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Critical observations regarding the reconstruction project of the historic bridge over the Buzau river at Vadu Pasii

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The Anghel Saligny bridge was built in the year 1886, for the simple railroad Buzau – Marasesti. The old railroad bridge was transformed in 1949 into a road bridge for local traffic, reason for which it had a wooden floor on which an asphalt layer was poured. In the year 1980, based on a project by IPTANA, the bridge was rehabilitated by replacing the wooden floor with a precast reinforced concrete slab.
After the floods in 2005, the bridge was decommissioned because the elements from the infrastructure and superstructure were not safe for vehicle traffic, the bridge being presently used by pedestrians from the village near Buzau.
Once the design/construction works started, in the initial phase, the project implied rebuilding the bridge over the Buzau river near the village Vadu Pasii but keeping the historical substance.

In the eastern part of Buzau city, the river with the same name is currently being crossed by two parallel bridges, one railroad bridge for the line CF 500 (Bucharest – Moldova), and one road bridge on DC15 which links Buzau city with Vadu Pasii village.

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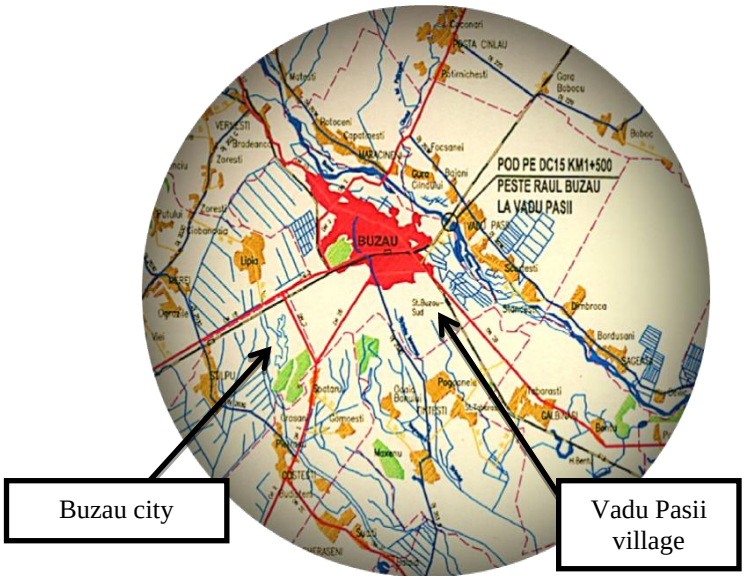

Fig. 1 Emplacement of Anghel Saligny bridge.

Currently, the railroad bridge is being used, while the road bridge (the old Anghel Saligny bridge) is completely closed for vehicle traffic.

The Anghel Saligny bridge was built in the year 1886, for the simple railroad Buzau – Marasesti. The bridge, built with massive masonry piers and abutments and a metallic superstructure, replaced the wooden one (24x15.00m) which was in use for 4 years after the inauguration of the railroad Buzau – Marasesti, in the year 1881.

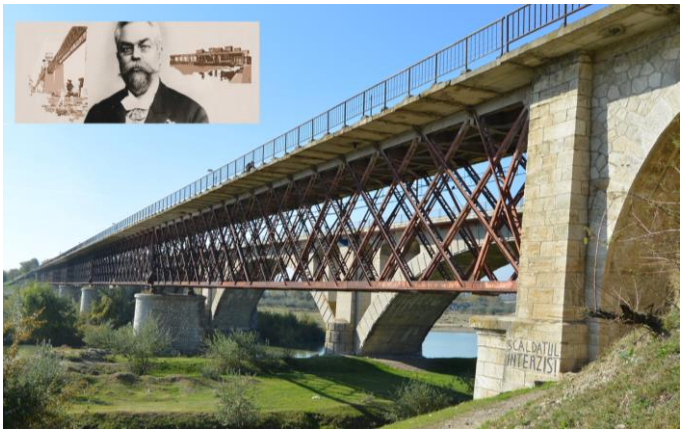

Fig. 2. The Anghel Saligny bridge with the railroad bridge in the background.

The work of art, based on the project of engineer Anghel Saligny, has a superstructure designed as a truss with a top carriageway, having a static scheme composed of two continuous girders with 3 spans of 54.00m each.
During the World War in 1916-1918, the bridge superstructure suffered damages on several spans, the most significant being on spans IV and V.
At the end of the war, in 1920, a provisional consolidation took place, the railroad circulation being resumed.
The metallic bridge was used for the railroad until 1928, when traffic was deviated to the new reinforced concrete arch bridge, located 20m upstream.

1. Short history of the Anghel Saligny bridge

The old railroad bridge was transformed in 1949 into a road bridge for local traffic, reason for which it had a wooden floor on which an asphalt layer was poured. The bridge had a carriageway width of 4.00m, without sidewalks and safety lanes. The change of its purpose was made with the condition that it would be reutilized for railroad traffic in case of necessity. In case of railroad traffic, the bridge was capable of withstanding the circulation of train convoys composed of two locomotives with an axle load of 15 tonnes and an uniform distributed load of 5 tonnes/m. Used as a road bridge, it was capable of withstanding the convoys from the first class of loads designed for road bridges (24 tonnes rollers and 12 tonnes trucks).

Fig. 3 The Anghel Saligny bridge

In the year 1980, based on a project by IPTANA, the bridge was rehabilitated by replacing the wooden floor with a precast reinforced concrete slab (light concrete with granulite) which provides a width of 6.00m for the carriageway, and two sidewalks with a width of 1.00m each. The carriageway is bordered by reinforced concrete kerbs, and the sidewalks are bordered by the pedestrian guardrails. The calculations made pointed out that the superstructure can withstand the loads from the A10 truck convoy (second class of loads – STAS 3221/86, trucks with a maximum axle load of 13 tonnes and special vehicle with a weight of 40 tonnes).
The Anghel Saligny bridge was subject to several technical analyses after 1995, all of them having similar conclusions regarding the bridge's ability to fulfill its function for which it was adapted in 1980 – county road bridge by introducing the reinforced concrete slab at its top.

After the floods in 2005, the bridge was decommissioned because the elements from the infrastructure and superstructure were not safe for vehicle traffic, the bridge being presently used by pedestrians from the village near Buzau.

2. Technical data

2.1. Anghel Saligny bridge

The existent bridge has a superstructure consisting in two metal bridge decks, continuous on 3 spans with a length of 54.00m each, and a massive infrastructure using a shallow foundation.
The abutments have an arch shape, with a 6.00m span, which unloads on two towers, with a total length between the ballast walls built behind the abutments of 344.00m.

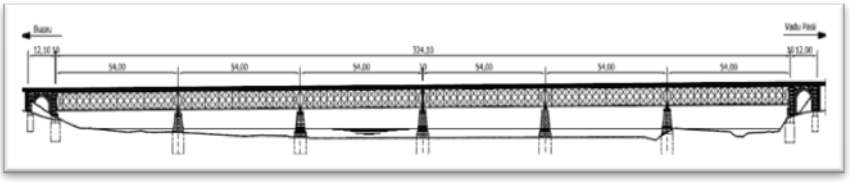

Fig. 4 The longitudinal profile of the Anghel Saligny bridge.

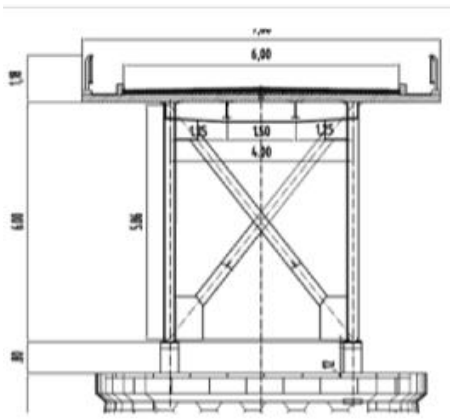

Fig. 5 Cross section of the bridge

The total width of the existing bridge is 8.00m of which 6.00 is the carriageway and 2x1.00m are the sidewalks.
The bridge deck consists in a multiple triangular system truss with a width of 4.00m and a height of 6.00m made out of puddled steel. The slab consists in precast reinforced concrete elements with the dimensions (4.10 x 1.50 x 0.20)m which lay on the longitudinal ties and the upper flanges of the beams.

2.2. Technical expertise

The technical expertise from 2006, realised by engineer Ionel Beli, shows the path to follow for the rehabilitation of the bridge at Vadu Pasii, the proposal being to remove the existent steel bridge deck composed out of the concrete slab and the

metallic structure followed by the introduction of a new bridge deck with steel beams and a reinforced concrete slab at the upper level designed for class E loads. The proposal included to simultaneously start consolidation works for the piers which endured an intense process of erosion lately, as well as defense works for the abutment on the left bank of the river. The expertise contained a comparative analysis with the consolidation solution of the superstructure and infrastructure for the existent bridge, solution which although financially similar with the one described before, could not withstand the conditions corresponding to the E class loads.

In these conditions, the expertise recommended to start the first scenario in the restoration process of the bridge at Vadu Pasii. It was mentioned that the existing metallic bridge deck could be decommissioned, used with minimal interventions on less important rivers with adequate bearings (small spans), for inferior load classes, keeping the historical substance (solution which was not retained). According to the technical expertise from 2006, which was put at the disposal of the employer, the bridge qualified in the 4th technical class, total unsatisfactory state, with construction elements in an advanced state of degradation which require major repairs and replacement or consolidation of some elements.

2.3. The initial D.A.L.I. proposal

In accordance with the proposals in the technical expertise, the D.A.L.I. project recommends consolidating the infrastructure and building a new bridge deck in order to keep the historical substance for all the elements of the bridge.

After the geotechnical studies of the emplacement, two solutions regarding the consolidation of the bridge foundation were taken into account (through injections or the use of bored piles).

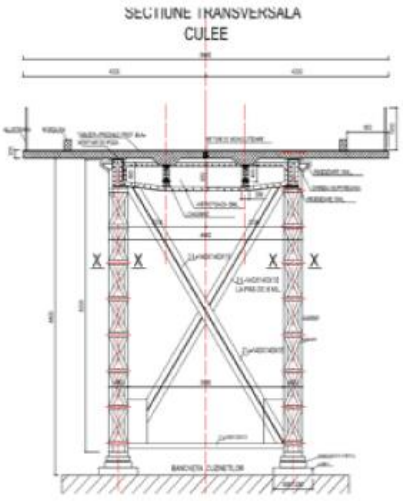

Fig. 6. Cross section of the bridge on the abutment.

3. The superstructure

For the D.A.L.I. two solutions were taken into account:

3.1. Solution A:

The assisted disassembly of the existing metallic bridge deck, in order for its components constituted in full sections, be reassembled, structurally rehabilitated and used as bridges over rivers, secondary roads with the adequate bearings. After the decommissioning of the metallic bridge deck, the next step will be to consolidate the infrastructure and build a new bridge deck on top of it.
This solution was not taken into consideration.

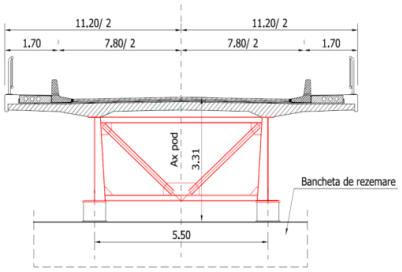

Fig. 8. Cross section in solution A.

3.2. Solution B:

This solution is characterised mainly by the fact that the existing metallic bridge deck is preserved in its present shape, while the new structure is being built independently, on the existing consolidated abutments and piers.
The new superstructure will be designed as a spatial truss, which will include in its interior the old bridge deck made by Anghel Saligny.

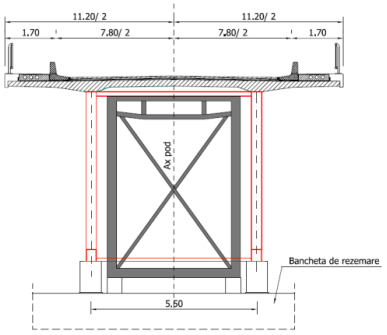

Fig. 8. Cross section in solution B.

On the upper flanges of the truss, the reinforced concrete slab in junction with the flanges will be placed.
It is noteworthy that this new approach in the D.A.L.I. project does not correspond to any of the proposals in the Technical Expertise, most likely being a proposal of the Employer in order to obtain the approval from the Ministry of Culture, proposal also sent to being constructed.

4. The County Council approach

This method was the objective of the Technical Project ordered by the Employer who also chose the solution to be used, namely the “solution B”. The project was finished and given to the Employer.
Once the design/construction works started, in the initial phase, the project implied rebuilding the bridge over the Buzau river near the village Vadu Pasii but keeping the historical substance, which means building a bridge deck around the existing one and keeping the appearance of the existing infrastructure.
The existing metallic bridge deck will be preserved in its actual form (after repairs and painting), the existing reinforced concrete slab will be removed.

The bridge deck was designed as a truss, which will include in its interior the existing metallic bridge deck.
On the upper flanges of the truss, the reinforced concrete slab in junction with the beams will be constructed.
The reinforced concrete slab was designed for vehicle traffic as well as for pedestrians, with cantilever sidewalks at the level of the upper flanges of the truss.

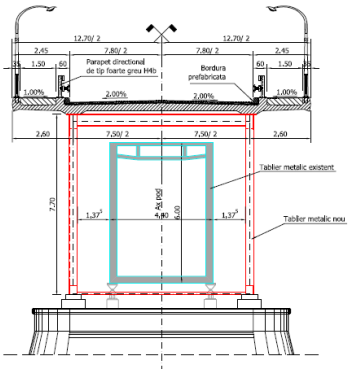

Fig. 9. Cross section of the solution chosen by the County Council.

The design process for the pier's elevation in the solution B (the description of each stage of construction):

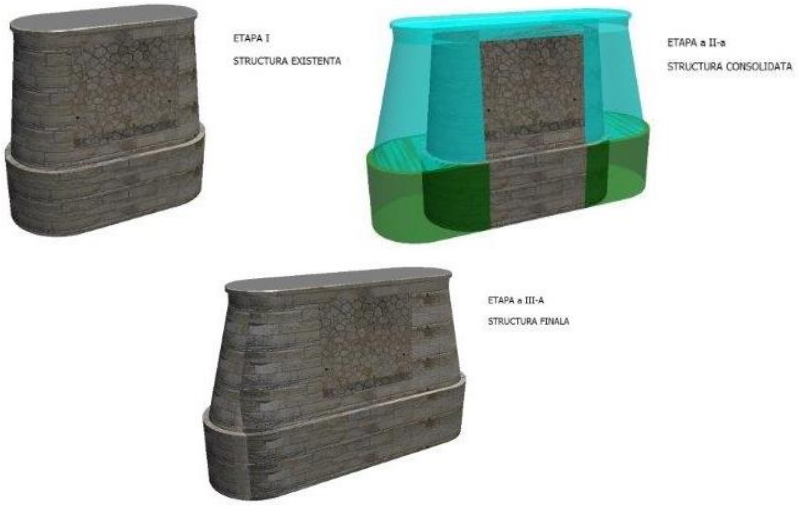

Fig. 10. Construction stages for the pier in solution B.

In view of building a bridge that will keep the historical substance of the objective, the infrastructure of the bridge was designed independently from the existing one.
Thus, the new superstructure will be laid on frame type piers, using deep foundation, on high diameter piles, independent from the existing infrastructure, but also keeping their architectural appearance by using stamped reinforced concrete.
By using this solution, the new structure will be independent from the existing one, also leaving the impression that the structural elements – piers and abutments have a unitary structure.
Given the fact that at the tendering phase, the approval from the Minister of Culture was one of principle, once the procedure for obtaining the building permit started, it was necessary to obtain the definitive approval of the Minister of Culture. This implied obtaining the permit of an expert certified in the field of protecting historical monuments of this kind. Following this approach, the technical expertise was required to be updated, considering the solution that was bid.
The Technical Expertise updated in 2015 says, however, that the solution proposed by the Employer involves a number of drawbacks (in terms of maintenance) and risks, so it proposes the implementation of a new bridge downstream of the existing one and restoring the latter (Anghel Saligny bridge).
By making a new bridge downstream and dismantling the existing bridge ramps up to the level of the new bridge, the visibility of the Anghel Salingy bridge would be total and will highlight the grandeur, beauty and suppleness of the unique bridge, declared historical monument.
This solution also has the advantage that the construction time is smaller and the old bridge will be kept in its current form.
The infrastructure of the new bridge will be built in continuation of the existing bridge's infrastructure and will have a deep foundation consisting in large diameter piles and a reinforced concrete pile cap.

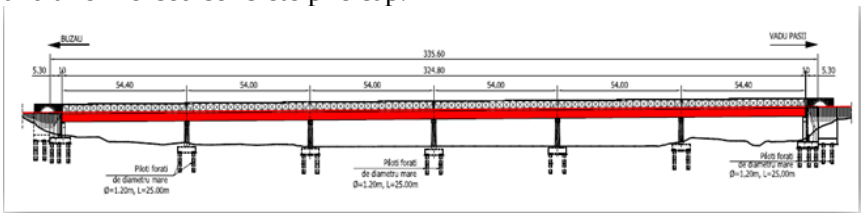

Fig. 11. The longitudinal profile of the new bridge.

The superstructure of the new bridge will have a composite section, steel – concrete and will consist in two steel beams in junction with the reinforced concrete slab at its top.

The static scheme for the new bridge deck will be a continuous beam with six spans of 54.00m each, and a total length of 324.00m.
The bridge will have a clearance of 5.00m for the exploitation roads of the dam, and the longitudinal slope of the bridge will be the same as the existing one (approximately 0.6%).

4.1. Final conclusions

The road bridge over the river Buzau at Vadu Pasii is necessary to allow the circulation of road vehicles, which amongst other aspects represents an economic component for the city of Buzau. In addition, the reconstitution of the historic bridge "Anghel Saligny", declared a historical monument, is respected.
This operation has two components:
The funds necessary for the work component and the historic component for restoring the Anghel Salingy bridge as a historic monument.
The Employer (Buzau County Council) started from one of the solutions examined in the D.A.L.I. study (variant B) keeping the incomplete conclusions from that date and commissioned a project in Technical Project stage to the company Search Corporation. The project was developed and handed over to the employer.
But the discussions on obtaining the architectural achievement, as a historical monument continued producing a new expertise and new discussions with the Ministry of Culture which criticised particularly the solution that implied enveloping the old bridge.
Recently there were talks about a new solution: building a new road bridge as in solution B, but the existing bridge (Anghel Saligny) to be slid out of the new one by providing a foundation to support both structures and the refurbishment of the old bridge.
This way, the historic non-enveloped bridge will have (by restoring it) the necessary appearance of a historical monument. This proposal (unveiled by PhD. Eng. Viorel Constantinescu, author of the D.A.L.I. study) would probably involve more money than the Technical Project developed, but less than the construction of the two bridges separately.
There is also the possibility of abandoning the idea of sliding the Anghel Salingy bridge and placing the new one over it. Another possibility is placing the Anghel Saligny bridge over the new one, by sectioning it and reassembling it at the top.
The problem must remain in the County Council's attention but also in the higher levels of state who can find the necessary funds.