



Co-funded by
the European Union



European
Investment Bank | Institute



7 Most Endangered 2022

Programme run by **Europa Nostra**,
The European Voice of Civil Society committed to Cultural Heritage,
in partnership with the **European Investment Bank Institute**

Zogu's Bridge, Albania Technical Report



Peter Bond
Consultant EIB Institute
Luxembourg

March 2023

Table of Contents

	Page no.
1. Summary	3
2. Purpose, location	5
3. Context	5
4. Description	6
5. Technical aspects	7
6. Implementation	10
7. Procurement	12
8. Environment, sustainability, social	13
9. Use	13
10. Operation and maintenance	14
11. Investment cost	14
12. Economic review and financing possibilities	15
13. EIB Grant	16
14. Conclusions and recommendations	17
Appendices:	
1. Details of mission, persons met, meetings.	19
2. References.	20
3. Photographs and designs.	21

1. Summary

1.1 Context and current situation

Zogu's bridge is an exceptional structure of national and international importance. It crosses the Mat River and was opened in 1927 with six bowstring arches in reinforced concrete of innovative design. It now comprises five arches as the northern span was destroyed at the end of World War II. The bridge has degraded badly since it was excluded from the national road network in 1978 being unsuitable for modern traffic. It has been replaced by new national roads and bridges elsewhere. In 1999 the bridge was recognised as a National Monument and ownership was transferred from the Directorate of Road Authority to the Institute of Cultural Heritage in the Ministry of Culture.

Recently a bridge pier has settled badly creating the serious risk of collapse. Urgent measures are in hand to rehabilitate the bridge under an initiative from the Prime Minister. A very competent technical team, mainly from the University Polytechnic of Tirana (UPT), is developing proposals, working under the aegis of a broadly representative Working Group. This is a sound arrangement, and the early progress so far has been remarkable.

The immediate proposals for stabilising (Phase 1) and then restoring the spans and replacing the failed pier (Phase 2) are still being developed in detail. Challenges remain with difficult foundation work and complex issues on raising the two heavy spans and then replacing the failed pier. These two phases are essential to save the bridge and preferably the works should be carried out so that both phases are completed before the 2023 autumn flood season. If this is not possible the works need to be properly secured for the winter floods.

Cost estimates and timetable should reflect the project's state of advancement. Phase 1 is tentatively estimated at 69 M ALL and of two months' duration. Phase 2 is still at an early stage and so cost and timing are currently imprecise. The funding of these two phases will probably need to be covered by the State. The extent of the full rehabilitation is still unclear, and this will need attention once the urgent works are properly advanced. It should however be carried out in time to restore the bridge to its former grandeur and to appropriate use.

The bridge forms an integral part of the landscape and is affected by and impacts on numerous and diverse sectors. River flows with associated floods and flood control, geology and gravel abstractions, adjacent road traffic and new construction, tourism and heritage interests are all associated with the rehabilitation exercise and these all need to be considered as well as the purely technical challenges.

1.2 Recommendations are detailed under §14 and are summarised below:

The urgent Phase 1 (Stabilisation) and Phase 2 (Restoration) works.

It is recommended to agree to details of the Restoration phase before starting construction work on the Stabilisation phase as these phases are closely linked. Phase 2 should follow on directly from Phase 1 and be completed before October 2023 but if this is not possible the Phase 1 works must be fully completed and secured. In view of the nature and urgency of the works, negotiated construction contract(s) seems fully justified and early contractor involvement is strongly recommended. Legal compliance to these procedures should be checked. Appropriate strong contract management and supervision should be adopted.

Longer term issues.

Efforts should be made to manage better the lower Mat River by controlling the excessive gravel abstractions, by encouraging less concentrated flows and by reducing the flood risks through better hydro reservoir release management. Better cooperation between all the relevant Ministries is to be encouraged. Consideration should be given to enhancing public interest in the bridge by better access and by providing more information on the site and elsewhere.

The European Investment Bank Grant is under discussion and could be used to provide technical expertise to assist in the design development and perhaps also for suitable information panels at the site. The expertise is required soon in order to be most effective.

1.3 In conclusion:

This is a worthwhile and challenging rehabilitation project which needs to be implemented urgently to save this emblematic bridge from collapse. Recent arrangements and proposals to achieve this have so far been sound but major challenges remain both to define and then to complete the works on time. These efforts should extend in due course beyond the immediate preventive measures to a complete rehabilitation of the bridge to allow safe and appropriate use of the bridge, thereby enhancing its industrial heritage and scenic value.

The centenary of the opening of the bridge is in 2027 and this could be a suitable target for its full rehabilitation.

2. Purpose, location

The purpose is to rehabilitate Zogu's Bridge.

This historical road bridge, which no longer forms part of the national road network, is in imminent danger of collapse.

The bridge crosses the Mat River north of the town of Milot and is located 15 km from the river mouth and 40 km north of Tirana, the capital of Albania.

3. Context

The bridge crosses the Mat River and was in the past an important part of the national road network from Tirana towards the north-east and Kosovo.

The bridge is of historical interest being constructed of reinforced concrete (RC) at a time when this technology was still being developed. It comprised six elegant bowstring arch spans and other simpler spans to cross the 500 m wide riverbed. It was commissioned in 1927 and was considered such an innovative and attractive structure that it was named after the King of Albania, Zog I.

In 1944 the bridge was briefly out of service due to war damage when the northern arch was destroyed. After the war this span was replaced by a simple flat slab structure with additional supports. The crossing then continued in service until 1978 when it was replaced by a new north-south road, the SH1, and a modern bridge downstream. Zogu's bridge had been designed to the standards of loading capacity and width relevant to 1920s traffic which are clearly inadequate for modern use. The national road network continued to develop with two other bridges being built across the Mat River in 2002 and 2007. The road built in 2007 was termed the "National Way", the A1, towards Kosovo, and runs along the south riverbank over several of the low spans of Zogu's bridge, thus cutting it off completely from the road network.

The bridge was classified as a National Monument 1st Class in 1999 and ownership was transferred to the Ministry of Culture. Some renovation took place in 2000 but the bridge was effectively neglected thereafter with no serious maintenance or technical supervision being carried out and this has resulted in the gradual degradation of the structure.

This degrading situation has become more serious recently with the settlement of one of the piers supporting two spans near the north end of the bridge. The river flow, especially under flood conditions, has undermined and eroded the alluvium at the pier whose foundation has clearly failed. Settlement of 4 m had occurred at the pier by mid-February 2023, and further movement is feared in the short term which could result in the spans falling into the river. This would be a disaster resulting in the loss of this important national treasure.

The Government is now aware of this serious situation and has mobilised its best talent to study the problems and propose a solution as soon as possible. This would comprise several phases with the immediate priority to stabilise the pier's settlement and then to restore the two bridge spans to their original position before further work is undertaken to restore the bridge more fully.

4. Description

The proposed project works.

The work will be undertaken in phases in line with the priorities and the available capabilities. The technical solutions are still under intensive study.

It should be stressed that the work is complex and will require expertise and great care by designers and contractors working closely together.

The works, as currently conceived, may be summarised as follows:

Phase 1: Stabilisation of Pier No. 5 (from the south end).

- Provide safe access to the site by diverting the river flow and giving access from the main road south of the site. Establish the site works compound and move riverbed gravel to establish a firm working zone around the pier.
- Undertake further geotechnical studies on the pier and its surrounds to aid the technical decisions on the proposed foundation work.
- The concrete of the two spans resting on Pier No. 5 should be inspected and tested to check its condition to avoid damage when the spans are restored to their initial position and configuration in Phase 2.
- Provide a support structure across the pier to relieve the pier of the load from the two spans thus avoiding further settlement. The proposed two-level steel structure would take the span loads initially at the lower level.
- Temporary foundations are required to support the steel support structure. Two main options are under review either with two sets of piles or two massive raft foundations, situated upstream and downstream of Pier no. 5.
- Gravel would be placed around the pier to protect it and a suitable grout would be injected under the existing pile cap to stabilise the foundation.
- Ensure stability of the spans during the later raising process by inserting flexible links between the spans and by other means.
- If phase 2 does not follow at once, provision for extra flood protection measures may be required to avoid damage to the site and the works.

Phase 2: Restoration of the spans to their original position and pier replacement.

- The special structure, installed during Phase 1, is to provide the framework for heavy duty jacks via cables to move the two spans back to their original position. Details are still being developed.
- While the spans are suspended in their original position, the existing Pier no. 5 will be replaced by a new more robust one. Details are still being developed.
- As noted, the design of Phase 2 has not yet been finalised and it will be complicated in concept and challenging to construct. Other options may be considered and could be adopted to achieve the same objectives.

Phase 3 The full rehabilitation

- The northern span, which replaced the arch destroyed in 1944, and its foundations will need to be restored. It may be simpler to construct this span anew rather than repair the existing structure; maybe a modern steel arch bridge (e.g. similar to the pedestrian crossings on the SH1 motorway).
- Additional renovation work will be required on the concrete work, bearings and maybe piers of all the spans and this will need to be defined.

- Restoration of safety barriers and similar bridge components.
- It is proposed elsewhere in this report to enhance the heritage interest of this exceptional structure. Ideas include setting up information panels at both ends of the bridge and later providing better access to pedestrians from the road south of the bridge with an overbridge and some car parking.

5. Technical aspects

5.1 RC bowstring arch design

The total length of the bridge crossing is 480 m and the six main spans are each 54 m long – thus being 324 m of the total length. The main spans are bowstring arches, with vertical height of about 10 m, and each arch provides 15 vertical ties to support the bridge deck. The arches are cross raced at their tops with beams. The whole structure, including the vertical ties, is in reinforced concrete. The bottom chord stiffening beams have been reinforced with steel rods firmly anchored at each end. The vertical hangars are in reinforced concrete with the steel bars lapped over the steel reinforcement in the arches. These hangars are primary tension members which is inappropriate for reinforced concrete and so this design has been rarely adopted since. Steel cables are now the standard hangar solution, often combined with steel arches.

The spans are simply supported with a joint at each end and supported by bearings on to massive concrete piers underpinned by concrete piles (22 under each pier according to the original design). Larssen type sheet piles driven into the riverbed contain the piles under massive concrete pile heads.

The side spans which extend over the gravel terraces at the south end comprise 10 spans with variable lengths with the maximum of 19 m. The piers are simpler with supporting piles driven into the gravel. The recently built national road at the southern end (A1) covers the last six of these spans thus shortening the bridge and cutting it off from the road network.

This is an important historical monument with industrial heritage interest. At the time it was considered very advanced and elegant in its design and construction. No other equivalent structure exists in the world, according to a short study; other shorter span bridges of similar RC design built about the same time still exist in USA and New Zealand but nothing really similar or on this scale.

5.2 Proposed rehabilitation

The spans each weigh about 500 tonnes and the classical technical solution of lifting the two spans off the pier by cranes is not possible as this equipment is unavailable. The concept proposed to support the two spans initially, thus avoiding further settlement, and then to restore them to their original position by means of a double function support structure is ingenious. However, details still need to be agreed on how the span raising operation and the application of the motive force, presumably via hydraulic jacks, will work in practice in both phases, initially by underpinning and then by lifting. The stability of the steel structure during the raising operation (with a 4 m lift) will need special attention. Note that the wind blows very strongly down the valley. A physical monitoring system has already been set up to track changes in the movement of the piers and this is an excellent initiative, providing advance warning.

Overall, the proposed concept seems sound, but much more detailed design work is required, and time is short to complete both construction phases before winter. Phase 2 may need more time to finalise in detail and the timely availability of special jacking equipment may further complicate progress. Other comments on the potential risks are covered elsewhere in this section.

5.3 Concrete condition and tests

The bridge is nearly 100 years old and well exposed to the elements with a wide temperature range and often strong winds. With recent neglect the concrete has degraded with numerous cracks and steel being exposed with inevitable corrosion. The pier settlement has considerably worsened the state of the two adjacent spans with evidence of extensive cracking, particularly in the transverse bracing structure and flakes of fresh spalled concrete are clearly seen on these spans.

The eccentric tilt of the pier may have imposed some twist on the two spans and, if this is found to be so, it is suggested that the twist should be taken out in Phase 1 to reduce the risk of complications during the Phase 2 lifting exercise.

All these span movements will need to be undertaken with great care and at an appropriate slow pace with continuous monitoring.

It is suggested to carry out strength tests on the adjacent span concrete and to include tests to determine the concrete's elastic characteristics in the working range. This would determine whether the concrete has become "brittle" with age effecting its elastic behaviour. There is not much experience of concrete of this age in such conditions and it may be prudent to do these checks.

5.4 River flow and control

The Mat River regime is under the control of the Water Resources Management Agency. The river has an average flow of about 100 m/s at the bridge and the 100-year peak flood flow was estimated in 2010 as 3100 m/s, recently upgraded to 3500 m/s. The 10-year peak flow, more relevant for the current work, may be about 2000 m/s but estimates vary. Data from the damaging flood in November 2022 is not yet available. These floods, which occur more frequently from October through to April, are clearly large and would destroy any working site in the riverbed and so proper precautions are needed to limit this very real risk.

The upper catchment has three major hydro-electric plants with storage reservoirs. There are two plants on the Mat River, the Ulza and Shkopeti, with maximum reservoir storage capacity of 17 M m³ and 22 M m³ respectively. On the major tributary, the Fan River, the plant was commissioned in 2017 with maximum storage capacity of 205 M m³. Hydro-electric plants inevitably operate to maximise their electricity output and may not have much concern for flood control, but this approach is no longer acceptable and should be changed. Modern forecasting can anticipate inflows allowing plants to optimise generation and to provide some flood control. These two main systems have different operating companies and they should be encouraged to cooperate to smooth out peak releases and particularly to avoid the peak flood flows from the two rivers coinciding. The benefits of such flood reduction extend beyond the protection of Zogu's bridge into the lower catchment area below the bridge.

5.5 Gravel mobility and its control

An important contributory cause of the pier settlement is due to lowering of the level of the alluvium at the bridge. The general water level at the bridge has been estimated to be 2 m lower than in 1924. This has been mainly due to excessive gravel abstraction for construction purposes. These abstractions have disturbed the flow regime by concentrating flows and have increased the flow velocity by steepening the water gradient in this section of the river.

The river alluviums are much sought after by construction firms, being of excellent quality for concrete work. The commercial benefit from this resource needs to be balanced against the environment and other damage incurred and every effort should be made to minimise these negative impacts.

Recent measurements undertaken by the Albanian Geological Survey between 2008 and 2022 have shown a deficit of alluvium of some 10 M m³ in the Mat basin. These estimates may be conservative as the Fan River dam and reservoir have only recently been completed and will trap more sediment and gravel from now on. In simple terms, a deficit of about 1 M m³/annum of alluvium is estimated and this is unsustainable longer term and will have increasing negative impacts on the river regime, especially in the lower section.

A River Management Plan is being set up under the Water Resources Management Agency to comply with the various EU Directives. In theory gravel abstractions are controlled, and specific permissions are given by the Ministry of the Environment, linked to active construction projects. It seems that at present three firms are officially allowed to abstract gravel from the lower Mat River, two upstream of Zogu's bridge and one downstream. In reality, numerous other firms also abstract gravel in an uncontrolled and illegal manner. It is normal practice that no gravel abstraction or other such disturbance should take place within 500 m of a bridge. The Albanian Road Authority reports that it carries out inspections for its bridges to ensure that this is enforced. The police force has a role in ensuring that gravel abstractions are carried out legally, but this may not always be effective as seen here.

The flow in the river at low flows is diverted to an irrigation canal just downstream of the bridge on the north bank. This clearly must be retained but it has the effect of encouraging flows to concentrate on the northern section of the bridge and so undermine the piles there – especially pier no. 5. The river upstream has a wide meandering configuration. It would be interesting to see how this could be managed to divert and broaden the flow across the river, perhaps by inserting groynes some 600 m upstream on the south bank; this might also help to protect the road which is close to the bank at that point. Another solution, put forward in informal discussion, would be to build a permanent weir downstream of the bridge; this would help to control the flow across the river and stabilise the gravels. However, it would have to be located to allow the irrigation offtake to operate and would be a major and expensive work.

It is clearly important to control better the gravel abstraction in the future in order to reduce the present environmental damage in the lower catchment. More rigorous approval procedures and proper policing are necessary, in particular to ensure that no abstractions should take place within 500 m of the bridge.

Ideas on how to reduce the concentration of flow on some piers should be explored, for example by controlling the meander upstream or by other means.

5.6 The piers and pile foundations

Details of the bridge piers and piled foundations are given in the original design drawings which still exist in the archives. It is assumed that they were constructed according to these drawings, which seems probable. Visual inspection shows that the piles have failed on the damaged pier with the pile cap settling some 4 m inside the surrounding sheet piles. The concrete piles have lost their friction bearing capacity, probably due to erosion of the gravel under the pile cap. It may also be that the sheet piles have been damaged underneath as they appear in poor condition near the surface. This damage would further encourage erosion under the piers. The 2019 earthquake may have contributed to this sheet pile deformation. More detailed study into the underground state of this pier would be necessary prior to reconstruction.

This reconstruction of the pier will be complicated and delicate. The danger is that further work near the pier to construct adjacent foundations may disturb the original piles and encourage further settlement, already nearly critical for stability. It is proposed to meet these challenges by providing “comfort” to the damaged pier by compacted selected gravel around it and then to inject grout under the pile cap. The next step would be to provide the foundations for the two supports for the main temporary steel structure which will support the two bridge spans. Two alternatives are under consideration for these foundations, either by using piles or by means of rafts. The latter may be simpler with less risk of disturbance to the existing pier and the choice will depend on further data on the local geological and other conditions.

The emphasis has been on the first stabilisation phase but the next phase of raising the spans and then replacing the damaged pile itself is a key challenge as access will be difficult and meanwhile the lifted spans will need to be kept stable. The whole process will need to be agreed at least in workable detail before work on the Phase 1 starts. A possible alternative might be to provide the new permanent pier foundation where the temporary piers are currently proposed and leave most of the damaged pier in place. This however would be visually less desirable.

In summary, further design development is essential for Phase 2 before the temporary foundations in Phase 1 are too advanced to avoid incompatible or unnecessary work.

6. Implementation

6.1 The owner

The owner was originally the Ministry of Infrastructure and by delegation the Directorate of National Road Administration.

In 1999 the responsibility passed to the Ministry of Culture and by delegation to the Directorate of National Monuments.

6.2 Coordination, technical design & supervision

A Working Group (WG) was set up in January 2023 by order of the Prime Minister to provide the overall coordination of the rehabilitation programme. The Deputy Prime

Minister, the Minister of Infrastructure, is in overall charge and the chairman is Mr. Ami Kozeli, adviser from the Prime Minister's Office.

The WG comprises some 18 members representing several relevant Ministries. The project covers a wide range of interests such as heritage/culture, roads, water, agriculture, environment, tourism, energy etc. Most of these are represented in the WG which is excellent but others such as environment, tourism, energy (hydro) are not, and these should become more involved.

Technical experts, covering a wide range of specialities and experience, have been co-opted to assist the WG. Many of these are Engineers from the University Polytechnic of Tirana (UPT). This technical team, led by Professor Markel Baballëku, has been responsible for studying the bridge and for proposing solutions for its full rehabilitation.

It is essential that this technical team continues its work at least through the crucial design stages and with the technical supervision of the works. These arrangements need to be confirmed as University Professors may have other commitments. The design team has shown by its work to be extremely competent and committed and a great asset to the project.

Separate arrangements may need to be made for the longer term activities and for the contracts management depending on the strategy adopted.

6.3 Programme.

The initial technical study was commissioned in late December 2022 and by mid-February 2023 outline proposals were agreed by the WG and others. This was an impressive achievement.

Considerable preparatory work is necessary before construction can begin on site. Obviously the design and specifications will need to be refined, the contractors will need to be selected and, as recommended elsewhere, become involved in the final design proposals and the necessary approvals will need to be obtained. Agreement on the arrangements for the contract management, the site supervision and other issues will also be required and these may take some time and it is important these strategic decisions are advanced in line with the technical progress.

The key objective is to complete the essential rehabilitation works of stabilisation and preferably also of restoration before the flood risk increases in the autumn.

An initial pro forma programme for the Phase 1 works gives a duration of 30 working days. This seems ambitious and assumes continuous working and no technical or supply issues. A more detailed timetable with the latest proposals may result in the programme being extended. Meanwhile it is suggested to adopt a more cautious duration of say 8 weeks for the construction period after final approval of the design.

If it is tentatively assumed that construction on site could start in May 2023, then completion of Phase 1 could be by the end of July.

Phase 2 works of raising the spans and inserting the new pier underneath, should then follow on directly from Phase 1.

If it is assumed tentatively that Phase 2 works would take two months then completion could be before October, thus avoiding the main flood season.

This programme is very tight and will need good coordination between all parties involved and that there are no equipment supply delays.

Carrying out both phases in 2023 would be highly desirable as if the works are paused between the phases the flood damage to the works and site could be considerable. Only when the new pier is installed will this risk be controlled. If Phase 2 is put back to 2024 then special protection measures will be needed with extra costs.

7. Procurement

Contracts strategy and procedure

The design and construction of the first phases of works are complex due mainly to the unknown condition of the damaged structures, the unpredictability of working in the alluvium and later the unusual requirements for lifting the spans and replacing the pier. The works must be completed to a tight schedule to avoid the collapse of the structure and taking into account the risk of the autumn floods.

The design team has been directly selected by the Ministry of Culture and this approach seems fully appropriate in the special circumstances of urgency. The later phases of the design of the rehabilitation may require a more traditional approach.

The definition of the construction works for the first phases of repairing the pier and restoring the two spans may need to be adapted when the actual conditions are met on site requiring flexibility from the contractor(s). Full benefit should be taken of the contractor's expertise in these unusual and challenging operations.

A suitable contract strategy needs to be adopted to allow this flexible cooperative working. The strategy should allow for rapid mobilisation and for early contractor involvement. Strong contract management is a necessary part of such an approach. It is probable that the contract management (as opposed to the technical design and supervision) should be carried out by a specialist firm following a suitable and timely consultation.

To optimise the outcome with these timing and technical challenges, it is recommended that the most experienced contractor available should be selected, following an exceptional negotiated procedure. Preferably several experienced contractors should be approached initially to aid the choice and ensure some competition. The local legal situation should be checked but this procedure is expressly allowed by the EU Directive in exceptional circumstances. It would reduce the selection lead time by several months and reduce both the flood and technical risks and should help contain costs if properly managed.

A special contract arrangement is recommended, either some form of negotiated "Cost +" contract or possibly a more complicated "Target cost" arrangement.

These suggestions will need to be adapted to local practice to ensure pragmatic solutions are used with which the consultants and contractors are familiar.

8. Environment, sustainability, social

8.1 Environmental impacts

The negative local environmental impact due to the works needs to be kept to the minimum. This particularly concerns the alluvium movements at the work site and the site access works. The issue of excessive gravel abstractions is discussed under §5.4 and controlling these will not only benefit the river's regime but also provide a more stable and sustainable situation for the bridge.

8.2 Tourism potential

There is considerable interest and pride in the bridge in the local area and further afield. This local interest has been shown by the enthusiasm of the members of the NGO Association Sebastia, based at Lac.

The bridge is in a dramatic setting with the Mat River emerging from the hills and it is an attractive site with an important landscape value. The rehabilitated bridge would have a double technical attraction as not only was it an exceptional and innovative structure when it was built but the repairs and rehabilitation work (if followed through as envisaged) would be of considerable technical interest.

It is recommended to enhance further the tourism potential as follows:

In the short term by providing information panels at the north end of the bridge site. A panel with historical information might be followed later by one describing the rehabilitation works. See under §13 EIB Grant.

In addition, the Authorities should consider providing two roadside panels indicating "Zogu's bridge" to be placed strategically on the A1 main road to draw the attention of passing motorists to the historic bridge.

In the longer term. The A1 main road on the south bank is planned to be widened to dual carriageway. This opportunity should be taken to add a new pedestrian overbridge to give improved access to Zogu's bridge from the south and combine this with a small parking zone beside the road for visitors.

These and other means of enhancing the interest in and access to the bridge should be considered by the Ministry of Tourism & Environment.

It is noted that the bridge has been recognised for its historical importance by being awarded the "Miss Balkans" award in 2001 but details of this are unclear.

It is also worthwhile noting that the year 2027 will be 100 years since the bridge was opened to much acclaim. This could be a suitable target for its full rehabilitation and so provide a worthy cause for celebration.

9. Use

Zogu's bridge provided the main road link from Tirana and the Milot region to the north-east and was thus a strategic link with appropriate traffic levels.

The bridge is now completely cut off from the road network at its southern end and while there is access from a secondary road at the north end it is closed to all traffic for obvious safety reasons.

After rehabilitation, the bridge should be opened to pedestrians and maybe cyclists and others, depending on the final condition of the bridge and the availability of access. Appropriate cultural and social events may be made possible by rehabilitating the bridge and there is much local interest and enthusiasm in these possibilities.

10. Operation and maintenance

It will be important to ensure proper maintenance once the bridge is rehabilitated and that inspections and regular maintenance is carried out with adequate funding. The Ministry of Culture as owner will be responsible for ensuring this is carried out correctly with technical advice and support from bridge specialists.

11. Investment cost

The project is still under intensive study and several options and variations are being optimised so the present cost estimates should reflect this uncertainty.

The base estimate of Phase 1 of the Rehabilitation construction works was made by the UPT design team in January 2023. These estimates comprised the site works and off-site fabrication but did not include the design development and associated work (tests, monitoring). This estimate should be considered as preliminary and subject to revision when further design details become available and (as recommended elsewhere) the contractors become involved.

A contingencies margin of 5% was included and this is considered inadequate in view of the risks, so a 20% margin is recommended as shown below.

	ALL	Euro (=115.4 ALL)
<u>Phase 1 Stabilisation phase:</u>		
Base estimate Construction	44 620 000	
Contingency 20%	<u>8 924 000</u>	
Subtotal	53 544 000	464 000
VAT 20%	<u>10 708 800</u>	
Total	64 252 800	556 800
Site supervision, tests say 7%	<u>4 497 700</u>	
Grand Total (rounded up)	<u>69 000 000</u>	<u>600 000</u>

Phase 2 Spans Relocation and Pier Replacement phase

Details are awaited so any estimate is very preliminary.

Indicative cost could be > €0.5 M.

Phase 3 The full Rehabilitation

These estimates depend on the extent of works, which is not yet decided, and cannot yet been costed in any detail. Indicative cost could vary between say €2 M and €5 M.

12. Economic review and Financing possibilities

12.1 The economic case

The economic case for restoration cannot be based on road traffic as the bridge no longer serves as part of the network. However, this bridge represents more than a part of the road system as it is a unique structure of great elegance and of historical importance to Albania and beyond. The design and construction were very innovative at the time, using the newly developed concrete as a construction material to great effect. No known examples of equivalent bridges at this scale and interest remain anywhere in the world. The bridge and what it represents should be a source of national pride. Its rehabilitation can be justified on heritage and historical grounds and allowing its collapse would be very negative.

By restoring the bridge under challenging technical conditions should also be a cause for celebration and reflect the strong technical capacity of Albanian engineering. Attracting tourists to visit the bridge should be encouraged and facilitated as the industrial heritage it represents would certainly attract international and local specialists to visit the area with some benefit ensuing locally and nationally.

12.2 The sources of funding

It is understood that funding for the current Phase 1 of study and construction for restoring the pier, at an estimated €0.6 M is covered by the Ministry of Culture. The essential Phase 2 might cost another say €0.5 M or maybe more. Further funds should be sought for the full rehabilitation of the bridge.

The EU is involved in the heritage sector with an ongoing grant programme “EU for Culture”. This €40 M programme is aimed at the reconstruction of heritage sites damaged by the 2019 earthquake, but this grant has already been fully allocated and is underway. Another smaller grant for “Culture and Tourism” is under consideration and has also been fully allocated. The EU has thus been very active in the sector but is unlikely to provide more such grants soon. Long lead times and preparation are a feature of these grants.

The EIB is active with flood studies in the Mat basin through the West Balkans Investment Framework. It is intended that these studies should result in defining works to reduce the impact of flooding in the lower Mat River. There may be an opportunity for an EIB loan or framework loan to support these works which are under the Ministry of Agriculture. There might also be a possibility to include the bridge project or works beneficial to it in such a future loan. Any loan would clearly not be available for the urgent initial phases of the Zogu’s bridge rehabilitation. Note that all grant or loan applications are submitted by the Albanian Authorities and so are prioritised by them. Separately there may be some limited possibilities for private funding, but this seems rather unlikely.

Further efforts are required to identify suitable funds for the later phases of the project’s programme but as the urgent “safeguarding” phases need funds this year, if the programme is met, the only realistic source is State funding.

13. Grant from the EIB

The EIB has allocated a grant of €10 000 to each project selected for the “7 Most Endangered” Programme to be spent on catalytic actions directly related to the project. The Grant proposal should be submitted by the beneficiary and would normally comprise a costed description of the work or study to be undertaken.

Preliminary discussions have taken place and have identified the following possibilities:

- Through the Ministry of Culture or the Working Group.
Technical expertise for specific problems or possibly an overall technical review or exchange of ideas on the final design by a recognised expert.
To be most effective this is required soon and before the design is finalised.
- Perhaps through the Nominator, Association Sebastia, based in Lac.
Prepare information panel(s) to be sited at the north end of the bridge. Approval of the details and the location to be arranged with the Authorities.

14. Conclusions and recommendations

Zogu's bridge is an exceptional structure of national and international importance, damaged due to long-term neglect and compounded by the recent settlement of a pier creating the serious risk of the collapse of two spans.

This risk has now been recognised and urgent measures are in hand to rehabilitate the bridge. This work is under the highest authority, with a very competent design team associated with a widely based Working Group, which could be widened by including environment, tourism and energy interests.

With this caveat, these arrangements seem appropriate and recent progress and output have been remarkable. However important design issues are still to be resolved and finalised and this work is being actively advanced. Time is short to complete the essential works before October 2023 and the onset of the winter flood season.

It is important that this progress and support by the Authorities continues so that the essential works phases are completed preferably in 2023 and that later the bridge can be fully rehabilitated to its former state.

The following ideas and points of concern are put forward to this aim:

14.1 Design and technical issues:

- The design of the stabilisation (Phase 1) is at a preliminary stage and several technical options still need to be finalised. In situ studies are required into the local geology under the settling pier as well as into the condition of the concrete to limit cracking when the two spans are relocated.
- The details of Phase 2, the relocation (span raising) and pier replacement phase, are at a more preliminary stage and these need to be finalised before starting work on Phase 1 to ensure compatibility. Availability of the heavy-duty jacks may be an issue with probable long lead times.
- It is strongly recommended that Phase 2 follows on directly after Phase 1 to limit the exposure to flood risk with completion by October 2023.
- Both Phases will require attention and care, but particularly for Phase 2 as the operation of raising the spans is of considerable complexity and risk.
- If for some reason Phase 2 cannot be completed by October, then the works and site must be properly secured against the flood risk.

14.2 Contracts and construction issues:

- Proper arrangements need to be adopted for optimising and limiting the technical and contractual risk in the construction phase.
- It is recommended that a specialist contract manager or equivalent is used to manage the construction contract(s) in close cooperation with the design team composed as now of a team from UPT.
- The design team, which is clearly very competent, should continue to be closely associated with the technical aspects of the construction.
- In view of the nature and urgency of the works an exception to normal procurement procedures to select the contractor(s) by using a negotiated procedure is recommended. This should be checked to ensure compliance with Albanian law.
- Early Contractor involvement is strongly recommended to ensure optimisation of construction, thereby reducing programme and cost risks.

- Wider coordination with relevant Ministries on environment, tourism and energy should be considered as these are all relevant to the project.

14.3 Longer term general issues.

- Efforts should be made to control better the abstraction of gravel in the vicinity of the bridge, as this has contributed to the current damage.
- Efforts should be made to encourage the large hydro-electric schemes upstream to consider managing the outflows from their reservoirs to reduce the downstream flood risk, and to cooperate in these actions.
- Consideration should be given to studying the upstream alluvium regime to encourage modified river flow perhaps by introducing groynes to reduce the present flow concentration on the north bank at the bridge site.
- Ensure that proper maintenance and monitoring is provided to the bridge after the rehabilitation is complete.
- Consideration should be given to enhancing public interest in the bridge. This could entail providing National Monument notices on the A1 Road south of the bridge indicating “Zogu’s bridge”. In the longer term take advantage of the planned construction of a dual carriageway on the A1 Road by providing better access to the bridge with some parking places and a pedestrian bridge over the new road.

The EIB Grant needs to be discussed and agreed with potential recipients, notably the Ministry of Culture to ensure it is used effectively for the benefit of the project.

In conclusion:

This is a very worthwhile and challenging rehabilitation project which needs to be implemented urgently to save this emblematic bridge from collapse.

Recent arrangements and proposals to achieve this have so far been sound but major challenges remain both to define and then to complete the works on time.

These efforts should extend in due course beyond the immediate preventive measures to a complete rehabilitation of the bridge to allow safe and appropriate use of the bridge, thereby enhancing its industrial heritage and scenic value.

The centenary of the opening of the bridge is in 2027 and this could be a suitable target for its full rehabilitation.

Details of mission, meetings, people met

The Appraisal mission by Pedro Ponce de Leon (Europa Nostra) and Peter Bond (EIB-Inst.) took place between 6th February and 11th February 2023 in Tirana and on site.

Project Nominator: Emarilda Leti, Head of Association Sebastia, Lac

Europa Nostra Representative in Albania: Professor Lida Miraj.

Meetings and additional people met:

- Site visit.

Markel Baballëku. Petrit Picaku, Alb. Geological Survey.

- Association Sebastia at Lac.

Emarilda Leti. Elton Laska, Ymer Hysa, Gjetan Gjetani, Elsa Sula, Luiz Piroli, Gledia Toma, Ronaldo Qema, Liridona Ura, Lor Sana. Entenela Ndrevataj.

- Water Resources Management.

Director Greta Lubonja. Adviser Hermon Bonati.

- Albanian Association of Consulting Engineers.

Chairman Farul Kaba. Prof. Fisnik Kadiu. Prof. Ylber Muceku. Engineer Gëzim Beqaj. Engineer Fatos Tusha. Engineer K. Proseku.

- Ministry of Culture.

Minister Elva Margariti. Eugen Kallfani, DG Nat. Institute of Cultural Heritage.

- Directorate of Albanian Road Authority.

Director Elvis Berberi. Ilir Belba, Nifollaq Mihali, Fatbardh Sakoli.

- EU Commission.

Entela Sulka. EU Programming Officer.

- Technical team from UPT and Working Group.

WG Chairman Ami Kozeli. Prof. Baballëku. Rikard Luka. Tralda Khaferaj. Andiu Kërpaçi. Altin Seranaj.

References:

- “7 Most endangered heritage sites 2022”. Zogu’s bridge, Nomination form.
- “Bridges in Albania” by Gjergj Thomai et al. 2016.
- “Mati River Basin Management Plan”. EU Commission. Sept. 2010.
- “Environmental Overview – the case of Zogu bridge”. Amfora Center. 2023.
- “Preliminary evaluation of “Zogu” bridge and necessary measures” Working Group Engineers. Jan 2023.
- “Technical Project” for Zogu’s bridge rehabilitation. UPT. Feb. 2023.
- WBIF “Mati River Flood Protection – Technical design report”. Appendix 1 Hydrological report. April 2021. Informal exchange on hydrology with Fahri Maho, CEO of E.B.S. Skpk Engineering Consultancy.



Zogu's bridge from the north-west shortly after completion.
(source "Italian architecture in Albania 1925-43 Armand Vokshi")



Zogu's bridge in 2022 from the north-west.



Pier No.5 and adjacent spans. February 2023



The proposed temporary structure to stabilise and restore the spans.
(Source: Technical Project UPT February 2023)



View looking south. February 2023



Pier No. 5 from the south. February 2023



Pier No. 5 from the east. February 2023

(Source Pedro Ponce de Leon)