Lakes, reservoirs and ponds, vol. 1-2: 132- 140, December 2008

THE SURDUC RESERVOIR (ROMANIA)

Niculae Iulian TEODORESCU
National Administration "Apele Române"
Banat Water Directorate Timisoara
niculae.teodorescu@gmail.com

Abstract

The Surduc reservoir was projected to ensure more water when water is scarce and to thus provide especially the city Timisoara, downstream of it with water.The accumulation is placed on the main affluent of the Bega river, Gladna in the upper part of its watercourse.The dam behind which this accumulation was created is of a frontal type made of enrochements with a masque made of armed concrete on the upstream part and protected/sustained by grass on the downstream. The dam is 130m long on its coping and a constructed height of 34 m. It is also endowed with spillway for high water and two bottom outlets formed of two conduits, at the end of which is the microplant. The second part of my paper deals with the hydrometric analysis of the Accumulation Surduc and its impact upon the flow, especially the maximum run-off. This influence is exemplified through the high flood from the 29th of July 1980, the most significant flood recorded in the basin with an apparition probability of 0.002%.

Keywords*:* Surduc, accumulation, the role of accumulation, the influence over the water flow.

1. INTRODUCTION

The Surduc reservoir was projected with a view to ensuring additional water discharge during periods of low water supply, and to thus ensure water use downstream (esp. in the city of Timisoara). At the same time by lessening/diminishing the surge of the freshnet the defence against floods is indirectly produced, too. The accumulation started functioning in 1976. Later on, a water plant was built downstream, in this way the evicted water is used to produce electric energy.

The Accumulation Surduc was created behind the dam placed on the river Gladna - affluent of Bega, at 12.7 km upstream the confluence (fig.1).

2. MAIN FEATURES OF THE SURDUC RESERVOIR

The Surduc reservoir was created behind the dam placed on ther river Gladna-affluent of Bega, 12.7 km upstream the confluence (fig.1).

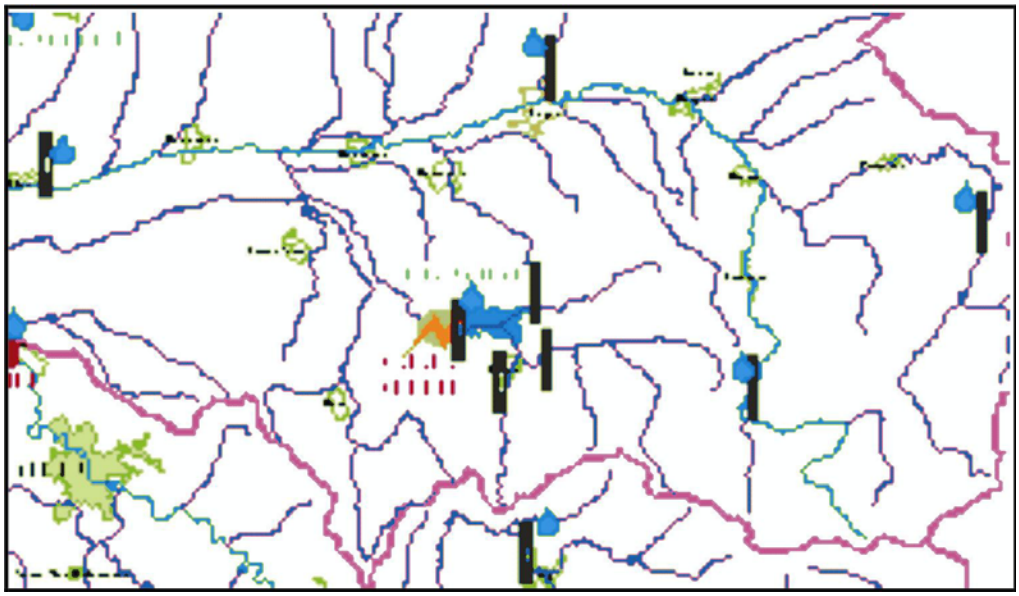

Fig. 1. The superior basin of the river Bega and the Accumulation Surduc on the river Gladna

From a physico-geographic point of view, the catchment basin of the Surduc reservoir is part of the area The Poiana Ruscai Mountains, the highest peak is Pades 1382 m. The main water courses that enter the Accumulation Surduc are Gladna, Hauzeascsa and Matnicel. These have slopes that vary between 42% (Gladna) and fall till 7% (Munisel) and offer a torrential regime. A number of hydrometric stations function on these water streams, the main morphometric elements are offered in table 1. From a geographical point of view the region is formed of methamorphic rocks which belong to the facies of green slates, represented through schist, mica schist, and somewhere granite.

The surface occupied by forests predominantly deciduous forests is 52.4%.

The dam behind which the Surduc reservoir was created is a frontal one with an armed concrete mask on the upstream parameter and protected by sods of turf downstream. At the altitude of 184.00 and 193.00 moBS there are two 1.50 m. wide concrete berns. These are placed on the basic rock (in the area of quartz-graphite and chlorite slates) on a drainage cushion, 1m thick.

Tabel nr. 1.

Gauging stations on the affluents that form the Surduc reservoir

No.	River	Gauging station	Surface F Km^2	Lengh L km	Mean Altitude H_m m	Period of f
1	Gladna	Fardea	62,0	14,0	456	1980 - actual
2	Hauzeasca	Fardea	30,0	9,0	364	1980 - actual
3	Munisel	Matnicu Mic	23,0	7,5	261	1980-1998

The main characteristics of the dam are:

- The length of the barrier front part 130 m
- The built height 34 m
- The altitude of the river thalweg at the dam 171.50 moBS
- The altitude of the coping 203.99 moBS

The coping of the dam has a width of 6 m and is not open for public circulation; the parapet is made of concrete and is 1.00 m tall.

2.1. The constituent elements of the work

There are two discharge of water possibilities from the Surduc reservoir

- The spillway

It is an overfall with a free profile and the altitude of the sill at 198.00mdMB. Initially it was an overfall with a wide sill.

The discharge is produced through a rapid canal 82.90 m. long, the width between 6.00m in the overfall axis and 3.20 at the brise-charge. The slope of the canal is 26.70%.

The energy brise-charge is concrete-armed basin with a width of 3.20m and a length of 21.00m.

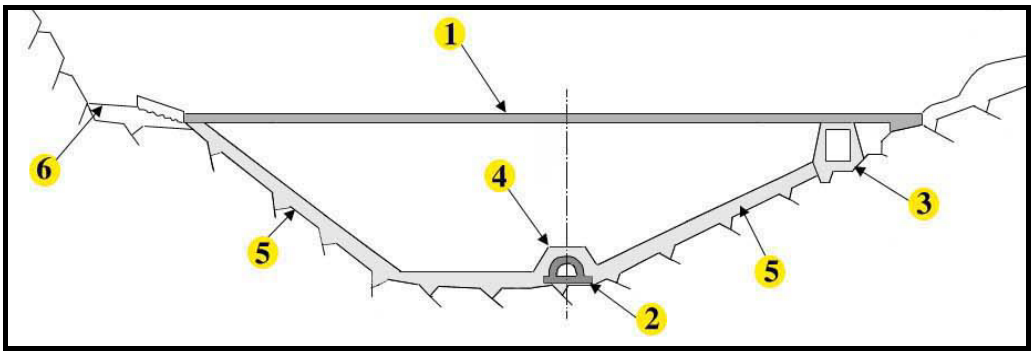

Fig. 2.. Longitudinal section through the Surduc Dam

1. coping of the weir 2. Bottom outlet 3. Side overfall 4. Transversal drain 5. longitudinal drain 6. Rounding way of the lake

- The bottom outlet

It is formed of two pipes placed in a concrete armed galleries at the altitude of 172.00 moBS and downstream at the altitude of 171.00mdMB. Each pipe has a conic grate and a valve butterfly with a Ø 1500. These are used to supplement the low discharge on the Bega river so as to offer enough water for consumption, in order to attenuate freshet and in case of accident for bottom outlet.

The capacity of bottom outlet through a pipe was through construction 17.00 m^3/s.

- The micro hydro power plant

It is placed at 2 km downstream the dam of the Surduc reservoir. The upstream waterway is achieved through concrete pipes Type SENTAB d 2000mm with L=6.00 m and section molded on the spot.

The water level of the soothing basin is 159.70 moBS when both water houses of the micro hydro power plant and the altitude 159.30 moBS when only one water house functions.

The installed discharge for a water house is 3.00 m^3/s a there is a level difference of 21 m.

3. THE HYDROMETRY OF THE SURDUC RESERVOIR

As previously mentioned two hydrometric stations are functioning now on the affluents which form the Surduc reservoir. Upstream the dam there was a hydrometric station which was relocated approximately 2 km.-that is in the immediate proximity of the discharge canal of the micro hydro power plant Surduc. The standard program of observations and measurements provide information that is used efficiently to manage the water in ordinary and extraordinary situations.

Having these elements as a starting point one can realize the balance analysis of the water and the transportation of suspended alluvium. This balance analysis is done yearly. The data recorded on the hydrometric stations on the rivers is compared to the data resulted from observations made on the measuring staff at the Surduc reservoir.

3.1. The balance calculation at the Surduc reservoir

According to the directions elaborated by The National Institute of Hydrology and water Management, the national network uses a series of elements to calculate the balance at the reservoirs. In the following section of this paper we will deal with the specific elements of the Surduc reservoir. These elements are presented in Table 2.

Tabel nr. 2.

The calculation of the water balance for the year 1997

No.	The element of calculation	Mouthly value											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
	Affluent flow	2.23	1.50	0.936	3.74	1.29	0.629	1.19	1.14	0.879	2.59	1.16	1.94
	Defflunetflow	4.39	1.22	0.010	4.29	1.46	0.194	0.910	1.10	0.894	2.95	0.662	2.16
	The balance												
6	The difference of volume in the lake	-1.48	0.196	0.799	-0.373	-0.192	0.339	0.138	0.071	-0.146	-0.300	0.240	0.355
	ε - error %	-33.5	1.40	10.3	-8.60	-5.80	8.90	-2.90	-11.4	8.60	-5.40	18.0	2.70

Tabel nr. 3.

The alluvium balance for the year 1997

Section	The element of calculation	Mouthly value											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Gladna – Fardea	g (Kg/m^3)	0.116	0.137	0.055	0.382	0.070	0.148	0.174	0.300	0.118	0.777	0.121	0.084
	W_R (t)	377.6	271.0	80.35	190.2	131.2	140.0	270.5	514.2	160.7	2665	186.6	195.5
Hauzeasca Fardea	g (Kg/m^3)	0.094	0.185	0.093	0.454	0.080	0.021	0.080	0.066	0.093	0.416	0.064	0.084
	W_R (t)	133.9	154.8	50.89	1094	56.2	5.18	56.2	32.1	28.5	54.6	33.7	123.2
Munisel Matnicu M.	g (Kg/m^3)	0.070	0.167	0.094	0.298	0.115	0.061	0.064	0.253	0.098	0.080	0.049	0.062
	W_R (t)	29.5	36.3	8.04	223	24.1	5.18	8.04	64.6	20.7	69.6	20.7	32.1
Total solid discharge		541.0	462.1	139.3	3219.2	211.5	150.4	334.7	607.9	209.9	328.1	241.0	350.8
Golire Ac. Surduc	g (Kg/m^3)	0.021	0.021	0	0.022	0.020	0	0.022	0.022	0.20	0.033	0.021	0.019
	W_R (t)	251.8	62.9	0	243.6	69.6	0	42.8	53.6	41.5	246.4	36.3	112.5
Tota exit W_R (t)		251.8	62.9	0	243.6	69.6	0	42.8	53.6	41.5	246.4	36.3	112.5
Total deposited W_R (t)		289.2	399.2	139.3	2975.6	141.9	150.4	291.9	554.3	168.4	3034.6	204.7	238.3

Total alluvial deposit entered the lake: 9,748.8 t
Total alluvial deposit exit: 1,161.1 t
Total alluvial deposited in the lake: 8,587.7 t; 88,1% alluvium remain;
Clogging rhythm for the year 1997 = 0,04% ; average rhythm of clogging (for the entire period of observation) = 0,02%

3.1.1. The calculation of the water balance

As noticed to establish the balance of the lake Surduc for the affluent of the discharge the data obtained as a result of the observations resulted from the hydrometric stations are used. It is important that we notice that till 1998 there were hydrometric stations on all water streams. Later on some data are obtained through indirect methods: e.g. contribution resulted from the interbassin surfaces or the one resulted from precipitations fallen directly on the surface of the lake.

The diffluent discharges in our case appear under three aspects: the turbinated ones, evacuated through bottom outlet or on the overfall as well as the lost discharge through evaporation of the surface of the lake water. For a considerable time, for this latter element there was an evaporimeter raft and it facilitated through observations the estimation of values in a direct way. As a result of high degree of wear the raft is no longer used and the data are determined indirectly.

Finally a comparative estimation is done between the discharge calculated in this way and those established as a result of the level (volume) differences in the Accumulation Surduc, the error being established through the two methods. More than once between these two values there have been recorded values, sometimes even significant ones. Table 2 presents a balance analysis of the water for the year 1997.

3.1.2. The calculation of the balance of suspended river deposits

The calculation is determined on the basis of direct measurements performed at the two hydrometric station on the affluents and the results obtained downstream the dam. An example of such a situation is offered in Table 3. As it can be observed a significant quantity of alluviums is stored in the lake. However, the calculation of the clogging rhythm shows that it clogs in 500 years.

4. INFLUENCE OF RESERVOIR ON THE MAXIMUM RUNOFF

The biggest high water in the analysed area was recorded on the 29th of July 1980. It appeared as a result of intense precipitation which occurred in the afternoon of the above-mentioned date from a cumulonimbus cloud which was located above the reception basin of the river Hauzeasca. There is a rainfall station in Hauzesti 4 km upstream the hydrometric station. The rain intensity was so big that - according to the information of the villagers - a torrent of water on the valley-side took with it big objects, including the pluviometer post. As a result there is no recording of the rain quantity. In Fardea the

quantity was of 42.6 mm and 40.8 mm at the Surduc dam. A quantity of 64.9 mm was recorded at the gauging station Nadrag, in the vicinity of the hydrographic basin of the river Hauzeasca. 15 km farther, there was no recorded precipitations.

As a result of the flood the instruments at the gauging station Fardea were destroyed. The limnograph and the limnigramm were found in the newly formed bank of the river and had recordings of some values on the decreasing branch of the flood. The information from the neighbouring stations corroborated with the level readings offered by the staff working at the hydrometric station Fardea on the river Gladna and in Matnicu Mic, on the Munisel river, made the presentation of this flood possible (figure 2).

The rain started round 15.45 and lasted till 17.00. The peak of the flood was recorded on the river Hauzeasca at 18.15. As a result of the reconstitution of the maximum flow, it was established that the maximum volume was 320m^3/s. The reconstituted volume of the flood was 3,250,000 m^3. The total volume recorded evicted by bottom spill was of 341,000 m^3.

The reconstitution of the flood in the section Surduc dam was made through composition (figure 2). On the other affluents the water volume was of 421,000 m^3 whereas the balance of the volume in the Surduc reservoir resulting from the accumulated volume and respectively the discharged volume was 4,241,000 m^3. What results is that on the surface of the basin that is not hydrometric controlled as well as on the surface of the lake a volume of 570,000 m^3 was recorded, which enables us to appreciate that we have acceptable precision for this flood.

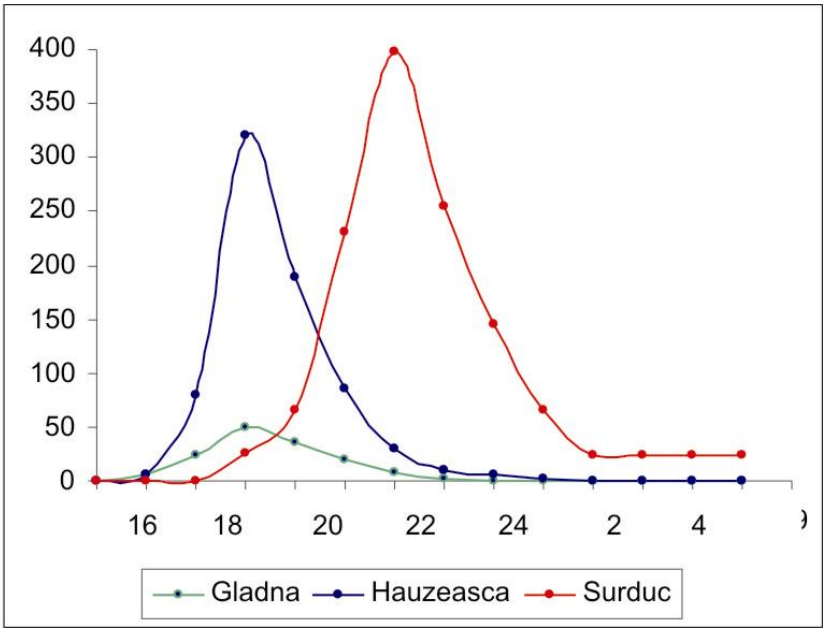

Fig. 2.. The flood from 29th July 1980 on the rivers and Surduc reservoir

Noticeable is the value of the maximum specific flow q_{max} of 10,667 l/skm^2 – exceptionally big values atypical of the physic-geographical region studied. In fact if we compare the recorded values with the value of precipitations with an apparition probability of 1% (INMH,1998) and considering the value of the global discharge coefficient recorded at the other hydrometric stations, it can be considered that the value of the quantity of water resulting from the rain was at least 160 mm.

In order to check the values established in this way we compared these values with those entered the Accumulation Surduc by processing the observations recorded in the interval 29 July (before the beginning of the flood) and 30th of July 7 o'clock. The level of the lake rose with 0.89m from 191.46 moBS to 192.35 moBS corresponding to a volume of 25.527 million m^3 from 22,378 million m^3) in a time span of 12 hours.

We would like to mention some of the damages produced by the flood: 8 people died and some material damages that affected communication means and a series of homes were affected.

5. CONCLUSIONS

The flood on the Hauzeasca valley had an exceptional profile, fact emphasized by the value of the specific maximum discharge value 10,667 l/skm^2 which makes this value unparalleled so far in Banat.

If we compare the value recorded during this flood with the value determined with the generalization relation valid for this area results the apparition probability of 0.005%.Taking into consideration the maximum discharge recorded on other small streams in other parts of the country we have come to the conclusion that it is imperative that we pay more attention to the determination of parameters of maximum charge on rivers with basin surface having areas of 50km^2,especially if we think of the floods recorded on such water streams in the last 3,4 years. At the same time it is important that we underline the extremely important role of accumulation capacity of the maximum volume of the flood in the Surduc reservoir taking into consideration the extreme rare occurrence of a similar flood.

References

Gastescu, P.(1963), *Lacurile din R.P.R., geneză şi regim hidrologic*, Edit. Academiei Române.

Gâştescu, P. (1971), *Lacurile din România. Limnologie regională*, Edit. Academiei Române

Gâştescu, P., Breier Ariadna (1973), Atificial lakes of Romania, în vol. *Man-made lakes-their problems and environmental effects*, published by American Union, Washington.

Gâştescu,P., Sandu, Maria, Driga, B. (2003), Lacul de baraj antropic între necessitate şi impact asupra mediului, în vol. *Riscuri şi catastrofe*, Edit. Casa cărți de ştiință,Cluj-Napoca

*** *The Archive of Hidrological Station Lugoj*

*** – *1998 – Instructiuni pentru calculul scurgerii maxime in bazine mici,* (Instructions for the calculation of maximum discharge in small basins), INMH, Bucuresti, 39 p.