. Also, the impact of the construction of the dykes may be negative from the ecological perspective, or even economically or socially.



Fig. 1. Dyke on Someșul Mic River, Cetan village (September 2008).

Support walls have been built more on Someșul Mic tributaries, in settlements near the confluence, in built-up areas with a higher population density, for example in the case of Fundătura village, on Lujerdiu River (fig. 2).



Fig. 2. Support wall on Lujerdiu River, in Fundătura village (September 2008).

In the same village, Fundătura, the water flow section was expanded, next to the bridge, by rebuilding and by raising the road bridge (fig. 3).

Cleaning works by removing the natural vegetation were made on Lujerdiu Valley, as presented in figure 4. Also, the same type of works are required on Chinteni River, or on Lonea River (fig. 5).



Fig. 3. Rebuilding of the road bridge on Lujerdiu River (Fundătura, September 2008).



Fig. 4. Cleaning works by removing the natural vegetation on Lujerdiu River (September 2008).



Fig. 5. Lonea River near the hydrometrical station (September 2008).

We can mention that the cleaning works by removing the natural vegetation which have been carried out in the riverbed of Chinteni River in 2006 had an expected positive effect: the reduction of flooding on the neighbouring land. However, in some valleys, it is absolutely necessary to perform this type of work, especially along the ones where cleaning works have not been carried out since the 1960s, as in the case of Lonea River (fig. 5). Without them, the result may be the production of flash floods with numerous damages in some areas of the valley.

Recalibrations and corrections of water courses are specific works, which in the short term give very good results in the reduction of the maximum level of the water and then of the overflows. The correction of water courses refers to shortening the route between two cross-sections, through the detachment of all or part of the loops. By increasing the longitudinal slope of minor riverbed, a faster transit of the water is obtained. Recalibration of riverbed is carried out by the operation of cross-section enlargement or deepening, in order to increase the volume of water passed through, lowering the risk of flooding on riparian lands. Figure 6 shows recent correction works on Valea Mărului River, in the area of confluence with Someșul Mic River. These works had to be done as a result of the many negative effects of flooding and back stream phenomenon that occur on the tributary. The works were needed to safeguard the railroad and especially the railway bridge which is close to the confluence.

Thus, in Cluj and Dej Hills there are some hydraulic works, intended to defence against flooding the settlements, the socio-economic objectives, farmlands and communication networks. However, the continuation of these works remains a necessity of the first order, as long as the annual flooding leads to damages in numerous bordering localities. In conclusion, the risk areas with a higher probability of being affected by flooding are:

- Dej area;
- tributaries of Someșul Mic River, not equipped with hydraulic works, between Cluj-Napoca and Dej.



Fig. 6. Correction works on Valea Mărului (September 2008)

4. 2. Critical presentation of the main existing flood defence works in Cluj and Dej Hills

Special attention has to be paid to the status of the existing flood defence works in Cluj and Dej Hills.

Regarding the main existing flood defence works in the studied area, one notices that not all of them work at the designed parameters. We find that the current situation of these defence works is mainly due to damage caused by flooding and ice produced on the rivers. Also, the incorrect maintenance of equipment, unfinished repair works, lack of funds and an incorrect promotion of documentation for restoration and repair, are other causes for this situation.

The existing flood defense works in Cluj and Dej Hills that have shortcomings and do not work at the designed parameters are the following:

a) Nadăș River regularization in Aghireș-Cluj-Napoca area (8.9 km long). There are some damaged works (thresholds of water, defence banks) due to the floods. It is necessary to repair the works and new works have to be built to ensure the continuity of the lines of defence;

b) Căpuș River regularization, at Căpușu Mare (2 km long and 3.7 km bank consolidations), where thresholds and banks of defense are damaged by floods and residents;

c) Salca River regularization, at Dej (2.2 km long). The riverbed is clogged in the middle and lower sector and thresholds and support banks are damaged.

During the 2002-2007 period, works of defence against floods in Cluj and Dej Hills have been achieved by completing objectives started in previous years, as well as newly promoted objectives. These objectives have been funded from the state budget and external credits. The latter is part of the funding agreement between Romania and the European Investment Bank signed in Luxembourg on 04.08.2000 and Bucharest on 09.08.2000, ratified by the Government Decree No. 97/2000, as amended by the Emergency Decree no. 150/2001.

The scheduled works were the following:

- *“Improvements against the floods caused by Someșul Mic River, in Cluj-Napoca-Dej sector”*. In the framework of this project, in 2003 the works in phase I were provided for completion (riverbed correction on Lujerdiu River and the left bank of Someșul Mic River) and works on stage II of this objective started (improvement and adjustment of the Someș river);

- *“Reconsideration of flood defence works on Căpuș River”*. In this project, the objective related to Gilău village was aimed to be complete in 2003.

For the period 2007-2015, the following flood defense works are proposed:

- improvement of the defence against floods of Dej City on Someș River, including a non-permanent accumulation of water with a capacity of 10 million m³ and an embankment along the right river bank for 10 km in length;

- improvement of watercourses in the area of Dej City:

- improvement on Ocna River - 4 km riverbed correction;

- improvement on Olpret River - 20 km riverbed correction and 3 km of bank consolidation;

- improvement of watercourses of Someșul Mic tributaries, in Cluj-Dej sector, which includes water accumulation in the upper reception basin for mitigation of flood waves;

- improvement of watercourses of Someșul Mic tributaries in Cluj-Napoca.

The long term proposal (after 2015) provides the following flood defense works:

- improvement on Jichiş River - 4 km riverbed correction and 0.5 km of bank consolidation;
- improvement and adjustment on Nadăş River, the sector between Aghireş and Baci - 22 km riverbed correction, and 6.5 km of bank consolidation.

5. CONCLUSIONS

The effects of hydrological risk phenomena are generally adverse to the natural environment, generating a lot of material damages. A management activity of these phenomena and a planned activity to prevent and combat their adverse effects is absolutely necessary. To mitigate the negative effects of hydrological risk phenomena or to reduce the danger, people have completed technical hydrological works to combat the destructive effects of water (flood protection works, correction of torrents, afforestations, works to combat soil erosion, works for removing excessive soil moisture).

Regarding the main flood defence works that exist in Cluj and Dej Hills, one must mention that not all of them function at designed parameters. The current situation of these works is due mainly to the damage produced by flooding, by the ice on rivers, improper maintenance of the equipment, incomplete repair works, lack of funds, or by non-synchronized documentation for the works of restoration and repair.

Assessing all the analysed elements previously presented, and the prognoses about the future socio-economic development in the Someş catchment area, we consider that it is necessary to correlate the proposals regarding measures to combat the destructive effects of the waters between them. These proposed measures are: flood defence works, works to correct torrential bodies, afforestation, works for removing the excessive moisture of the soil, works to combat soil erosion.

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