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PARTIAL EXAMINATION OF THE DESIGN OF THE BOMBED OLT BRIDGE IN SÂNCRĂIENI

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Abstract

Throughout Transylvania, the ruins or remains of many engineering structures and buildings can be observed, and this allows us to draw a lot of interesting conclusions. This research seeks to shed some light on the design process of older bridges in Transylvania through a case study. Hydraulic calculations based on field measurements show the hydraulic requirements used in the original design of the bridge. The obtained data was compared to the current requirements of the Romanian design standards.

Keywords*: technical history, bridge design, flood .*

1. Introduction

The subject of our topic is the old Olt Bridge in Sancraieni, which was blown up in September 1916 by the retreating Austro-Hungarian army. The original plans of the bridge are not known, but the structure is not unique on the Olt River, similar bridges were built in Sântimbru, Sfântu Gheorghe and in other places. A postcard illustrating the original state of the bridge can be seen in **Figure 1**. Although the superstructure of the bridge (truss, deck and barriers) was completely destroyed, no damage was caused to the two abutments (**Figure 2.**), thus an impromptu pedestrian bridge was made with their help (**Figure 3**).

The only road bridge in the settlement is located 200 meters from the remains of the old bridge on the county road marked 123A. The technical overhaul of the new bridge and the start of repair work are due to begin in the near future, so flood control of the remains of the bombed-out bridge has become increasingly important.

Figure 1. *Postcard illustrating the former Olt bridge in Sâncrăieni, before 1916* **[1]**

Figure 2. *Ahe current state of the abutment*

Figure 3. *Pedestrian bridge on the original substructure*

2. River section analysis

The subject of this analysis is the cross section of the Olt River in Sancraieni, where the old bridge illustrated in **Figure 1.** was located.

At a distance of 180 meters in front of the cross section of the old bridge is a hydrometric station, the known measurement data of which greatly helped the accuracy our hydrological calculations.

Table 1. *Long-term average flow in the analysed cross section* **[2]**

River	Cadastral number	Average flow
Olt	VIII.1	5,74 m^3/s

Table 2. *River parameters in the analysed cross section* **[3]**

Parameter	Value
Length	58 km
Average slope	1.5 %
Sinuosity	1.26
Retention area	902 km^2
Average altitude above sea level	644 m

Using the above data, based on the hydrological calculations performed, the resulting maximum flows of the river in its cross-section under the bridge are shown in **Table 3.**

Table 3. *The maximum flows of Olt River in the bridge cross section*

Qmax	
%	m^3/s
1	406
5	219

2.1. Current cross section

Following the field measurements, the current cross-section of the riverbed under the position of the former bridge are as shown in **Figure 4.**

2.2. Regenerated, original cross section

A large amount of sediment deposits can be seen in the current cross section of the riverbed, which can be attributed to the constructions in the river channel in front of the old bridge. Based on the geometry of the intact abutments and the level of the riverbed, the cross section presumably taken into account in the design of the bridge is shown in **Figure 5.**

3. Design specifications

Based on Romanian standardization, the flow value used in the design of bridges is selected depending on the priority classification of the structure, according to standard 4068/2 **[4]**. The bridge we examined belongs to priority class 4, according to standard 4273 **[5]**, so the flow value corresponding to the 5 % probability of flood water flow was considered for the calculations.

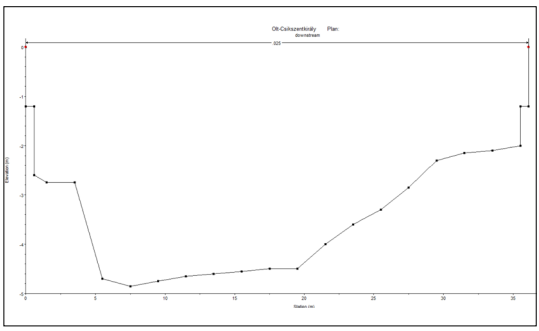

Figure 4. *Current cross section of Olt River at the remains of the old bridge*

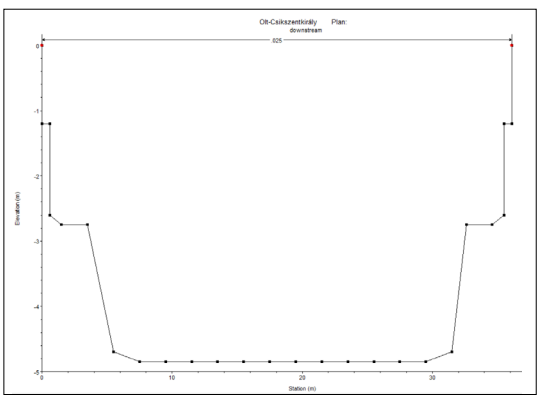

Figure 5. *Assumed original riverbed cross section*

A 2010 government decision stipulates that the target set on the basis of the national strategy for the future is to ensure that the design flow value in rural settlements should be the one corresponding to a 1 % probability of flood water flow [6].

When determining the flow section of the bridges, a certain free height must be taken into account, which, according to the Romanian PD-95 standard, in our case means a height of 1.5 meters [7].

4. Hydraulic calculations

The modelling was carried out using the HEC-Ras software of the US Army Corps Engineers, which uses the Chézy-Manning hydraulic model.

With the help of a first model, we examined whether the bridge, designed more than 100 years earlier, met the pre-2010 Romanian standards, and also whether it meets the current standards..

Based on the results, we can state that the original cross-section meets the requirements of both pre-2010 and post-2010 Romanian design standards. In the case of a maximum flood flow with a probability of 1%, the free height is 2.03 meters (Figure 6).

With the help of a second model, the current cross section of the river was investigated for the maximum flood flows mentioned before.

As can be seen from the results shown in Figure 7, the current cross-section no longer provides the required free height in the case of a maximum flood flow of 1 % probability.

5. Conclusions and further plans

Hydraulic calculations based on the remains of the bombed-out bridge in Sancraieni clearly show that the standards used in the design of the original bridge were stricter, not only by the Romanian regulations valid until 2010, but even by the current standards, thus ensuring the required free height even in case of a 1% probability maximum flood flow, so the newly built pedestrian bridge made on the old abutments meets the requirements of the current Romanian design standards from a hydraulic point of view.

Our second conclusion is that the current riverbed cross-section does not provide the free height required by the standards, and therefore it is necessary to remove the deposited bed sediment shown in Figure 8. and to stabilise the riverbed.

Our further plans include the search for and examination of the remains of similar ruined Transylvanian bridges in order to determine the original design requirements.

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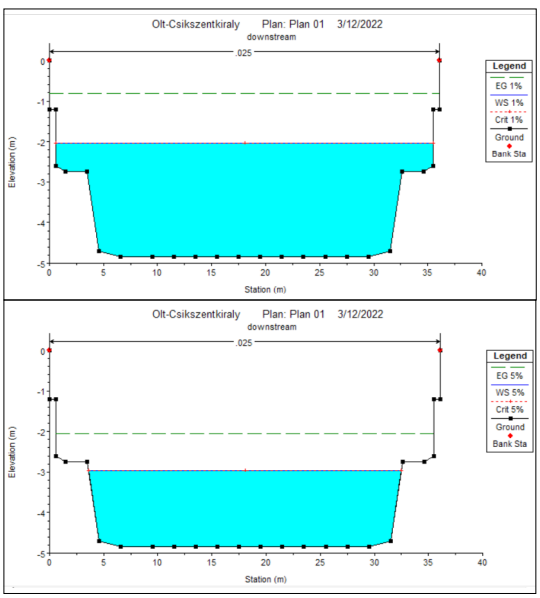

Figure 6. *Assumed original cross section with 1 % and 5% probability maximum flood flows*

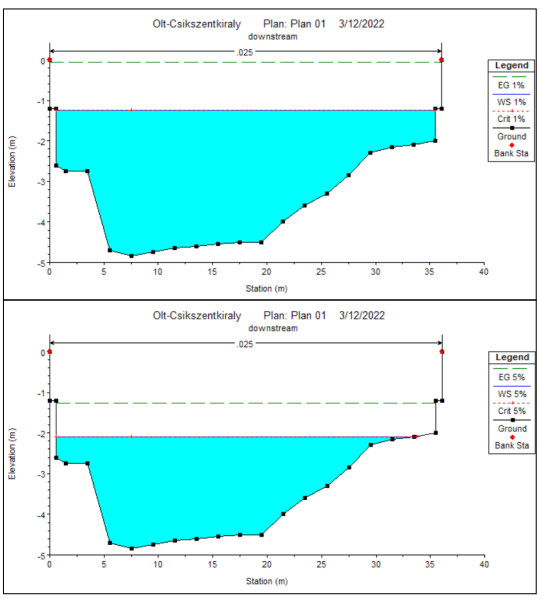

Figure 7. *Current cross-section with 1 % and 5 % probability of maximum flood flows*

Figure 8. *Islands created by riverbed deposits*

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