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TORRENTIAL FORMATIONS ARRANGEMENT BY INTRODUCING NEW CONCEPTS TO LIMIT SOLID AND LIQUID LEAKAGE

Giurma-Handley Catrinel-Raluca[1], Telișcă Marius[2], Paerele Cosmin-Marian[3]

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Abstract: The concept of sustainable development resulted from the conciliation of three aspirations: economic and social development, protection of the state of environment and increasing the importance of environmental policies. In order to protect the water quality, the catchments are arranged by organizational, agricultural and technical measures and works that need to be applied both on the slopes and in the drainage network. The paper presents new concepts of authors to limit the liquid and solid runoff that could affect water quality as an indispensable factor for life.

1. Introduction

The key issue of sustainable development is the reconciliation between two human aspirations: the need to continue economic and social development but also to protect and improve the state of the environment as the only way for the well-being of present and future generations.

The arrangement of catchments and watercourses is in line with this concept and requires the set of organizational, agricultural and technical measures and work to be applied both on the slopes and on the drainage network and aiming to meet the quantitative and qualitative requirements of various uses and floods mitigation to protect endangered objectives. In this respect, the most important works are for erosion mitigation and landslides, leakage regulation on slopes and on the torrential network, river bed regulation for stabilization, to ensure the proper transport capacity and to regulate the flows by floods mitigation and the water use. These works have to be applied in a staggered complex and require technically and economically justified justifications (Chow V.T., 1964).

[1]Technical University "Gheorghe Asachi" of Iasi, Romania, giralcat@yahoo.com
[2]Technical University "Gheorghe Asachi" of Iasi, Romania, mtelisca@tuiasi
[3]Romanian Waters Administration, Bacau Water Directorate,cosmin.paerele@gmail.com

Priority is given to landscaping on the catchments slopes as they are the most economically and socially efficient due to their major contribution in improving the hydrological regime the slopes are the most important source of sediments and have a strong influence on other types of water courses (Giurma I., Giurma-Handley C., Craciun I, 2010; Giurma I., 2006, Giurma I., et al.2010).

2. Runoff regulation on the slopes

Runoff regulation on the slopes is accomplished by anti-erosion works, which must represent the first and most important measure for the complex rehabilitation of catchments.

Problems of runoff regulation on the slopes are related to the erosion process, torrential formation, humidity excess and landslides (Anderson J., 1971).

Next, the arrangement of torrential formations will be discussed by introducing new concepts to limit solid and liquid runoff.

These arrangements are aiming to protect agrarian land, communications routes, populated centres, water management and environmental protection objectives, against negative effects of floods using schemes and types of works differentiated according to the torrential formations characteristics, according to the construction materials and the social- economic objectives importance.

The transversal hydrotechnical works used for the arrangement of the torrential network are divided, by their height, into sleepers, thresholds and dams.

According to the construction materials used and the applied execution technologies, these works can be of: earth, wood, stone masonry, concrete, reinforced concrete etc.

Adopting the solution for a certain material results from the fact that it must correspond to the technical and functional specificity of the works it encompasses, as well as the possibility of procuring, transporting, and putting into operation the respective material; works must meet certain economic and energy requirements; materials such as stone, wood and earth are recommended (Giurma I., 2006; Giurma I., Craciun I., Giurma-Handley C.R. 2006).

3. New transverse hydrotechnical works with flexible or semiflexible resistance structures

Classical transverse works in the form of thresholds and dams made of different building materials used in these developments are rigid works with high consumption of materials and energy. Therefore it is necessary to put into practice some types of works that have structures of flexible or semi-flexible resistance that can replace the classic ones with great advantages because they have: a low consumption of deficient materials (concrete, iron, etc.) and embedded energy, presents an increase on the operation reliability, have a pleasant aesthetics, easy

execution in hard-to-reach places, a high work-productivity, a lower construction volume and cost than all the types of works used so far, a better operating behaviour as they can ensure the slope designing and a flood stream dissipation better than classic disposers.

Among these we can mention the following significant works: (Giurma I., 2006; Giurma I. et al., 1990; Giurma I., Stanila Al., 1990; Stanila A., Giurma I., Stanila Al. (1996).

- dam for non-permanent water network management;
- filter dam with flexible elements for torrents;
- filter dam with prefabricated elements for torrents;
- filter dam made of prefabricated elements in monolithic foundations;
- filter dam with prefabricated elements and local materials;
- integral prefabricated filtering dam for the arrangement of torrential structures with "V" cross-section and stable banks;
- variable-geometry filter dam for torrents;

4. Efficiency of some types of proposed works

In order to highlight by comparison the advantages and disadvantages of the technical solutions taken into consideration for the economic efficiency study, the following parameters were considered useful:

- evaluation of direct labour costs;
- evaluation of equipment expenses;
- evaluation of expenditure on materials;
- evaluating the total cost price for a certain height;
- assessing the workload in man hours.

In order to preserve the relative validity of the economic calculations performed for the first 4 parameters, the bill of quantities values in the lei currency were valued in USD. For the application of the economic efficiency criteria, the following types of dams were chosen:

- filter dam for torrents made of prefabricated elements and local materials for optimum heights of 2.0 m, 4.0 m and 6.0 m;
- plan filter dam for torrents made of prefabricated element for optimal heights 2,0 m, 3,0 m and 4,0 m;
- classical foundation dam for torrents, considered as a benchmark with 3.0 m (minimum as a yield limit), 4.0 m and 6.0 m height as the upper limit of comparison.

In order to make a comparative study between the proposed solutions and a classical transversal work (the dam with a flared foundation was taken standard), the measurements were performed for each dam type and height, as well as the estimates for the corresponding categories of works.

Five benchmark for multi-criteria economic analysis were selected. These criteria were:

- direct labour costs;
- expenditure on machinery;
- expenditure on materials;
- total expenses;
- the volume of work in man hours.

For each type of dam were made:

- cumulative quantity take-off on dam height and categories of works and
- evaluation of the comparison parameters by dam type.

With the help of the obtained data, evaluating the comparison parameters, centralized data were obtained for each comparison parameter.

For the comparison parameters, representative graphs were drawn up for each type of barrier and then a cumulative graph was presented which allows direct visualization of the difference in value between the types of studied cross-sectional works (figures 1, 2, 3, 4, 5 and 6). Percentage assessments on the comparison parameters were also made between the standard dam and the two types of new dams, but also between the last two (Giurma I., 2006).

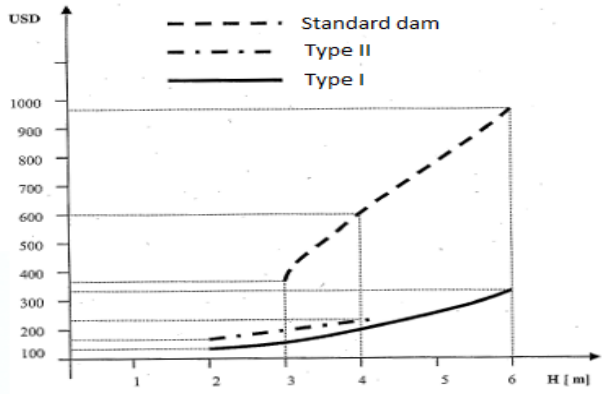

Fig. 1 - Estimate costs for direct labour (Giurma I., 2006)

Each comparison parameter should be considered based on the on-site specific conditions that ultimately impose the most appropriate technical solution.

Within the graphs, regardless of the comparison parameters, can be noticed the special advantages brought by the two new technical solutions. At the same time, the technical superiority of the Type II dam against the Type I dam was found, but under the concrete conditions of the torrential formation in which it can

be used. The specific conditions for the location of the Type I dam are advantageous to apply when no anchorages can be made on the torrent's banks.

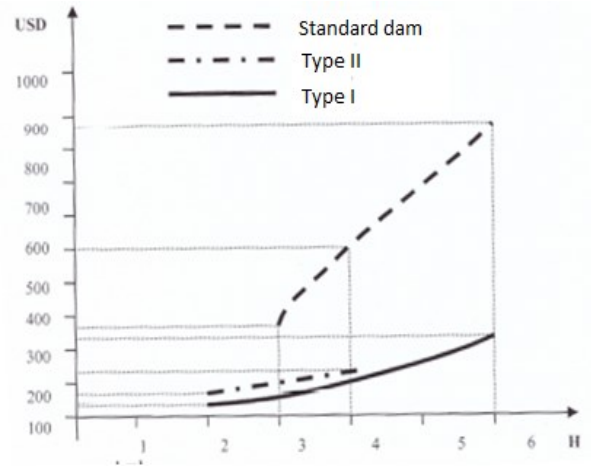

Fig. 2 - Estimated costs for the machine work (Giurma I., 2006)

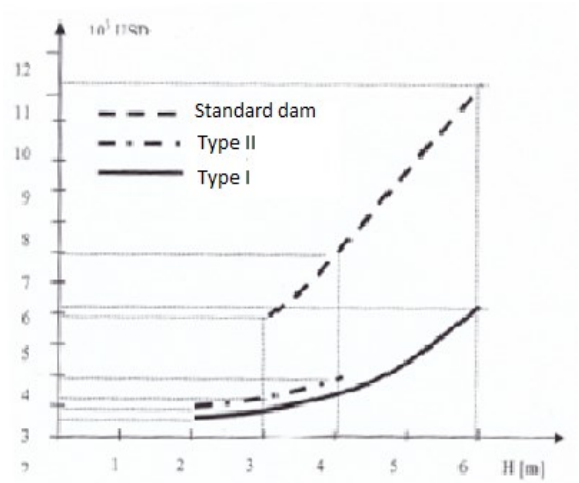

Fig. 3 - Estimated costs for the materials (Giurma I., 2006)

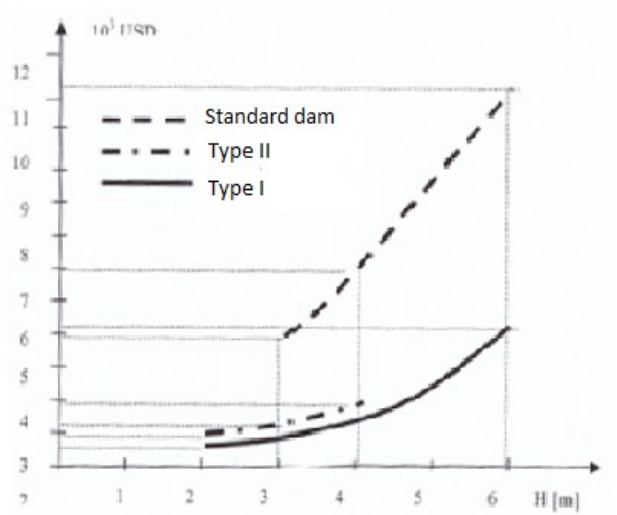

Fig.4 - Total price estimate for a certain height (Giurma I., 2006)

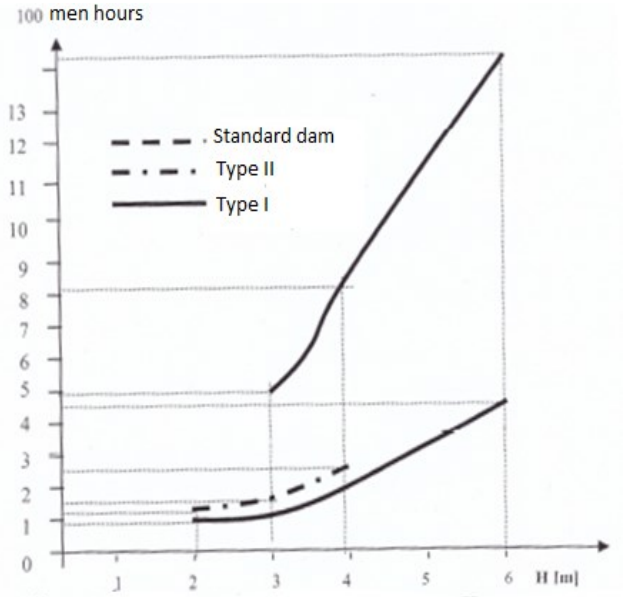

Fig. 5 Assessing the workload in man hours (Giurma I., 2006)

As a summary of the economic efficiency, was chosen the graph in Figure 6, for the overall cost assessment of the standard dam and the filter dam of prefabricated elements and local materials (type I dam), for heights of 3 ÷ 6 m was

chosen for comment. In this context were analyzed the cost savings achieved by replacing the standard dam with a type I filtering dam.

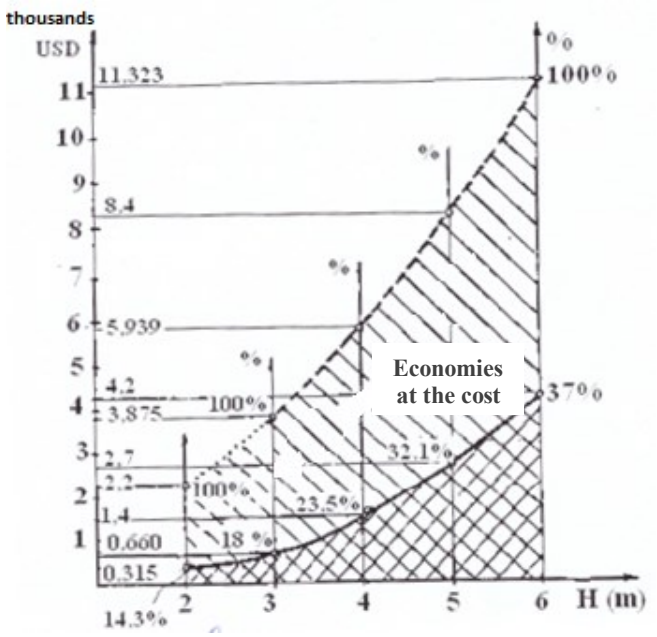

Fig. 6 Cost benchmarking between the standard dam and the type I dam (Giurma I., 2006)

Conclusions

The concept of sustainable development consists in continuing the economic, social and environmental development of a community, but also protecting and improving the state of the environment.

The arrangement of catchments and watercourses is part of this concept and is a practical way of applying it.

Arranging torrential formations to limit liquid and especially solid runoff is a priority.

The hydrotechnical works used in this respect may be classic type and new transverse works with flexible or semi-flexible resistance structures.

In order to reduce investment, it is necessary to use new types of flexible transversal works instead of the known ones.

Apart from the financial effort itself, these works have the following advantages: bed adaptability, structural flexibility, high prefabrication, fast execution time and easy maintenance.

References

Anderson J., (1971) *Runoff Evaluation and Streamflow Simulation by Computer*, U.S. Army, North Pacific Corps of Engineers, Portland, Oregon;

Chow V.T., (1964), *Handbook of Applied Hydrology*, New York;

Giurma I. Giurma Handley Catrinel Raluca, Craciun I., (2010), *Impactul lacurilor de acumulare asupra mediului*, Ed. Performatica, Iasi;

Giurma I., (2006), *Solutii constructive pentru amenajarea formatiunilor torentiale*, Ed. Performantica, Iasi;

Giurma I. et al. (2010), *Managementul integrat al resurselor de apa*, Ed. Politehnium, Iasi;

Giurma I., Craciun I., Giurma Handley Catrinel Raluca, (2006), *Hydrology*, Ed. Politehnium, Iasi;

Giurma I., Stanila Al. et al. (1990), *Baraj filtrant pentru ravene inguste cu structura de rezistenta ancorata pe fundul albiei, construit din materiale prefabricate, cu sistemul de retinere al aluviunilor din fier-beton si materiale locale*, Simpozionul de irigatii si drenaje, Bucuresti,

Giurma I., Stanila Al., (1990), *Baraj filtrant integral prefabricat pentru amenajarea formatiunilor torentiale cu sectiune transversala in "V" si maluri stabile*, I.N.I.D., Bucuresti,

Stanila A., Giurma I., Stanila Al., (1996), *Barrage filtrant plan en elements prefabriques et materiaux locaux an ancrages dans le lit*, Buletin I.P. Iasi, Tom XLIV, Fasc 1-4, Hidrotehnica,

*** Water Framework Directive, 2000/60 EEC.