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setec magazine

Preserving and enhancing our heritage - shaping tomorrow's legacy.

Editorial

Be it historical, classified, industrial or modern, we are surrounded by heritage, which comes in many forms and can raise a number of questions. Aware of our responsibility as an actor in the construction chain and firmly committed to the fight against climate change, it is common practice at **setec** to frequently question our methods.

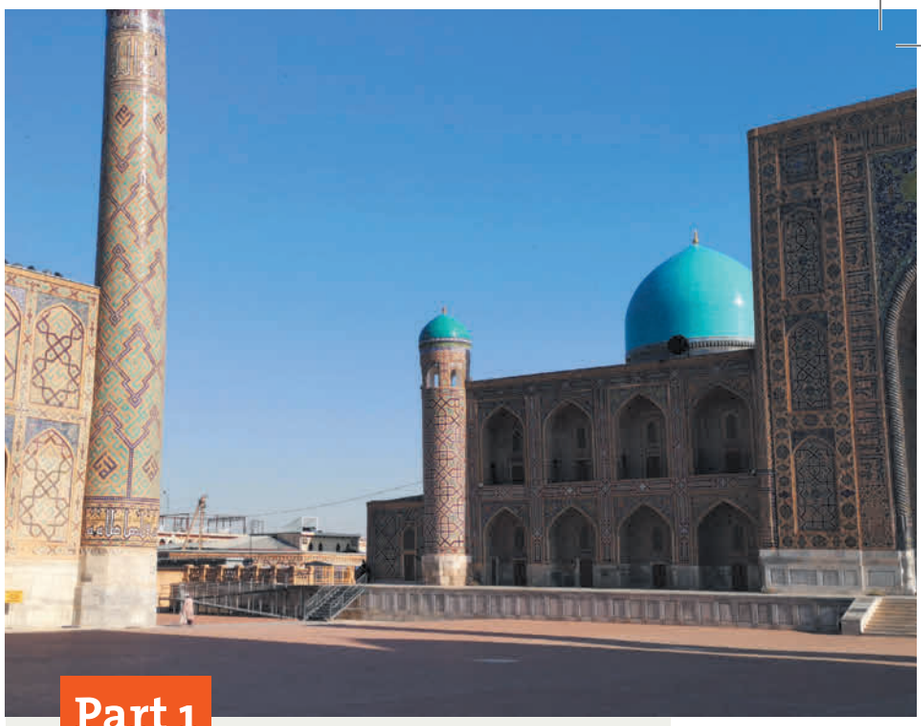
It was with this in mind that in 2022 we launched an internal challenge on low-carbon alternatives to our construction projects. The results showed that the carbon impact of deconstruction-reconstruction is two to three times greater than that of rehabilitation. This determination to rehabilitate, maintain and renovate is at the heart of our heritage and preservation approach.

What are the challenges? Should we be developing the study of materials, thinking about new constructions in terms of reuse and transformation of use, or concentrating on the maintenance of historic structures? To explore the issues and the role of engineering as part of this commitment to heritage, we invited historian, architect and engineer Bertrand Lemoine to talk to our experts on the subject. Whether in France, with the restoration of the Rocher Noir viaduct, or in Brazil with the reopening of the Ipiranga museum, a cultural landmark in São Paulo, heritage is a key element in a country's history, identity, culture and economic dynamism. The annual success of our National Heritage Days in France, for example, proves this point.

2024 will be remembered as the year of the renaissance of Notre-Dame Cathedral in Paris. On the 8th of December, following years of extraordinary restoration work, this architectural jewel was literally able to rise from its ashes. Our teams worked on this exceptional project with dedication and commitment, equal to the scale of the icon.

Protecting our heritage means passing on our legacy and preserving our collective memory. It's also part of a responsible and sustainable approach. Notions that are dear to our philosophy of engineering and which we hope will contribute to a better world.

Enjoy your read,
Anne-Marie Choho, Michel Kahan



Part 1

HISTORICAL HERITAGE

A subject at the heart of our challenges

... INTERVIEW

Bernard QUÉNÉE
Director of Heritage Preservation
setec consultants

Whether it's major historical projects such as the Musée d'Orsay or the Fondation Pinault, setec has always been involved in heritage conservation and enhancement. Bernard Quénée, Director of Heritage Preservation at **setec consultants**, explains the importance of this subject in the history of **setec** and in the light of the challenges we face today.

Can you tell us about your background and your current role at setec?

I am a qualified geologist and completed my academic career with a doctorate with the French electricity company EDF. After five years in a geotechnical design office in Paris, I joined the **lerm**, **setec**'s building materials testing and consultancy laboratory. It has been a great adventure, spanning over thirty years, twenty-five of which were spent at General Management level.

My present role is part of a transversal approach to federating the group's companies involved in preserving built heritage, both commercially and technically. I also work as a materials expert on certain projects, for example in Bukhara, where a hundred or so Uzbek monuments are being classified as UNESCO World Heritage Sites. I also lead a number of national working groups, including the Civil Engineering History & Heritage Commission within the AFGC (French Civil Engineering Association).

What role does heritage play in the Group's history?

Heritage plays a huge part in our history. Since the company was founded, **setec** has been involved in a number of major projects that have had a lasting impact in France, as well as emblematic renovation projects, such as the Orsay train station in Paris, the Saint Jean station in Bordeaux, and the former Paris Stock Exchange. The Group's identity is therefore particularly influenced by our heritage, with an everyday life punctuated by old structures, buildings and sites.

How does this issue relate to our current concerns and challenges?

Preserving our built heritage is closely linked to studying and preserving our natural resources. The conservation of resources such as sand, gravel, rock, soil, biodiversity and aquifers, which we need to include in our studies of the preservation of old buildings and recent structures, is a major challenge.

The environmental impact of our projects, particularly in terms of the carbon footprint of maintenance works, is crucial if we are to avoid major repair or demolition/reconstruction works. To preserve this heritage, we identify and adapt the materials of the future, including low-carbon concrete and bio-sourced materials, while rediscovering traditional materials such as wood, stone and raw earth.

Can you name a few emblematic projects that involve work on historic buildings? And future projects?

The most emblematic examples are found in Jerusalem, with the Tomb of the Kings and the Grotto of the Pater... Two sites owned by the French government! A selection of Le Corbusier's works in France: the Firminy housing unit, the Cité Radieuse in Marseille, the Salvation Army barge in Paris and, more recently, the restoration of Notre-Dame de Paris.

The list of current and future projects is long and diverse, ranging from the restoration of old buildings such as abandoned bridges, castles and fortifications, churches and cathedrals, to the transformation of historic buildings into libraries or museums.

Tell us about your mission?

I coordinate a transversal group involving our group companies: 'heritage preservation', with the primary aim of encouraging exchanges and the sharing of information between companies, and federating energies on this subject.

The research behind these projects and the associated innovations is now an integral part of our approach to engineering in a fast-changing world. Respecting our built heritage, saving natural resources, ensuring the sustainability of projects and preserving the natural environment are crucial issues for future generations. Protecting this historic heritage also means committing ourselves to a mission of passing on the legacy.

+ ZOOM ON

Registration as a Historic Monument in France concerns a structure that is of interest in terms of history or art to such an extent that preservation is recommended. It is the subject of a decree issued by the regional prefect after consulting the Regional Commission for Heritage and Sites (CRPS).

Classification, which is a 'higher' concept, concerns a work whose conservation is of public interest from a historical or artistic point of view. A decree is issued by the French Ministry of Culture.

LEXICON

The ACR (Architecture Contemporaine Remarquable - Remarkable Contemporary Architecture) label: established by the French Act of 2016, aims to identify buildings or constructions that are less than 100 years old, which are not classified as Historic Monuments, in order to emphasise their heritage value and create a link with older heritage and contemporary works.

The main organisations involved in the conservation of French historic monuments include UNESCO, ICOMOS*, the French Ministry of Culture, the DRACs, the CRMHs, the ACMHs, the ABFs, the APs, the LRMH, the C2RMF and the specialist companies represented by the GMH. These stakeholders play a crucial role in the protection, restoration and enhancement of built heritage.

The FFB (French Building Federation) technical guide to the restoration of heritage concrete: written under the direction of Bernard Quénée, this collective work targets the entire profession, from companies to architects, students and teachers.

***ICOMOS:** Conseil International des Monuments et des Sites (International Council on Monuments and Sites). **DRAC:** Direction Régionale des Affaires Culturelles (Regional Directorate of Cultural affairs). **CRMH:** Conservation Régionale des Monuments Historiques (Regional conservation of historic monuments). **ACMH:** Architectes en Chef des Monuments Historiques (Chief architect of historic monuments). **ABF:** Architecte des Bâtiments de France (France's buildings architect). **AP:** Architectes du Patrimoine (Heritage Architects). **LRMH:** Laboratoire de Recherche des Monuments Historiques (Historical Monuments Research Laboratory). **C2RMF:** Centre de Recherche et de Restauration des Musées de France (Research and restoration center for France's museums). **GMH:** Groupement des entreprises de restauration des monuments historiques (Association of companies involved in the restoration of historic monuments).

in the headlines

NOTRE-DAME DE PARIS

The renaissance of Notre-Dame, an incredible human adventure

In April 2019, the fire at Notre-Dame de Paris shocked the world. Ravaged by flames, this jewel of Gothic architecture inspired an exceptional mobilisation, supported by the creation of a dedicated public establishment, presided over by General Georgelin and then by Philippe Jost, the project director.
Behind the technical prowess required for its restoration, a unique human adventure unfolded to bring the cathedral back to life in record time.

Philippe Mouton, Project Director at **setec opency**, sums up this adventure, which has gone beyond the simple issues of restoration: «Taking on a challenge of this scale means experiencing the unexpected on a daily basis, while maintaining a clear view on the final objective, which is to honour the memory of this emblematic site, known throughout the world, while respecting the deadlines set by the President of the Republic». Responsible for the organisation, planning, logistics and coordination of the different worksites, the **setec** team faced some extraordinary challenges during 5 years of intensive work. But above and beyond the technical aspects, it is the links forged with the people involved throughout this colossal project that stand out.
It has to be said that coordinating the work of the 250 selected contractors and the 500 craftsmen, artisans, architects and institutional partners present on average every day on site demanded constant attention and adaptability. «This project went far beyond a simple reconstruction mission. It represented a deep commitment, driven by the respect and pride of participating in the rebirth of an iconic historic site», confides Philippe Mouton, referring to the importance of maintaining harmony within this diverse team, united by the same desire to do the job well.

A strong collective commitment to restore an emblem of French heritage

There's no shortage of anecdotes to illustrate the scale of the project and the inevitable ups and downs that came with it. Right in the middle of the works, it was not uncommon for adjustments to be made at the last minute.
«Every day, we had to deal with the requirements of the different stakeholders, from the diocese to the DRAC (Regional Department of Cultural Affairs - Direction Régionale des Affaires Culturelles), in strict compliance with safety imperatives and heritage standards, while responding to the specific requests of each party,» adds Philippe Mouton.
Another major challenge was the interaction and management of collaborative work between the many different trades on site, in a context where each was making a significant contribution to the restoration of the cathedral. Yvan Rouard, Director of the Ile-de-France Agency at **setec opency**, remembers: «Every craftsman and every company wanted to leave their mark on this historic site. It was a project where everyone's commitment could be felt in every decision».
This collective passion often fuelled lively

debates about the choice of materials or the layout of architectural elements.
«Through discussions and agreements, a spirit of solidarity and collaboration was created, with everyone finding their place and sharing their expertise for the benefit of Notre-Dame,» he adds.
Spending 5 years on the same site inevitably creates bonds. «Over time, we developed a genuine family bond. There was a village atmosphere on the work site, which strengthened the cohesion that is essential if a project of this scale is to be successfully completed, even in moments of intense activity».

Events to remember

An emblematic moment in this adventure was the unexpected discovery of coffins under the scaffolding of the spire, a particularly memorable and moving episode for the whole team.
As Yvan Rouard explains, «This discovery reminded us of the historical importance of each element on this site. It allowed us to measure the impact of our work on the history of Notre-Dame itself». Philippe Mouton also confides that the death in August 2023 of General Jean-Louis Georgelin, the President of the French Republic's appointed representative and President of the public institution Rebuilding Notre-Dame de Paris since its creation in 2019, left a particular mark on the hearts of the teams.
«We were also doing this project for him. Everyone wanted to honour his memory, and that brought us closer together,» he explains, visibly moved. His memorial stone that stands on the site is a reminder of the unbreakable human bond forged throughout the project.
The project was marked by numerous events that testify a deep commitment of the teams to bring the Old Lady back to life. Among them, the Paris Olympic Games were a symbolic milestone, with a major objective: to present an identical replica of the spire, rebuilt according to the plans of Eugène Viollet-le-Duc, to the whole world as a powerful symbol of the project's progress.
The **setec** team had the opportunity to present its expertise and contribution to the restoration project to over 41,000 visitors, including tourists from all over the world who came to understand the challenges of this extraordinary restoration project, during the 'Village du chantier' (the construction village) organised by the public institution on the cathedral's esplanade as part of the European Heritage Days.
For the men and women behind the scenes working every day on the Notre-Dame project, these encounters were a source of renewed energy and strengthened their determination to complete the work on time. For Philippe Mouton and his team, the satisfaction of having contributed to this human adventure is enormous, well beyond the purely professional dimension.
« Each stone, each plank of Notre-Dame has a story, and each person who worked on this site can say that they left a part of themselves within its walls,» he concludes.

Over the years, we developed a genuine family atmosphere, the kind of cohesion that's essential if a project of this scale is to be successfully completed, even in moments of intense activity.

Philippe MOUTON
Project Director
setec opency

+ INTERVIEW

Philippe JOST

President of the public institution
Rebâtir Notre-Dame de Paris*

R. Toussaint © Rebâtir Notre-Dame de Paris

What was your first impression when you joined a project as emblematic as the restoration of Notre-Dame?

Philippe Jost: Right from the start, I was deeply convinced of the urgency and magnitude of the task.

The tragedy of the fire affected me personally: I was born in Paris and have always lived in the Paris region, I'm a Catholic, so this cathedral is 'my' cathedral. I've always had a particular interest in heritage, as shown by my studies at the École du Louvre while I was studying engineering.

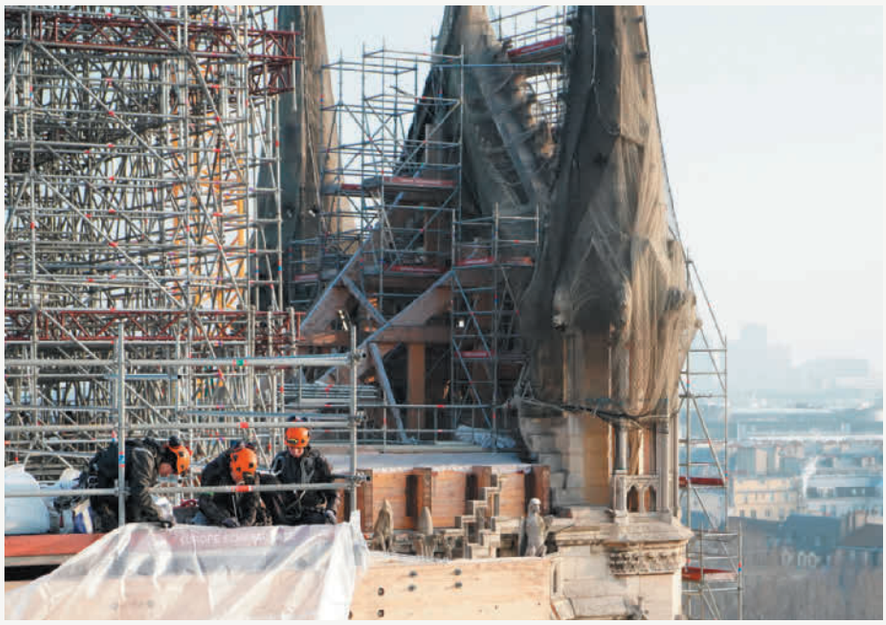
Contributing to the rebirth of Notre-Dame de Paris seemed an obvious choice, reinforced by the appointment of General Georgelin, with whom I had already had the opportunity to work and whom I joined in the very first days after the fire.

Can you tell us more about the collaboration with the setec group in managing this project?

Philippe Jost : The collaboration with **setec** was exemplary in every respect. From the outset, planning, steering and coordination, coupled with rigorous management of site logistics, were key to the successful completion of this major project.

We worked together as if **setec** were an

*Rebuild Notre Dame Paris



integral part of the public institution, with trust, proximity and unfailing commitment. Throughout this extraordinary adventure, the **setec** teams were able to fulfil their mission with the highest level of commitment and competence, thus guaranteeing the success of the five-year challenge.

What were the main challenges involved in the restoration?

Philippe Jost : The first challenge was technical: to rebuild the spire, the timber frames and the vaults, while at the same time carrying out a meticulous cleaning of the interior space, applying traditional techniques and incorporating the latest innovations.

A second major challenge was coordinating a worksite involving 250 companies and simultaneously more than 1,000 craftsmen, including up to 600 on site, in a restricted space in the heart of the historic city of Paris. Thanks to rigorous logistics, meticulous organisation and precise planning, we were able to manage these multiple operations simultaneously. This was made possible thanks to the know-how of French companies in managing large, complex projects.

In this context, **setec** played a decisive role with its expertise in OPC (Ordonnancement, Pilotage, Coordination; project construction scheduling, steering and coordination) and site logistics, ensuring smooth coordination despite the restrictions associated with the site. For their part, the CSPS (Coordination en matière de Sécurité et de Protection de la Santé - Safety and Health Protection Coordination) were a key element in guaranteeing the safety of all those involved. We are particularly proud and pleased that no serious accidents occurred during the entire works.

Notre-Dame is a monument steeped in history and emotion for the French. How did you manage the challenge of remaining faithful to the building while at the same time providing modern solutions?

Philippe Jost : The balance was achieved harmoniously. We opted for authentic materials - solid oak for the spire and roof timbers, lead for the roofing - as well as traditional skills, in particular by rebuilding the spire and roof timbers using 19th and 13th century techniques and methods.

At the same time, we made full use of modern technologies, such as a 3D digital model of the cathedral and simulation software, to check the solidity of the structures and guarantee their reliability. Finally, contemporary innovations were deployed, including a misting spraying system for fire protection, combining technology with respect for the monument.

Can you share an anecdote or a highlight from the project that particularly touched or inspired you?

Philippe Jost: There were many memorable moments. I'm thinking in particular of the final stone being laid for the vault over the transept crossing, or the bouquets laid by the carpenters once the frames of the spire, choir and nave had been completed. These were moments when the collective emotion was palpable, when everyone felt the pride of having contributed to something exceptional. But what I remember most of all was the unity that reigned throughout this adventure, marked by a rare solidarity and closeness between the craftsmen, artisans, architects, engineers, our teams and all the partners involved.

I also remember the moment when the bells rang for the first time after being replaced, or when the great organ found its voice again. More recently, the construction site's celebration reception, where 1,500 site workers came together, was a major highlight, symbolising the unity and fraternity that have brought us together. This unity, solidarity and shared passion are key to our collective success.

What will you remember about this extraordinary journey?

Philippe Jost : This restoration will remain an exceptional human and professional adventure. It reminds us that France possesses unique expertise and is capable of achieving great things.

In these times of doubt, I see the rebirth of Notre-Dame as a symbol of hope, optimism and confidence for the future. I hope that this experience will give us all the necessary motivation to believe in our collective potential, to commit ourselves and to move forward with strength and determination.

We designed a surface foundation using a temporary base, to ensure the stability of the scaffolding while respecting the history of the building.

Marie TARGOSZ
Project Manager - **terrasol**

The rebirth of Notre-Dame: a major technical challenge

The reconstruction of this landmark in the history of Paris and France required rigorous coordination and compliance with strict standards. With a five-year deadline set as an absolute priority, the project benefited from unprecedented organisation.

Selected by the public institution to carry out the OPC (Ordonnancement, Pilotage et Coordination - Scheduling, Control and Coordination) mission on the cathedral site, **setec** was also in charge of the logistical aspects. To do this, **setec** mobilised a team of around fifteen people and adopted innovative methods of management of projects, according to the subdivision of the site into seven specific sub-projects to deal with each aspect, from the spire and the framework to the interior cleaning and the treatment of lead pollution. «Reconstructing Notre-Dame required a methodical, tailored organisation,» explains Philippe Mouton, Project Director at **setec opency**. «This approach made it possible to optimally coordinate the different trades, while respecting the building's heritage requirements».

Following the fire, **setec lerm**, a specialist materials engineering company within the **setec** group, was asked to carry out non-destructive testing on the stonework of the eaves walls of the nave and transept, the gables, and part of the cathedral's vaults and pillars. A real challenge, given the restricted access conditions and the tight deadlines for delivering the results.

Using a miniaturised geophysical radar mounted on a remote-controlled robotic vehicle, **setec lerm** carried out a precise diagnosis of these weakened areas, under the direction of the chief architects of historic monuments and in collaboration with the LRMH (Laboratoire de Recherche des Monuments Historiques - Historic Monument Research Laboratory).

Situated in the heart of Paris, and more specifically on the Ile de la Cité, with its single entrance and exit, the cathedral also required meticulous management of access and traffic flows around the site. As Philippe Mouton explains, «Logistics had to be orchestrated so as not to disrupt the surrounding activity, which meant methodical organisation and constant adaptation to urban requirements. With our co-contractor SICA Logistique, we were able to coordinate, anticipate and regulate all site flows».

Strict sanitary requirements relating to the management of lead dust also meant that rigorous safety measures had to be taken. Each intervention required a meticulous decontamination protocol to guarantee everyone's safety, a fundamental element in the management of such an exceptional project.

At the same time, **setec** provided regular reporting at multiple levels on the progress made, in order to meet the needs of every body within the public institution, from the audit committee to the operations management team. «Each stage had to be precisely documented to guarantee transparency, provide information and maintain the confidence of all involved,» explains Philippe Mouton, underlining the importance of constant communication for the smooth running of the project. One of the major technical aspects of the project was to ensure the foundations of the new spire scaffolding, culminating at almost 100 metres and weighing around 700 tonnes, a task assigned to **terrasol**, **setec**'s specialist geotechnical subsidiary.

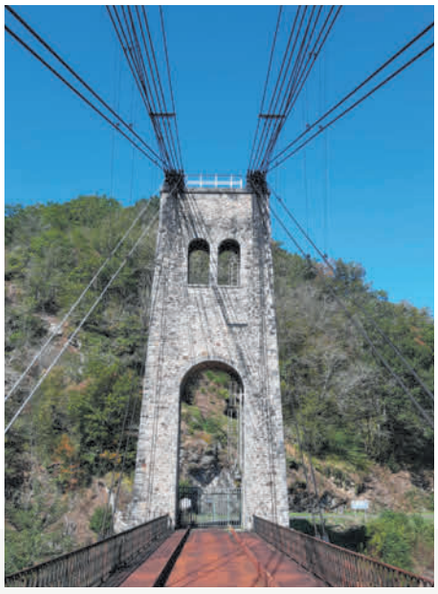
Marie Targosz, project manager and geotechnical engineer, explains: «We designed a superficial foundation using a temporary base, to ensure the stability of the scaffolding while respecting the history of the building». This technical choice made it possible to preserve the historical remains discovered beneath the building and to ensure a solidity compatible with modern safety requirements, without jeopardising the integrity of the existing structures. As for keeping to the schedule, there was no room for flexibility.

«Planning was not an adjustable factor», stresses Philippe Mouton. Indeed, special procedures were put in place to ensure that work progressed continuously, in order to meet the presidential deadline of reopening in December 2024. This requirement, combined with technical demands, guided every operational decision, in particular by integrating innovative solutions to meet the deadlines.

Alavoine and Saint-Michel spires: the restoration of two historic treasures

Since 2014, setec has been helping to restore the Alavoine spire of Rouen's Notre-Dame cathedral, a XIX century neo-Gothic masterpiece. Showing signs of extensive cracking and corrosion, this 151 m cast-iron structure, one of the tallest in Europe, requires expert intervention.
Under the supervision of the Head Architect of Historic Monuments (Architecte en Chef des Monuments Historiques- ACMH) and the project management of the Regional Directorate for Cultural Affairs, (Direction régionale des affaires culturelles -DRAC) in Normandy, **setec** is providing key technical support to reinforce the building.
«This project demands the utmost precision to ensure that the methods and materials chosen fully respect the historic structure, while guaranteeing its strength», explains Sylvie Ezran, Director of Studies at **setec tpi**. The modelling of the internal Corten steel structure, added in the 1970s and carried out by **setec**, makes it possible to accurately verify each restoration phase.
On the recently repainted lower section, the spire has already been restored to its original glory, and the team is delighted. «Seeing the structure restored, repainted and enhanced was a high point for everyone involved in the operation,» says Charles Bimier, civil engineer at **setec tpi**. Works are currently concentrated on the upper section, with completion scheduled for 2026.
At the same time, in Bordeaux, **setec organisation** is providing project management and assistance for the restoration of the Saint-Michel spire, a 114 m high 15th century bell tower.
The church of Saint-Michel, to which the belfry, to be restored, is attached, has been a classified historic monument since 1846, and has been a UNESCO World Heritage Site since 1998 as part of the Pilgrimage Route to Santiago de Compostela.
Since 2021, under the supervision of the ACMH, (Architects en chef des Monuments Historique - Chief Historic Monuments Architect) this project aims to repair damaged areas and signs of ageing. Completion of this first part of the project is scheduled for 2026.

The Rochers Noirs Viaduct enters a new era



Built in 1913 at the heart of the French department of Haute Corrèze, the Rochers Noirs viaduct is a masterpiece of engineering.
Suspended at 80 m above a deep canyon, the structure is reinforced by a Gisclard-type system of intertwined cables, which in the past allowed small trams to cross.
Classified as a Historic Monument in 2000, it was closed for almost 20 years before being restored thanks to an extensive renovation project. The project, carried out by **setec** with architects RL&A, aimed to restore the viaduct to its original glory while adapting it to modern requirements. It was a major challenge, involving compliance with heritage restrictions, difficult access and tight deadlines. «What made this project stand out was the need to mobilise very specific skills, while ensuring perfect synchronisation between the different teams,» explains Mathieu Cardin, Director of the **setec diadès** South-West agency.
«We preserved as much of the original materials as possible, working with specialised craftsmen to ensure that the authenticity of the structure was preserved,» says Etienne Combescure, Project Director at **setec tpi**. The renovated structure was officially opened on schedule during the French Heritage Days in 2024.

The Mallemort bridge, another symbol of architectural heritage preservation

This 1846 multi-span suspension bridge, listed as a Historic Monument, has a distinctive wooden deck, wrought-iron suspension lines and cables. The project, undertaken by **setec tpi** and **diadès** in association with the architectural firm RL&A, includes an assessment of the structure and a complete rehabilitation project to reopen the bridge to pedestrian traffic, while respecting its historic character. **terrasol, hydratec** and **setec international** are providing their expertise to guarantee the geo-technical stability and hydraulic safety of the bridge, taking into account the requirements linked to flooding on the River Durance and the wildlife present on site. In-depth analyses have determined that a specific support needs to be reinforced to ensure the stability of the structure. The enhancement of the rehabilitated structure was also the subject of a dedicated programming mission assigned to setec organisation.

Through these projects, a specific methodology has been developed for work on classified engineering structures. Combining heritage analysis with health and technical analysis has guided the proposals for work on individual elements, so as to balance the need to make the structures safe with the need to preserve their authenticity.

Sixte DOUSSAU, Heritage Architect, RL&A Architectes

The Pinault Foundation, between historical heritage and innovation

The transformation of the former Paris Stock Exchange into a museum for the Pinault Foundation required detailed coordination to enhance the historic structures while at the same time integrating modern infrastructures. «It was a challenge to guarantee the stability of the foundations, especially as we had to excavate under the structure to accommodate additional underground levels, while limiting the risk of settlement», explains Antoine Abboud, International Development Director at **terrasol**. During the clearance works, an unexpected discovery surprised the teams: an ancient fresco, hidden behind technical installations, added a new dimension to the project. The circular shape of the building presented a challenge to the project team, who had to imagine how the technical equipment could be integrated into the building in a way that was aesthetically appealing and in keeping with its geometric shape. Among the challenges met, the addition of a concrete veil at the heart of the structure reflected the vision of architect Tadao Ando, who was in charge of designing the contemporary elements of the project, while guaranteeing their future reversibility. «We also had to incorporate modern safety features, such as smoke extraction systems, while at the same time concealing them from the public,» adds Camille Bertin, project manager at **setec bâtiment**.

Beyond the technical aspects, the cooperation between the parties involved was also decisive. «Smooth communication and team spirit made it possible to harmonise contemporary requirements, as implemented by the NeM agency, and heritage demands, by respecting the vision of Pierre-Antoine Gatier, architect of the Historic Monuments,» concludes Romain Doucet, Director of Works at **setec bâtiment.**

Preserving without changing: The Arles amphitheatre for example

Just a short walk from the lerm, the Arles amphitheatre is a perfect example of the challenges that setec undertakes to preserve our heritage. The **lerm** played a major role in the restoration of this national treasure, which was built in the 1st century AD and remains a vibrant venue for a variety of cultural events. The overall aim of the project was to 'crystallise the building', in the words of Alain-Charles Perrot, ACMH*, (Chief architect of historical monuments - Architecte en Chef des Monuments Historiques), who was in charge of the restoration project. The works were focused on maintaining the monument in its current configuration, stopping or slowing down the processes of deterioration, restoring part of the ancient gallery and restoring the terraces. The **lerm** initially took part in the preliminary study to characterise the materials used, identify any pathologies and then define and recommend appropriate restoration solutions: cleaning, formulation of repair mortar or replacement with substitute stones. The **lerm** also helped ACMH to draft the technical documents, validate the protocols used by the restoration companies (desalination, hydrogumming, etc.) and inspect the stones chosen from the Fontvieille quarry for their close-to-original characteristics, replacing elements that were damaged beyond repair.

La BnF** Richelieu, a long and meticulous renovation project

Following a 12-year renovation project, the BnF's Richelieu site has been restored to its former glory. The long and meticulous restoration works were carried out while maintaining the institution's activities throughout the site. For our teams, the challenge lay in scheduling, steering and coordinating the studies and works into several phases, as well as managing joint site expenses. Each stage presented technical challenges, in particular removing old cladding and adapting the infrastructure to modern technologies, while preserving the authenticity of the site, which is a classified historic monument. The teams also had to design temporary facilities to ensure the continuity of activities during the works. A delicate balance between respect for the site's heritage and the use of new technologies enabled the infrastructure to be modernised while preserving its historic appearance. Over the years, the legend that Cleopatra's mummy was buried under one of the BnF's courtyards has resurfaced. Although largely denied, this myth has added a touch of mystery to this heritage adventure and aroused the curiosity of teams and visitors throughout the project.

** BnF -Bibliothèque nationale de France (National Library of France)
* Architecte en Chef des Monuments Historiques (Chief architect of historical monuments)

The transformation of the Louvre of Antiques Gallery (Louvre des Antiquaires) into the Cartier Foundation

Just a stone's throw away from the famous Louvre Museum, (the Louvre Antique professionals), a landmark building in the centre of Paris, is undergoing a transformation to become the future home to the Cartier Foundation for Contemporary Art. Directed by architect Jean Nouvel, this ambitious project aims to create a modular space where art and technology coexist harmoniously.

setec's original mission on this colossal project was mainly to design the building's structures and fluid systems. However, as the project progressed, **setec** was called upon to take on another major technical challenge: designing the motorisation for the mobile platforms. Covering a total of 1,200 m², these five platforms are designed to move to different heights that can reach up to 11m and will allow multiple configurations adapted to exhibitions and other cultural events. «These platforms can be modulated infinitely, offering essential flexibility to meet the changing needs of events and artists,» emphasises Daniel Abittan, Director of **setec bâtiment**. To achieve this challenge, **setec** mobilised the technical expertise of its subsidiary ISM, which specialises in mechanical systems for movable elements.

One of the major challenges also lay in managing the dynamic behaviour of the platforms, which are subject to significant crowd movements during major events such as concerts. «This required meticulous studies to guarantee the stability and safety of the structures,» explains Daniel. This challenge also inspired a university thesis undertaken by Vincent Baumann, an engineer at **setec**, in collaboration with the Cartier Foundation.

The aim of this research was to gain a better understanding of the vibratory phenomena involved when a crowd is jumping or swaying in rhythm on a floor that is relatively flexible due to its elongated shape.

As far as fluids are concerned, it is also worth noting the exceptional nature of the ventilation and smoke extraction systems, which treat the entire shell as a unique open volume and feature smoke extraction engineering. Beyond the technical aspects, this project bears witness to a remarkable relationship of trust between **setec** and the Cartier Foundation, which has been built on a number of successful collaborations in the past.

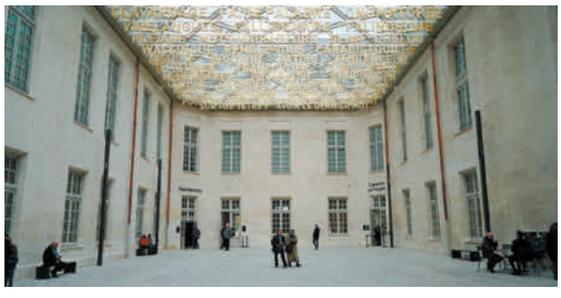
« We have a relationship of trust with the client, and this project is a natural extension of that trust »

Daniel Abittan,
Director - **setec bâtiment**.

These new headquarters represent a genuine turning point for the Cartier Foundation. By combining audacious architectural design with a deep respect for its heritage, the building opens a new chapter in which contemporary art can express itself in a flexible, innovative space, while perpetuating the cultural heritage of the site.

The building is due to be completed in March 2025, and the Foundation will open its doors to the public at the end of 2025.

The Château de Villers-Cotterêts: from Historic Monument to Museum of the French Language



The restoration of the Château de Villers-Cotterêts represents a significant step forward in the preservation of France's heritage.

After four years of restoration works, this historic site has been transformed into the International Museum of the French Language, a project that combines the enhancement of heritage with the creation of a dynamic cultural centre.

setec, represented by its subsidiary **setec opency**, worked alongside Olivier Weets ACMH to provide OPC (construction scheduling, steering and coordination) services for the final phase of the works. Acting as support during the final months, the team supervised this crucial phase to ensure that the works proceeded smoothly and that delivery deadlines were met.

Thanks to a disciplined method, including lean construction, the team was able to coordinate the contractors on site. This work focused in particular on setting up the equipment needed to open the interactive tour, with 15 rooms and 62 digital installations designed to welcome the first visitors.

The aim of this project was not only to restore a historic monument, but also to transform it into a place of cultural exchange. The Château de Villers-Cotterêts, with a diverse programme of exhibitions and shows, now embodies a meeting point between history and modernity.

Project owner:
Clermont Auvergne Metropole
Architects:
Stanton Williams Limited (lead architects), Marcillon Thuilier Architectes, Covalence, architectes of heritage

The donators' gallery and its vaults were reinforced during the preparatory works prior to the main works. © Maxime Dionnet - Project Manager setec organisation

The transformation of an iconic landmark in the history of Clermont-Ferrand, France

In the heart of Clermont-Ferrand, the Hôtel Dieu is undergoing a major transformation. This former hospital, well known to the people of Clermont-Ferrand in France, will become a city library in 2026. The project is being led by setec organisation, in close collaboration with Clermont Auvergne Metropolitan Council.

«It's an iconic place, and every Clermont-Ferrand citizen has a personal connection with it,» explains Julia Hysenj, Project Director at **setec organisation**. Combining renovation and new build, this transformation promises to be ambitious. Preserving the heritage while at the same time integrating modern spaces, represents a major challenge.

«We have to constantly find a balance between the architectural requirements of the old building and the technical requirements of the new extension,» explains Julia. «This requires close coordination between heritage architects, site teams and local authorities, with constant involvement of the DRAC (Direction régionale des affaires culturelles - Regional Directorate of Cultural Affairs) from the initial stages to ensure compliance with heritage preservation requirements».

Archaeological excavations, which are essential on this site steeped in history, have revealed Gallo-Roman remains.

«Stumbling across archaeological treasures is another rich aspect of the project,» notes Julia. The presence of volcanic soil and underground cavities meant that the project required innovative technical solutions, such as the use of speleologists to map and secure the cavities. «It's a colossal project, but the team is close and committed from the start, and that makes all the difference,» insists Julia.

As the old hospital continues to undergo transformation, **setec** is working hard to ensure the success of this metamorphosis. The Hôtel-Dieu will become much more than just a library; the site will host a garden, exhibition areas as well as thematic and visitor centres. A truly vibrant space, where heritage and modernity will come together for the enjoyment of the people of Clermont-Ferrand.

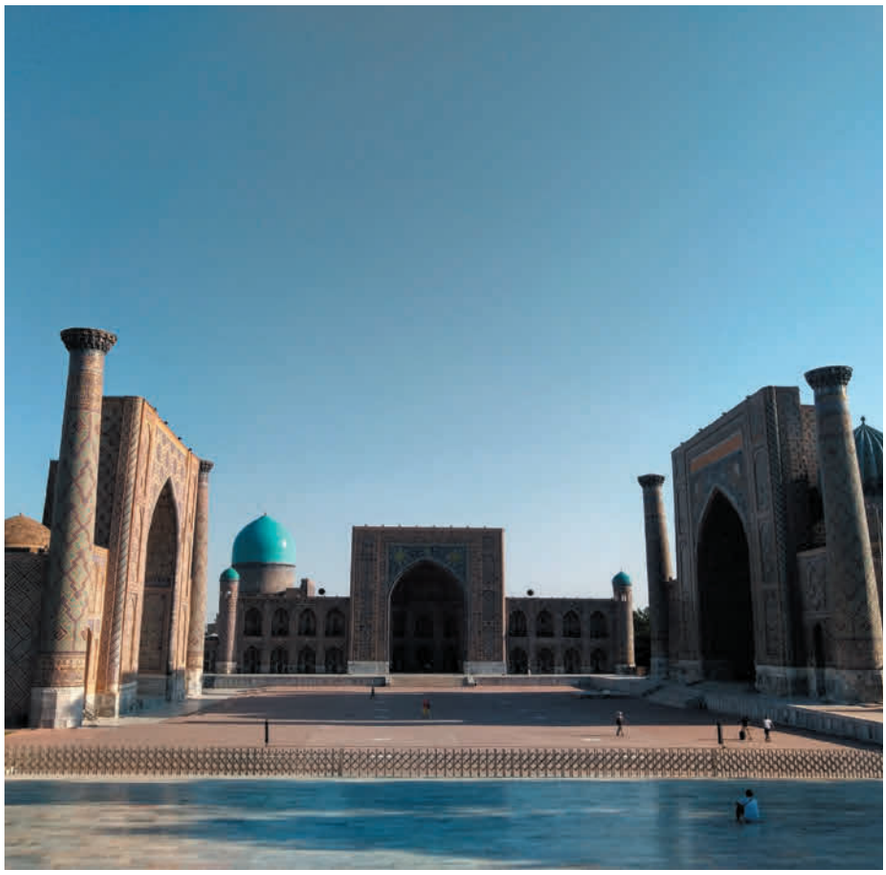
Renovating the Musée de la Marine* thanks to a combination of technical expertise and teamworkd'équipe

Located in the heart of Paris, the Musée de la Marine has undergone extensive renovation to modernise the exhibition spaces while respecting its historical heritage. This project called upon a wide range of expertise within the setec group. At every stage, consultation and coordination helped to meet the many challenges presented by this major project.

The first operations were entrusted to **terrasol**, who were responsible for evaluating the capacity of the historic foundations to support the new loads. «Working on such an historic building requires special precautions to be taken. We had to cross-reference our analyses with archive data to limit interventions and avoid unpleasant surprises related to the foundations", explains Olivier Payant, Team Manager. The analysis enabled us to verify the stability of the foundations before undertaking other operations. **setec organisation** was then appointed to audit the project and plan the reinstallation of the collections. «Our approach was based as much on instruction as on understanding the specific needs of each stakeholder," points out project manager Agathe Ségard. Over and above the technical challenges, the human aspect was vital in maintaining a positive atmosphere between all those involved.

During the final phases, **setec opency** was responsible for coordinating the sub-operations, ensuring that the work progressed smoothly up to the reopening of the museum. Throughout each stage, all teams brought their specific expertise to the project and met the technical challenges while ensuring harmonious collaboration. This orchestration, both meticulous and detailed, means that today the Musée de la Marine can continue its history by once again welcoming visitors since 2023 to see the magnificent works of art.

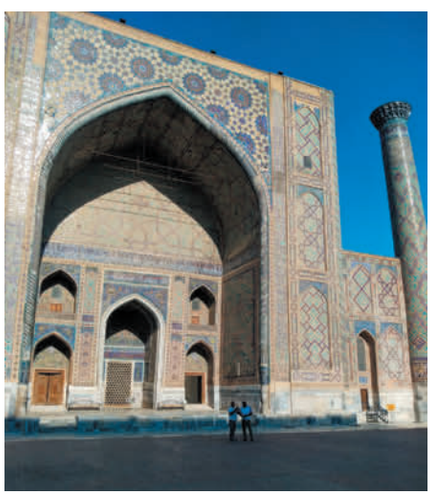
*Musée de la Marine (The French Navel Museum)



Boukhara: a master plan to preserve the city's heritage

In Uzbekistan, the historic city of Bukhara, a UNESCO World Heritage Site, is facing a major challenge: preserving its rich heritage while modernising infrastructure to the needs of the population today.
setec, in collaboration with several partners, is helping to draw up the city's master plan, a project aimed at harmonising conservation and development.

The purpose of the Bukhara master plan is to ensure the preservation of historic monuments, while ensuring that the city remains functional for its inhabitants. The plan takes into account elements as diverse as basic infrastructure (gas, electricity, telecommunications, transport) and the renovation of public spaces. Bukhara, with its virtually intact medieval centre, is an absolute gem. "This project will reactivate the city by means of modern infrastructure development and management," explains Bernard Quenée, Director of Heritage Preservation at **setec consultants.**
The main aim of this master plan is to prevent Bukhara from becoming a mere museum for tourists. «We want to preserve a living heritage city centre. It is essential that it remains residential and dynamic,» explains Karim Aït-Ali, department director at **setec organisation**. The project has several key objectives: to protect the historic centre, to ensure functional and landscape consistency between the modern and historic districts, and to strengthen the infrastructures while integrating sustainable solutions.
setec, along with agencies such as Wilmotte, Deloitte, IPR, RCH and others, is also responsible for providing expertise on the condition of the 136 monuments listed as World Heritage Sites by UNESCO, particularly in terms of their heritage value and state of conservation. The project also has a direct impact on the environment and quality of life for local residents. «We are seeking to reduce dependence on the automobile, a source of pollution but also of division between the medieval centre and the modern city, by promoting public transport and soft mobility,» emphasises Karim Aït-Ali.
The hydraulic system of historic canals and basins is being reactivated or rehabilitated, improving water management and creating areas of cooling that are essential in this barren region. By improving access to the centre, reactivating facilities and encouraging craft activities, the project aims to maintain a strong connection between the modern and historic districts of Bukhara. The Bukhara master plan is much more than just a conservation project. This is a genuine strategy for urban transformation that aims to ensure a balance between the city of everyday life and the city of cultural heritage, by improving the quality of life of local residents and enhancing the city's history.



The Ipiranga Museum, restoration of a historical building

The Paulista Museum, better known as the Ipiranga Museum, was officially opened on the 7th of September 1895, on the occasion of the anniversary of Brazil's independence. It was the first public museum to be built in the Brazilian state of São Paulo and is the fourth oldest museum in Brazil.

Its collection has been part of Brazil's federal heritage since April 1938. The whole of Independence Park, Monument Square, the gardens, the woods and the museum were also classified as federal heritage sites in 1999.

The museum was closed for nine years. It reopened on the 7th September 2022, to commemorate the bicentenary of Brazilian independence. The **setec** teams were appointed by the FUSP (Fundação de Apoio à Universidade de São Paulo - Foundation to Support the University of São Paulo) to manage the modernisation and restoration of the historic building.

The total surface area of the project is 16,260 m², of which 8,351 m² has been restored and 7,908 m2 extended. One of the key priorities was to bring the historic building up to current accessibility standards, which are still not widely applied in Brazil. A 200-seat auditorium and classrooms were also installed, as the museum is also a university institution, as well as new exhibition areas to house the collection, unique in Brazil, of over 125,000 pieces. The reopening and renovation of the Ipiranga Museum was a real challenge for the country. With uncontrolled urban expansion, the bureaucracy involved in obtaining restoration permits, environmental disasters and fires, such as the fire that broke out at the National Museum in 2018, the preservation of Brazil's historical heritage remains a challenge that urgently requires greater political priority, investment and the active participation of society. Nevertheless, this project has boosted cultural tourism in São Paulo and throughout the country.

The National Museum of Rio has risen from the ashescendres

The Paço de São Cristóvão (St Christopher's Palace), seat of the Portuguese (1808 to 1821) and Brazilian (1822 to 1889) empires, has been home to Rio's National Museum since 1892.

Brazil's first museum and its oldest institution for research and education in the natural sciences and anthropology, the museum suffered a major fire in September 2018, which not only caused serious damage but also destroyed a large part of the collections. The building was also badly damaged; the repercussions of this incident in the country and abroad were immense, due to the cultural importance of the Museum. Restoring the museum presented a number of obstacles.

The worldwide pandemic of 2020, the complexity of institutional relations and restrictions on obtaining and managing resources in Brazil are just some of the issues that slowed progress on this important project for the country's heritage and history.

The reconstruction works began in 2021, with a view to a partial reopening in 2026 and full completion of the works in 2028. This project aims to restore and modernise the Museum to meet current standards of safety, comfort and accessibility.

The challenge for the **setec** teams responsible for managing the architectural and complementary projects (44 projects and consultations) was to consolidate the most fragile remains as quickly as possible, and to bring together the multiple teams responsible for resolving conceptual, heritage, environmental, legal and technical issues. Although the fire destroyed the building, it also revealed information about its original construction.

At the end of the restoration, future visitors will be able to discover a more modern and secure museum, where traces of the past have been preserved in order to conserve the heritage value of this major cultural site in Latin America.

Part 2

PRESERVING, MODERNISING OR TRANSFORMING

OUR HISTORIC HERITAGE

...
ROUND TABLE

Bertrand Lemoine
Architect, engineer, historian

Michel Kahan
President
setec

Etienne Combescure
Engineer
setec tpi

Matteo Banchi
Development Director
setec bâtiment

Mélanie Beaugelin
General Director
setec lerm

Sylvie Ezran
Civil Engineering Project Director
setec tpi

Christophe Raulet
General Director
setec diadès

Bernard Quénée
Director of Heritage Preservation
setec consultants

The challenges for engineering

Bertrand Lemoine is an architect, engineer and historian, specialising in the history and current issues of architecture, cities and construction. Our heritage experts, accompanied by Michel Kahan, President of the Group, took part in a round-table discussion with Bertrand Lemoine on a range of topics relating to the study, importance and preservation of built heritage. It was a rich debate, touching on a wide range of themes, such as the use of materials, the transformation of their use and eco-design... Read the full report.

Heritage, a multi-dimensional debate

Michel Kahan: "Maintaining and preserving what already exists, designing the heritage of tomorrow": this is the theme we have decided to explore in this new issue of **setec** Magazine. Examining our heritage has three main aspects: studying the essential elements of the historic heritage of the past, preserving or transforming the use of this ancient heritage and, finally, incorporating a certain form of modernity to prepare for the future.
When we started works on the Grand Paris Stations, the Minister of Culture at the time said: "You are building stations for 100, 120, 150 years. In 150 years' time, you may not be mentioned by name, but the buildings will still be there".
But how can we build for the future? What is seen today as an obvious modern approach, will it withstand the test of time and changing requirements? These are just some of the issues we would like to discuss today.
Bertrand Lemoine: Heritage is a vast subject. There's even a certain contradiction in the concept, because it often evokes the past, whereas heritage is also built now and for the future. Engineers are in the business of designing, building and transforming, so their vision is immediate and even forward-looking.
When an engineering structure is designed, it is not thought of as "heritage", but as a construction that will have a certain utility. Nonetheless, these engineering structures are part of a lasting dimension that ties in

Heritage deserves to be seen as something that you have inherited, that you own and that will still be there in 100 years' time. It therefore covers the entire timeline. In that sense, everything is heritage.

Bertrand LEMOINE
Architect, engineer, historian

with the durability associated with heritage. I find it very interesting that **setec** is concerned with these questions of heritage, which are very much relevant today in the 21st century, with this trend towards sustainable development, which implies the notion of making things exist, making them last.
The importance of heritage is becoming more widely appreciated these days, particularly in the case of engineering structures, thanks to the intellectual context and the UNESCO World Heritage List.

From built heritage to a UNESCO world heritage site

Michel Kahan: What does it mean to classify a building as a UNESCO world heritage monument?
Bertrand Lemoine: There are around 1,230 listed sites, in a variety of categories. To be listed, a site must meet the following criteria: it must be of outstanding universal value, which has to be proven. The procedure lasts 10 years and is submitted to UNESCO after being sponsored by a country. The benefits include recognition for the regions concerned and for tourism, along with guarantees to protect the listed heritage over the long-term and ensure that it is not altered.

Heritage, a global approach

Bertrand Lemoine: In my opinion, we should add the history and value of heritage to engineer training, to give a better understanding of initial design methods. Heritage has multiple dimensions: it's not just aesthetic, it's social, technical, cultural, economic... it's a global entity. It's about understanding the value of an object now and the value it may have in the future. In the 21st century, we're thinking more in terms of upgrading and adapting what already exists. Understanding the history of a building helps us to understand its limits. This is something that is not completely understood in our cultures.
Matteo Banchi : I think that there is an additional factor, which is the preservation of resources or the carbon footprint of the operation. Today, at least at **setec**, we're more inclined to keep what already exists rather than demolish and rebuild. We almost never build new buildings these days.
Bertrand Lemoine : Indeed, the right philosophy to adopt is: what can we do with what already exists, how can we adapt to it? But this subtle approach is not yet automatic. New questions are arising about the use of materials, but rather slowly. We don't yet have the tools, particularly when it comes to regional

planning. Some regulations need to be more flexible, and there needs to be a better understanding of the mechanisms underlying construction. But things are changing, and the heritage value of large buildings is beginning to be seen.

Michel Kahan: Do you think it's a matter of an economic model or is it a question of political will, of the organisation's philosophy?
Bertrand Lemoine: These two reasons are intertwined. Today, developers want to have large-scale operations, thinking that this will give them an economic advantage; but in the building sector, this is not true. Some buildings, such as the Athletes' Village for the Olympic Games, are now starting to be redesigned around the idea of converting them from one use to another. Planning for a change of use at an early stage goes hand in hand with the heritage issue, in that it means planning for the building's long-term future. It will gain the heritage value that time itself confers.

Materials and maintenance, key elements of the durability of structures

Mélanie Beaugelin: But for how long? Because when we were involved in building the Vasco de Gama bridge, for example, we had to help formulate the concrete so that the structure would last 120 years. This bridge is part of our heritage, or at least it's part of the landscape in Lisbon. The Vasco de Gama bridge was one of the first to attempt such a long-term project. But this lifespan is planned within a certain operating framework and does not mean that the structure cannot continue to be used after 120 years.
Christophe Raulet: On structures like this, where a sustainable materials approach has been incorporated into the design and durability monitoring has been initiated, the design is inevitably more lasting. Is this the best way to prepare for the future of our heritage ?
Bertrand Lemoine: Anticipating a long lifespan is nothing new. Since 1906, there have been regulations concerning the steel construction of bridges, which stipulate a lifespan of 100 years for steel railway structures. And yet, many of them are still in service.
There is a notion of duration that is taken into account from the beginning, although it is implicit in the case of buildings, which are designed to function under stress. In fact, many structures last longer than expected. We know that current anticipation periods, such as 120 years for engineering structures, will probably be exceeded, provided of course that there is an effective maintenance service.
Bernard Quénée: I noticed this at the Bukhara site, during the assessment of monuments listed by UNESCO. We found ourselves faced with buildings that were centuries old and still in good condition.
The material used was not particularly long-lasting in itself - the bricks were quite ordinary - but it had become customary to renew damaged bricks over the years. This was cheaper, and by consolidating and reinforcing the monuments over time, they remained true to their original image, while being updated thanks to the materials used. There's a gradual shift, but in the end the material itself is what fuses it all together.
Bertrand Lemoine: This is a good example, as

The idea of extending the works beyond the period initially planned is in line with the notion of time associated with heritage value.

Christophe RAULET
General Director
setec diadès

+ BIOGRAPHY

Bertrand Lemoine is a qualified architect and engineer from the prestigious École Polytechnique and École Nationale des Ponts et Chaussées, and holds a doctorate in the History of Paris from the University of Paris-Sorbonne.

He is an honorary director of research at the **(1)** CNRS, and was General Director of the **(2)** Atelier International du Grand Paris and President of the **(3)** Académie d'Architecture. He is a specialist in the history and current issues of architecture, construction, major works, cities and heritage of the 19th and 20th centuries, with a particular focus on Paris and Greater Paris.

He is the author of some forty books on these subjects (most recently: **(4)**Une histoire des gares en France, Archibooks, 2022, **(5)** Gustave Eiffel, une vie monumentale, Éditions du Signe, 2023, **(6)** Charles Marville, 1813-1879, du pinceau à la chambre noire, Presses des Ponts, 2024).
He is currently a consultant on architectural, urban, digital and energy issues and President of the Construction & Beaux-Arts Committee of the **(7)** Société d'Encouragement pour l'Industrie Nationale.

1. CNRS - French National Centre for Scientific Research / 2. Atelier International du Grand Paris - Greater Paris International Studio/ 3. Académie d'Architecture - Academy of Architecture / 4. Une histoire des gares en France, Archibooks, 2022- A history of railway stations in France, Archibooks, 2022 / 5. Gustave Eiffel, une vie monumentale, Éditions du Signe, 2023 - Gustave Eiffel, a monumental life, Éditions du Signe, 2023 / 6. Charles Marville, 1813-1879, du pinceau à la chambre noire, Presses des Ponts, 2024) - Charles Marville, 1813-1879, from the paintbrush to the darkroom, Presses des Ponts, 2024) / 7. Société d'Encouragement pour l'Industrie Nationale - French Society for the Promotion of National Industry

L'écoconception n'est pas forcément uniquement liée à la frugalité des ressources dans la construction.

Mélanie BEAUGELIN
Directrice générale
setec lerm

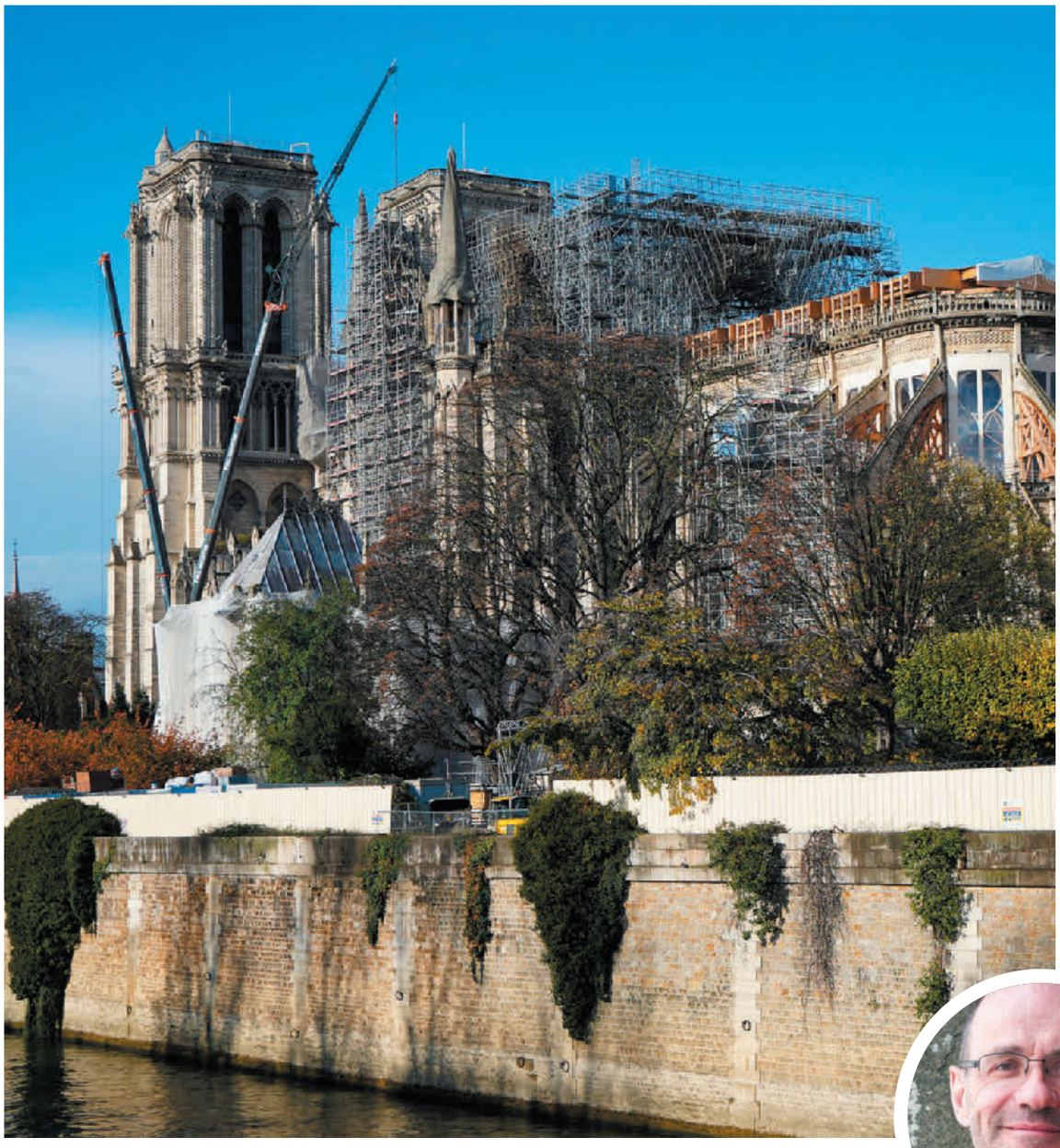
the notion of continuity is important when it comes to heritage.
Another example is the Eiffel Tower. Many wonder how long this monument will stand as it is. The good news is that it is possible to change all the pieces one by one, without changing the overall appearance. All that needs to be done is to replace the bolts with rivets. It can therefore be strengthened as required, without changing its appearance.
Sylvie Ezran: There is, however, a maintenance issue regarding the Eiffel Tower, as with other structures. To completely strip the Tower, it will be necessary at some point to close it to the public, and that presents a problem for operations. There is a calculation model produced by Cetim, which is calibrated using measurements, and with which any works to the structure are verified.

Eco-design: how to build tomorrow's heritage

Etienne Combescure: This subject also raises the question of redundancy. If it is possible to replace the small parts of the Eiffel Tower one by one, this means that this action does not in principle affect the overall stability and that there must be some form of redundancy.
There are certain structures where it is not possible to replace one piece at a time because the structure lacks redundancy. This can undermine the durability of a structure. I'm anticipating the question «How can we prepare for the heritage of the future?»: the answer would be, perhaps, by incorporating redundancy into the dimensions right from the design phase?
Sylvie Ezran: However, this would contradict the principles of eco-design, which advocates reducing quantities and optimising the use of materials.
Mélanie Beaugelin : It all depends on what we mean by eco-design. Does sustainable design only concern the quantity or type of materials used? Is it just about limiting the use of resources, or is it also about preserving durability over time?
Given that the longer a structure, building or otherwise, can be used, the more resources we save in the end, wouldn't it sometimes be better to use a little more at the beginning so as to use less later on?
Christophe Raulet: Can't we consider that redundancy is a fundamental premise of eco-design, as there will inevitably be a need for change over time? If a 100-year lifespan is just a theory, and it's possible to go further in terms of achieving ultimate sustainability, then eco-design could be the basic idea.

Is the transformation of use one of the keys to rethinking the city?

Matteo Banchi: Yes, of course, and in the building sector the key is to avoid over-specialisation of spaces. If changes of use are not included at the design stage, buildings will be less durable.
In Haussmann-style buildings, for example, the grid and depth of the buildings allow rooms to be adapted to different functions. In many modern buildings, everything has a predefined function and place and cannot be transformed. But changes in lifestyles, particularly with remote working, mean that we are increasingly looking at how uses evolve, and we can see that offices are becoming more and more "domestic", and vice versa.
Bertrand Lemoine: Haussmann-style buildings are a very good example of resilience, in terms of the adaptability of structures and even thermal insulation.
Even though these buildings were built 150 years ago, they were able to accommodate all modern comforts without being altered, while retaining their heritage, use and financial value. Today, we have a much broader timescale, with requirements that sometimes conflict with the



imperatives of sustainability and transformability, in the sense of sustainable development and eco-design. We need to think differently about the city and propose types of construction that are fundamentally resilient. Perhaps **setec**, with a capacity for innovation and expertise in a variety of fields, could influence this in the way we design. We need to experiment and make proposals.

Materials, from past to the future, an undeniable value

Bernard Quénée: I'd like to come back to the question of materials, and their importance to the durability of buildings. We can also learn from old buildings that they were built using local materials in the past. In the mountains, they built chalets; in regions without forests, they built with stone.
It's important to go back to using the right materials in the right region. Building with materials that come from afar can be considered heresy.

Mélanie Beaugelin: We need to look at the whole picture, at the scale of the project and the region. Some materials, such as raw earth, are suitable in one place, but in other locations they may not be appropriate. This approach has been somewhat lost, whereas in some parts of the world it has remained the norm.
Matteo Banchi: Ironically, the building materials of the future are wood, raw earth and stone, all of which have been the subject of much debate in recent years
Bertrand Lemoine: stone and raw earth are interesting, but only if they are used in appropriate local conditions, otherwise they don't make much sense.
As for wood, I'm very concerned about the preservation of forests. Thinking about heritage doesn't just raise questions about preservation, it also raises very practical questions about materials, construction, etc. Designing with future heritage value in mind brings into question many other issues, not least the fact that it is part of a more sustainable and eco-compatible approach

The tragedy of the Notre-Dame de Paris fire has at least had the benefit of raising our collective awareness of the value of our built heritage and the skills associated with it.

Bernard QUÉNÉE
Director of Heritage Preservation
setec consultants

Railway and industrial heritage being restored, upgraded or transformed

Transforming railway and industrial heritage is a challenging journey, where history and the modern world meet. In Bordeaux, Paris and Arles, emblematic sites such as the Grande Halle at Saint-Jean station, the former Mac Donald warehouses and the old SNCF railway workshops, transformed into the Fondation Luma, illustrate **setec**'s commitment to combining heritage preservation with adaptation to contemporary needs.

The Great Hall at Bordeaux railway station

The Grande Halle Voyageurs in Bordeaux Saint-Jean, an imposing metal structure classified as a heritage site, has undergone an ambitious renovation, aimed at preserving its historic value while ensuring continuity of use.

Built in 1898, this 300 m structure is the largest railway glass roof in Europe and is central to the station's operations, handling millions of passengers a year. Between 2012 and 2018, the consortium of **setec tpi** (lead contractor) and **setec ferroviaire** (co-contractor) coordinated and executed the works, which included restoring the framework, updating access and renovating the roof, while preserving the structure's emblematic architectural features.

In a particularly demanding technical context, the work teams had to deal with lead in the paintwork and asbestos in the window sealing. To avoid any risk of contamination, strict confinement was put in place, with totally enclosed work areas. The installation of scaffolding covering the entire hall meant that the work could be carried out without interrupting rail traffic, a major challenge in a station that is still in operation.

In addition to the need for structural reinforcement, replacing the existing ceiling and updating protection systems, the renovation works also focused on preserving the building's aesthetic appeal and authenticity, to enhance the beauty of this landmark in Bordeaux.

The former Macdonald warehouses

Built in 1970 in the 19th arrondissement of Paris, the Macdonald warehouses are 617 m long and 80 m wide. Converting them into a mixed-use complex incorporating housing, offices, shops and public facilities represented a major engineering challenge, both technically and in terms of organisation. Igor Mantaux, Project Director at **setec bâtiment**, explains: «One of the main challenges was to adapt the old structure so that it could support new construction».

The **setec** teams began by massively reinforcing the existing foundations and infrastructure, creating new levels for underground car parks. An innovative observation method was also implemented to monitor the stability of the structure, with advanced deformation sensors installed for live monitoring throughout the works.

New vertical technical units and a complex transfer floor will support and irrigate the new construction programmes. «Working on a project of this scale, with such a high density of participants, requires constant attention and impeccable communication», adds Igor. To meet this challenge, **setec** organised the coordination between the different partners, from architects to control offices, ensuring effective collaboration and optimum safety on a site undergoing major urban transformation.

The Luma Foundation:
a place where art and architecture merge

Located in Arles, France the Luma Foundation embodies a bold vision of heritage, combining pioneering architecture with areas dedicated to contemporary art.

This large-scale project, managed by **setec bâtiment** to ensure the execution of the works, represented an exceptional challenge, requiring flexibility and precision.
In a constantly evolving creative context, **setec** oversaw the works rigorously, coordinating numerous partners and integrating the works of renowned contemporary artists such as Philippe Parreno and Olafur Eliasson, whose installations were designed progressively as the works evolved. This project required constant adjustments to adapt the exhibition areas to new artistic creations, while at the same time respecting unique architectural choices, such as the tower whose facade is made up of 11,000 stainless steel blocks.
Striking a balance between the evolving needs of the artists and the technical requirements was a matter of meticulous engineering. Today, the building is an iconic landmark in the Arles landscape, at the crossroads of artistic innovation and heritage.

Focus on... setec and the National Bridges Programme

The accidents that have occurred in recent years and the gradual 'abandoning' of the management of local structures have revealed the fragility of certain infrastructures, spurring the French government to launch the National Bridges Programme.
The aim of this ambitious programme is to provide assistance, on a voluntary basis, to French municipalities with low revenue potential and often no resources, in identifying and maintaining their engineering structures. Commissioned by CEREMA, **diadès** has mobilised their teams for this project in the Auvergne Rhône-Alpes and Provence-Alpes-Côte d'Azur regions. «Coordinating our teams over such a vast area, with tight deadlines, was a real challenge», says Aurélien Berthier, head of the "inspections & diagnostics" department at the Rhône-Alpes agency. During the two survey campaigns carried out in 2021 and 2023 respectively, 3,550 structures were surveyed, including 2,000 bridges and 1,550 retaining walls. The most critical structures and those of significant size have required detailed inspections, and this created new challenges in terms of difficult access to certain sites. Jonathan Rible, head of the «inspections and diagnostics» department based in the South-East branch, adds: «We had to work closely with the local authorities to identify and understand the conditions of the structures under their responsibility». Not only has this work in the field made it possible to secure the infrastructure, but it has also raised awareness of the importance of preserving this shared heritage, which is essential to local communities and, in some cases, has a genuine historical value.

Saving the Eppeville sugar factory

Built in 1922 by architect Georges Lisch, the main building of the Eppeville sugar factory in France, was listed as a Historic Monument in 2021, saving it from demolition.
The building, which combines metal frames and brick facades, is notable for its Art Deco architecture. Under the direction of the French Historical Monuments Architect (Architecte en Chef des Monuments Historiques, ACMH), **setec tpi** carried out a diagnostic of the building to study the possibility of restoration. The project required skilful management of the divergence of interests between the Saint-Louis Sugar company, owner of the site, which was not in favour of conserving the building, and the local authorities, who wished to preserve it for its heritage value.
setec tpi therefore had to manage the structural emergencies in this context, determining the emergency repairs and stabilisation of the building, to preserve the architectural integrity of the building.
Coordination with the ACMH, the rope access technicians and the laboratories was crucial in adapting the work to site conditions. This preservation initiative not only guaranteed the safety of the building, but also laid the foundations for its future use and appreciation, ensuring that the sugar factory can bear witness to the treasures of our industrial heritage.

Christophe Raulet,
General Director, **diadès**

Our built heritage and engineering structures represent much more than an 'accumulation of structures' offering the services expected of them. Each structure, whether a bridge, viaduct, tunnel or dam, is a precious testament to human ingenuity.

These infrastructures are not just functional; they tell a story, that of the territories they link and the eras they cross. When a work of art reflects qualities of authenticity, rarity and exemplarity, it becomes much more than a simple construction. That's when it becomes part of our heritage, a symbol to be preserved. Our work within the AFGC* History & Heritage Committee is part of this approach: to raise awareness of the importance of these structures so that they can be protected and restored. By promoting these structures, we are helping to preserve a unique know-how and heritage for future generations.

Protecting engineering structures: how do engineering structures become heritage?

The restoration of the **Tancarville Bridge**

Inaugurated in 1959, the Tancarville Bridge is a masterpiece of engineering that is about to undergo major renovation to meet contemporary environmental and safety standards. Led by **setec tpi**, with the assistance of **setec diadès** for external design control and works supervision, and **setec opency** for construction scheduling, steering and coordination (OPC - Ordonnancement, Pilotage, et Coordination), this project requires a rigorous technical approach and coordination. Sylvie Ezran, Design Director at **setec tpi**, explains: «Our mission is to replace the paintwork while eliminating harmful substances such as lead and asbestos, without interrupting traffic».

The project involves a number of phases, from the installation of means of access and strict safety containment to protect the environment and operators, to the stripping of the existing paint using abrasive blasting, and the application of new coatings. Thomas Julien, civil engineer at **setec tpi** and project manager on the project, highlights the logistical challenges involved: «The works are being carried out over the River Seine, with a road in operation, and therefore requires innovative access structures and meticulous planning to avoid disrupting traffic». Adrien Sicaud, design engineer certified for inspection of paint and coating works (ACQPA/FROSIO) at **diadès**, supervised the external control of the diagnostic and preliminary design studies. The works will also be supervised by **diadès**. «On a project of this scale, a permanent presence is essential to guarantee compliance with safety and quality requirements,» he explains.

This renovation of the bridge at Tancarville is part of a series of major projects undertaken by **setec** to preserve French engineering structures. In the 1990s, the Group had already demonstrated its expertise on the Normandy Bridge, helping to guarantee the structure's stability in wind conditions - a crucial issue for this cable-stayed bridge, which at the time held the longest span of its kind in the world. As with the Normandy Bridge, this project is not just about extending the use of the structure. It aims to preserve a living heritage, a testament to the history of the area and the ingenuity of those who built it.

*AFGC - The French Civil Engineering Association is a professional organisation dedicated to the promotion and development of civil engineering in France. It brings together engineers, experts and companies in the construction and infrastructure sector. It also plays an important role in preserving built heritage, notably through its History & Heritage commission, which focuses on protecting endangered engineering structures and raising awareness of the importance of these historic structures.

Renovating the historic Corniche Kennedy

The Corniche Kennedy, an emblematic boulevard in Marseille, France has been renovated by setec tpi, setec organisation and diadès, commissioned by the Metropolitan Authority of Aix-Marseille-Provence.
This 1.7-kilometre structure, famous for its 'longest bank in the world', had been exposed to marine erosion for more than 60 years and required major repairs to enhance its durability while respecting the heritage character of the site. One of the main challenges was to deal with the advanced corrosion of the reinforcement. «The Corniche has suffered years of exposure to salt water spray, causing the concrete to crack,» explains Tancrède de Folleville, Project Director at **setec tpi**. The repairs required the use of special concretes, including BFUHP, an ultra-high performance fibre-reinforced concrete, for non-structural elements such as benches and balustrades.
These materials have enhanced the durability of the structure while preserving the original aesthetic appearance. Loriana Pace, Project Engineer at **diadès**, also highlights the adoption of an innovative solution: «Cathodic protection using impressed current was a first for us. It provides continuous protection of the reinforcement against corrosion».
Another major challenge was the restrictions dictated by Marseille's tourist calendar. The works had to be spread over several years to avoid disrupting traffic during the summer months. Despite the challenges associated with environmental conditions, logistics and the proximity of the Tide gauge, a classified historic monument, the coordination between the different teams, combined with the expertise of the heritage architect, meant that the works were completed in 2022, providing an ideal venue for the water sports events of the 2024 Olympic Games.

+ FOCUS

setec and partners awarded at the ACI Excellence Awards 2022 in Dallas

setec won 1st prize at the ACI Excellence Awards 2022, alongside Eiffage, Freyssinet, Vinci and Ginger, for the renovation of the Corniche Kennedy in Marseille. Awarded by the American Concrete Institute, the awards celebrate innovations worldwide concerning the use of concrete. Each year, exemplary projects are highlighted for their ability to push back the boundaries of concrete technology.
The Marseilles project, carried out on behalf of Marseille Provence Metropole, was singled out in the «Repair and Restorationé» category for the use of innovative techniques such as ultra-high-performance fibre-reinforced concrete (UHPC), combined with innovative methods of protection against corrosion, to ensure the long-term preservation of this emblematic structure in the face of climatic conditions.

The often forgotten heritage of dykes and dams

When we think of preserving our heritage, we naturally think of historic monuments or emblematic industrial infrastructures. However, other less visible structures, such as dykes and dams, play a fundamental role in protecting and managing our territory.
Benoît Cortier, Director of **setec hydratec**'s river and coastal activities, emphasises the importance of these structures, which are often forgotten but essential for public safety and water management.
«We are regularly involved in work on dykes and dams, some of which are very old and built in specific geotechnical contexts.
The challenge is to renovate these structures to meet the latest technical standards in terms of safety, while respecting constantly evolving environmental and legislative requirements».
Examples of emblematic projects include the restoration of navigation structures on the Oise Canal and the Settons masonry dam, which is almost 20 metres high and was built in the 18th century. These projects illustrate the company's commitment to preservation, combining modern techniques with respect for heritage.
setec's work on these infrastructures is not limited to technical work. It also covers wider issues such as the protection of territories, the maintenance of economic and tourist activities and the preservation of a unique river heritage, some of which is now protected.

Reinventing urban heritage

At a time when urban landscapes are being transformed to meet today's challenges, the emblematic towers of La Défense, Montparnasse and the Michelet district embody the ability of cities to evolve while reinventing their existing built heritage. Beyond their mere appearance, it is the way in which these sites are being transformed, through the expertise of **setec**, that draws attention.

Projection of the Aurore Tower (in green, the new structures added - in grey, the existing structures) - © setec tpi /Aer2

The renovation of the La Défense and Montparnasse towers in the Paris area

«At La Défense, more than half of the projects we work on involve renovation», explains François Lebrun, Director of Activity at setec tpi. «Take the Aurore tower, which was built in the 1970s and then abandoned. Rather than demolish the building, the client chose to give it a new lease of life, and we accompanied this transformation by managing the structural project and interfacing with the different stakeholders involved. This enabled the building to be modernised while preserving its original structure, a sustainable and effective solution».

François emphasises the social dimension of this approach: «Rehabilitating rather than demolishing is part of a sustainable approach. It avoids wasting resources and allows projects to blend in better with their urban environment, while respecting the needs of the city». **setec** is also applying this expertise to another leading project: the rehabilitation of the Montparnasse Tower. Pauline Bleicher, Project Director at **setec bâtiment**, explains the challenges involved: «Built in the 1970s, the tower needed to be modernised without jeopardising its stability. Raising the building and creating new spaces, such as a hotel and an observatory, will reinvent the building's uses. This approach will enable us to breathe new life into this major building while complying with current environmental standards».

Hervé Tourlet, Project Director at **setec tpi**, adds: «The metro tunnel for line 6 runs directly under the tower, which means we have to make constant adjustments to avoid disrupting the existing infrastructure». Managing the co-ownership, which brings together a large number of stakeholders, also makes the project more demanding in terms of coordination. «We have to adapt our decisions to satisfy the co-owners while remaining faithful to the design concept. This requires great flexibility and a meticulous approach,» he concludes.

The profound transformation of the Michelet district

© Agence TVK

The Michelet district of Paris la Défense, built in the 1970s, is being transformed to meet modern urban planning and functional requirements.

setec is providing complete project management for this project, in collaboration with the TVK agency (lead contractor) and the landscape architects of the Roberta studio. The challenge is clear: to give a new perception of public space, by transforming the circulation routes through the buildings so that they are convivial and functional spaces.

By improving these transitions between the different levels, such as along The Link building, the new emblematic tower in the district, the walkways promote clear and inclusive access to the Michelet district from the quiet paths of natural land.

By making maximum use of the space under the slab, the creation of generously planted areas and water regulation basins contribute to more efficient environmental management and greater bioclimatic comfort.

«Our aim is to retain as many of the existing structures as possible, justifying or reinforcing them where necessary to avoid their complete demolition,» explains Laurent Berger, Project Director at **setec tpi**. 'This approach makes it possible to significantly reduce site movement and nuisance, and thus minimise the carbon impact, which are key objectives of the AMUR (Urban layout) project.»

Part 3

MAINTAINING OUR HERITAGE

Why and how can engineering play a role?

...
INTERVIEW

Mélanine BEAUGELIN
General Director of the **lerm**

Christophe RAULET
General Director **diadès**

Protecting our built heritage, whether old or new, is not just a matter of patching it up. Engineering, involved at every stage in the life of a structure, guarantees its durability through expertise and appropriate technical solutions. Christophe Raulet, Director of **diadès**, and Mélanie Beaugelin, Director of the **lerm**, explain their key role in these missions.

How can engineering contribute to heritage preservation?

C. R.: Engineering is essential to guarantee the long-term viability of structures. We are involved from the moment they are commissioned, with the implementation of maintenance policies, detailed inspections and regular monitoring to detect the first signs of deterioration, anticipate repairs and ensure the durability of all types of structures.

M. B.: Engineering also plays a role right from the design phase, through a relevant and informed choice of materials. For example, we have worked on the performance-based approach to concrete, to formulate materials with durability indicators that meet specific requirements, to extend the life of structures and limit the need for major repairs.

How do you contribute in practical terms to the preservation of heritage works?

C. R.: We concentrate on structural diagnostics of structures already in service. Based on our analyses, we propose the most appropriate solutions in terms of repair or reinforcement, to guarantee their safety and longevity.

M. B.: For older structures, it is often necessary to carry out in-depth investigations of the materials, as technical data is sometimes lacking. We therefore carry out investigations and analyses to characterise the materials and propose solutions adapted to the heritage requirements.

Can you explain how your expertise complements each other?

C. R.: The expertise of **diadès** and the **lerm** complement each other throughout the diagnostic chain. **diadès** acts as a general practitioner, both before and after the **lerm**. For example, on viaducts affected by internal pathologies such as swelling of the concrete, **diadès** carries out documentary analyses and inspections to recommend more detailed analyses.

M. B.: The **lerm** is then involved in monitoring the structures, both from a structural behaviour and materials identification point of view, performing laboratory analyses and finally confirming the diagnosis made, following accelerated ageing tests and modelling the lifespan of the concretes.

C. R.: **diadès** can then process this data using predictive calculation models, and then to define and monitor the best repair solutions, as part of our design and works technical management assignments.

How important is technological innovation in the preservation process?

M. B.: It is a crucial lever! Artificial intelligence and the Internet of Things are helping us to anticipate the ageing of structures, plan precise interventions and reduce the need for costly repairs.

C. R.: It's also very important for developing ever more reliable and accurate diagnostic tools. These developments improve our understanding of structures and help us to anticipate interventions. But above all, innovation is reflected in the way we work together, which is one of **setec**'s major strengths.

M. B.: Innovation also means developing low-carbon solutions to meet the new challenges faced by project owners.

setec's expertise

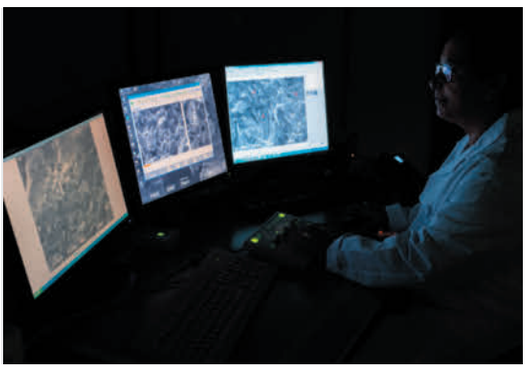
setec mobilises a wide range of skills to preserve built heritage. Thanks to in-depth, multi-disciplinary expertise in materials, geotechnics, structures, the environment, etc., we are able to offer solutions adapted to the sustainable design and durability of our heritage. Here's a closer look at this expertise, which is essential for anticipating and treating infrastructure pathologies, and guaranteeing their longevity.

The lerm, our Laboratory for Materials Study and Research

Preserving our built heritage requires in-depth knowledge of materials, their properties, ageing mechanisms and durability conditions. The **lerm**, **setec**'s integrated engineering consultancy, plays a key role in this mission. «We are involved at every stage in the life cycle of materials, from resource diagnosis to reuse», explains Mélanie Beaugelin, General Director of the **lerm**. This over-all approach aims to extend the lifespan of structures while minimising their environmental impact. Sustainability is at the heart of this approach.

«It concerns both the longevity of materials and their impact on the environment,» explains Mélanie. The **lerm** uses its expertise and laboratory resources to formulate low-carbon materials and recover resources from deconstruction, for example, thereby contributing to a more responsible use of raw materials and a reduction in waste. Diagnosis is also fundamental to heritage preservation.

«We characterise the state of repair of a structure's materials using our own testing and laboratory resources,» she adds. Thanks to this expertise, the **lerm** helps to extend the lifespan of structures while avoiding major interventions. Finally, the **lerm** is developing decision-making tools to optimise infrastructure management. «Understanding the condition of structures is essential for their long-term preservation,» concludes Mélanie.



3 000 m²
of laboratories
in Arles

Examination
and instrumentation
resources throughout
France

diadès, specialists in structural diagnostics

diadès is a key specialist in the diagnosis of existing structures.

«Just like a GP, we identify pathologies, prescribe tests and then analyse the results to ensure the safety of structures,»

explains **Renaud Leconte,**
Technical & Innovation Director.

This diagnosis is carried out at various stages in the lifecycle of a structure, for example when there are concerns about the structure or when there is a change of use. The aim is always to go beyond superficial repairs. «Treating only the visible symptoms, such as cracks, without tackling the root cause, risks causing further deterioration,» insists Renaud. The methodology used is therefore as follows: after detailed analyses, **diadès** identifies the cause of the defects, assesses the impact on the structure and prescribes appropriate repairs.

These interventions include analyses of the results of non-destructive methods, sampling and modelling to recalculate the load-bearing capacity of the structure, for example. The mission carried out on the Digoin viaduct, a major structure on the Centre-Europe Atlantic Route (Route Centre-Europe Atlantique - RCEA) crossing the Loire River, is a good illustration of this expertise.

On this 486 m long structure, **diadès** identified cracks and advanced pathologies in the concrete. Based on their recommendations, the **lerm** carried out extensive tests on the materials, enabling **diadès** to confirm the correct hypotheses and propose appropriate solutions for a rigorous follow-up. This approach perfectly embodies the **diadès** approach and the complementary nature of the diagnosis with the **lerm**: combining technical skills, materials expertise and collaborative work to offer tailor-made solutions adapted to the specific characteristics of each structure and its technical challenges.

terrasol, geotechnical engineering expertise

In the face of major environmental challenges, terrasol is mobilising innovative geotechnical expertise to ensure the durability and safety of infrastructures.
Charles Bernuy, Director of the Sobriety and Resilience Division, explains: «We study the behaviour of soils and foundations to diagnose the ability of structures to withstand greater loads and/or the effects of climatic hazards». At a time when drought and rising waters are threatening the stability of many structures, **terrasol** is effectively using advanced methods to analyse their condition, assess the risks and propose sustainable solutions. This approach makes perfect sense on the Remoulins viaduct in France, for example, where meticulous diagnostics are used to determine the re-use of existing structures. By focusing on the resilience of foundations, **terrasol** can avoid costly rebuilds and encourage targeted interventions. «Some projects involve adopting solutions that go beyond conventional benchmarks, by focusing, for example, on the eligibility of deformations. This allows us to provide a more relevant solution to the specific challenges of each structure,» insists Charles. «This requires close collaboration with project owners, to anticipate future needs and incorporate innovative methods,» he adds.
By encouraging clients to rethink their design criteria and question the traditional reflex of demolishing in order to rebuild, **terrasol** is contributing to more responsible infrastructure management, adapted to today's climatic challenges.

+ FOCUS

Playing our part in creating new buildings that will become the heritage of tomorrow

Today, the way in which buildings are designed has changed radically. It is no longer just a question of meeting immediate needs, but of anticipating possible changes in use, by incorporating solutions at the design stage to guarantee the adaptability of structures.
«We no longer design buildings for a single use», explains Bénédicte Danis, Deputy General Director at **setec bâtiment**. «Today, in addition to integrating the principles of circular economy right from the preliminary phases, we are adding the notions of reversibility and flexibility of use».
At **setec**, this approach is illustrated by a number of projects, including those linked to the major infrastructures of the Paris 2024 Olympic Games.
Although built as a temporary facility, they have been designed to evolve after the Games.
The athletes' village, for example, will be transformed into a residential area, to provide a sustainable solution to the region's housing needs. This is a perfect illustration of **setec**'s commitment to designing buildings with a long-term vision.

Reversibility and flexibility of use have become key issues. We no longer think of new buildings in the same way as we did 20 years ago. From the design phase onwards, it is essential to consider future requirements, while minimising the impact on the environment.
All these elements, such as modularity, demountability and reuse, should enable buildings to adapt to future uses and to survive the test of time.

Bénédicte DANIS,
Deputy General Director
setec bâtiment

How can we build tomorrow's heritage?

Building a bridge is more than just uniting two banks: it's creating a structure that will stand the test of time and become part of our heritage. The 3rd Bosphorus Bridge, the Vasco de Gama Bridge and the Mohammed VI Bridge in Turkey, Portugal and Morocco all illustrate this quest for sustainability. They embody the adaptation to technical and environmental challenges while meeting the needs of modern societies.

I THE VASCO DE GAMA BRIDGE

The Vasco de Gama Bridge, which was opened at the Lisbon World Fair in 1998, is a 17 km structure spanning the Tagus River. setec played a major role in the development of the concrete formulation to guarantee the resistance of the concrete to aggressive environmental conditions, and in particular to the risk of corrosion of the reinforcement.

The objective set was ambitious: to guarantee 120 years of durability for the structure, an unprecedented challenge at the time. This project was one of the first to adopt a performance-based approach to durability, based on the optimisation of physical indicators of the material and on a predictive model of the penetration of chloride ions into the concrete over time, developed by the **lerm** during the project. The predictions obtained are compared with the results of analyses of samples taken by the **lerm** during investigation campaigns, to verify the trend in terms of achieving the expected lifespan and to formulate monitoring and maintenance recommendations for the project owner.

I THE 3RD BOSPHORUS BRIDGE

The third Bosphorus Bridge, also known as the Yavuz Sultan Selim Bridge, spans 2,164 m, linking the European and Asian shores of Istanbul.

Built by the Içtas-Astaldi consortium, this combined bridge with its hybridisation of suspension and cable-staying is a real technical feat designed to last and withstand the test of time.

As an independent controller, **setec** provided expertise in verifying the stability of the rock foundations and validating the structural calculations using advanced 3D modelling. Since the bridge was inaugurated in 2016, rigorous monitoring has ensured its longevity, making it a key feature of the Istanbul landscape.

I THE MOHAMMED VI BRIDGE

Located in Morocco on the Rabat motorway bypass, the Mohammed VI bridge is a remarkable example of modern, sustainable design.

This cable-stayed concrete bridge has been designed to withstand the seismic and climatic conditions of the region, with particular attention paid to the choice of materials and construction methods. Concrete, a locally available resource, was favoured for its durability and resistance to environmental conditions.

setec played a role in assisting the project owner, contributing to the technical and architectural design of the bridge and ensuring quality control of the works.

Today, **diadès** carries out regular inspections to guarantee the structure's longevity. This monitoring is essential to ensure that this emblematic bridge can survive for generations to come.

setec

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