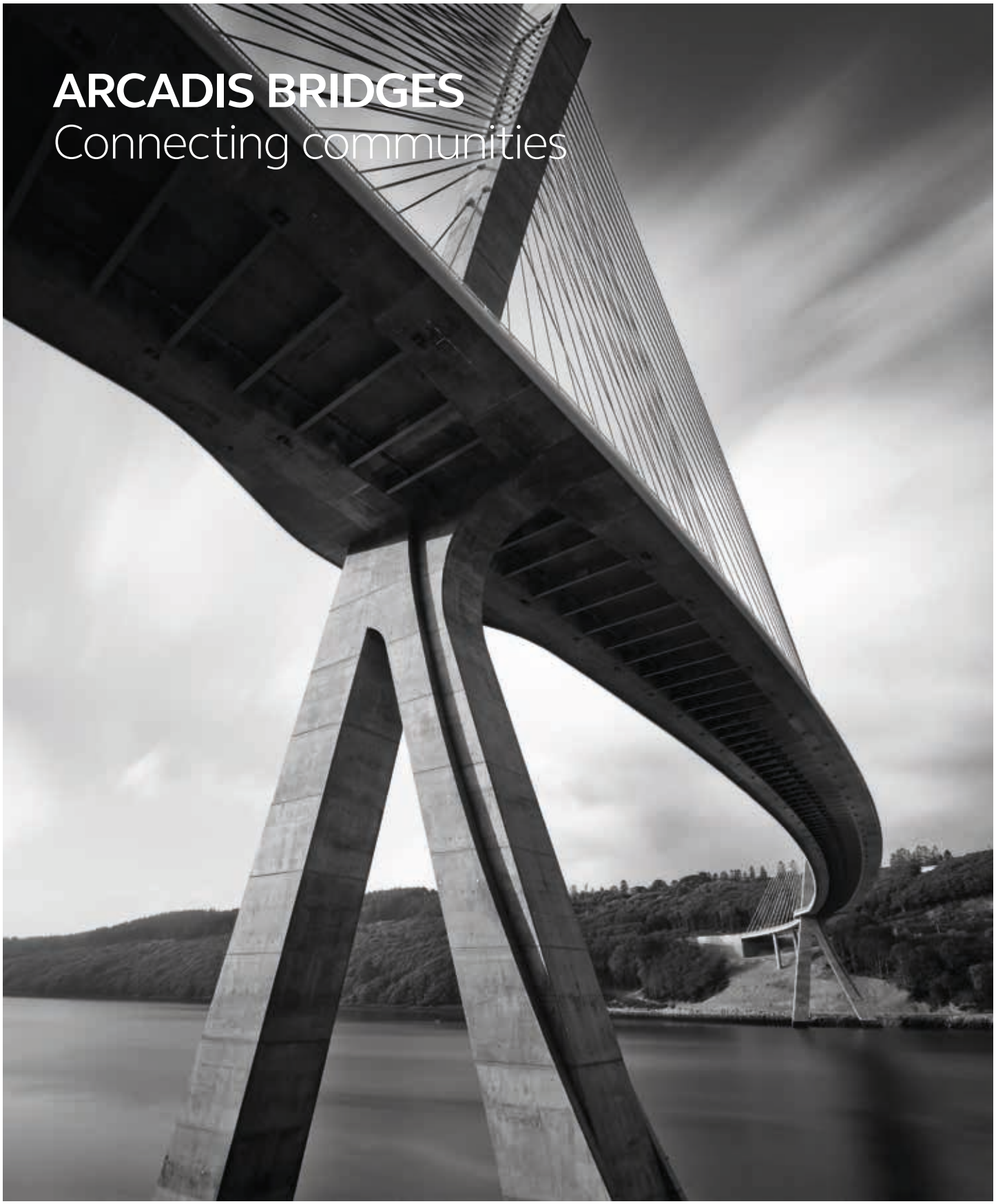
ARCADIS Design & Consultancy for natural and built assets

ARCADIS BRIDGES
Connecting communities



Eric Tabarly Bridge
Nantes, France

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Cover: Terenez Bridge, Finistère, France

CONNECTING COMMUNTIES

Michel Moussard
Transportation
Bridges

Arcadis is the leading global natural and built asset design and consultancy firm, covering the whole asset lifecycle. For over a 125 years we have been working in partnership with clients around the world to deliver exceptional and sustainable outcomes.

Our reputation is built on a deep understanding of client needs, combined with our knowledge and experience worldwide. With 28,000 people and €3 billion in revenues, we have built a global network that enables us to serve our local clients on a global basis.

The megatrends of the 21st century place increasing demands on clients worldwide.

Rapidly increasing urbanization, shrinking budgets and environmental sensitivity require innovative approaches to deliver advanced infrastructure for the Megacentury.

With our multidisciplinary approach to architecture and engineering we build bridges of distinction that enhance their built and non-built environment, connecting communities around the world.

We look forward to working with you.

FACTS

Founded in Amsterdam, the Netherlands, in 1888, Arcadis now operates in Europe, the Middle East, Asia, Australia and the Americas.

We have more than

300

offices in over

40

countries.

We are ranked

No 3

in Europe and

No 10

worldwide.

Dilsen-Stokkem Bridge,
Dilsen-Stokkem, Belgium

ABOUT ARCADIS

Arcadis provides consultancy, design, engineering and management services in infrastructure, water, environment and buildings. Established in the Netherlands in 1888, Arcadis now operates with 28,000 staff in over 40 countries worldwide.

We provide services throughout the entire value chain – from strategic advice, planning, design and implementation, through to maintenance and total lifecycle operation. We offer our clients solutions that are robust in the long-term, viewed within the context of their business needs.

Our experience shows that the challenges faced by our clients are rarely met through simply providing traditional professional services. It is our ability to understand the specific needs of clients, in their local context, and our innovative application of services that are new to the industry combined with traditional skills that deliver real results.

Arcadis has a substantial global footprint. Our network enables us to bring our knowledge and experience of projects worldwide and apply that expertise to specific local situations and needs.

Our mission is to improve the quality of life worldwide by creating assets of distinction and sustainable solutions that enhance the environment. Sustainability is central to everything we do; in our work with clients, in the way our company is organized and in our approach to social responsibility. Arcadis supports UN-HABITAT with knowledge and expertise to improve the quality of life in rapidly growing cities around the world.

FACTS

Gross revenue by activity:

Infrastructure
24%

Water
15%

Environment
33%

Buildings
28%

Gross revenue
€3 billion.

Sydney Harbour Bridge,
Sydney, Australia

The mega trends of the 21st century will bring rapidly increasing levels of urbanization as the global population is set to reach nearly 10 billion by 2050.

This demands advanced infrastructure across; roads, railways, ports and waterways, airports, energy resources and communication networks. There is increasing urgency for sustainable solutions to resolve the issues of; climate change, fragile environments and the scarcity of natural resources.

INFRASTRUCTURE FOR THE MEGACENTURY

THE TOTAL MOBILITY CHALLENGES

In mature markets, limited government ability to commit to new infrastructure and challenged budgets, as well as limited natural resources, mean that more innovative ways are needed to manage existing infrastructure assets through to refurbishment and optimization programs.

Emerging markets must also rise to the challenge by building new infrastructure in order to compete. Both require transformational thinking on mobility, connectivity, safety, durability, aesthetics and sustainable solutions. This is infrastructure beyond the technical: this is Total Mobility.

FULFILLING THE POTENTIAL, MEETING THE DEMAND

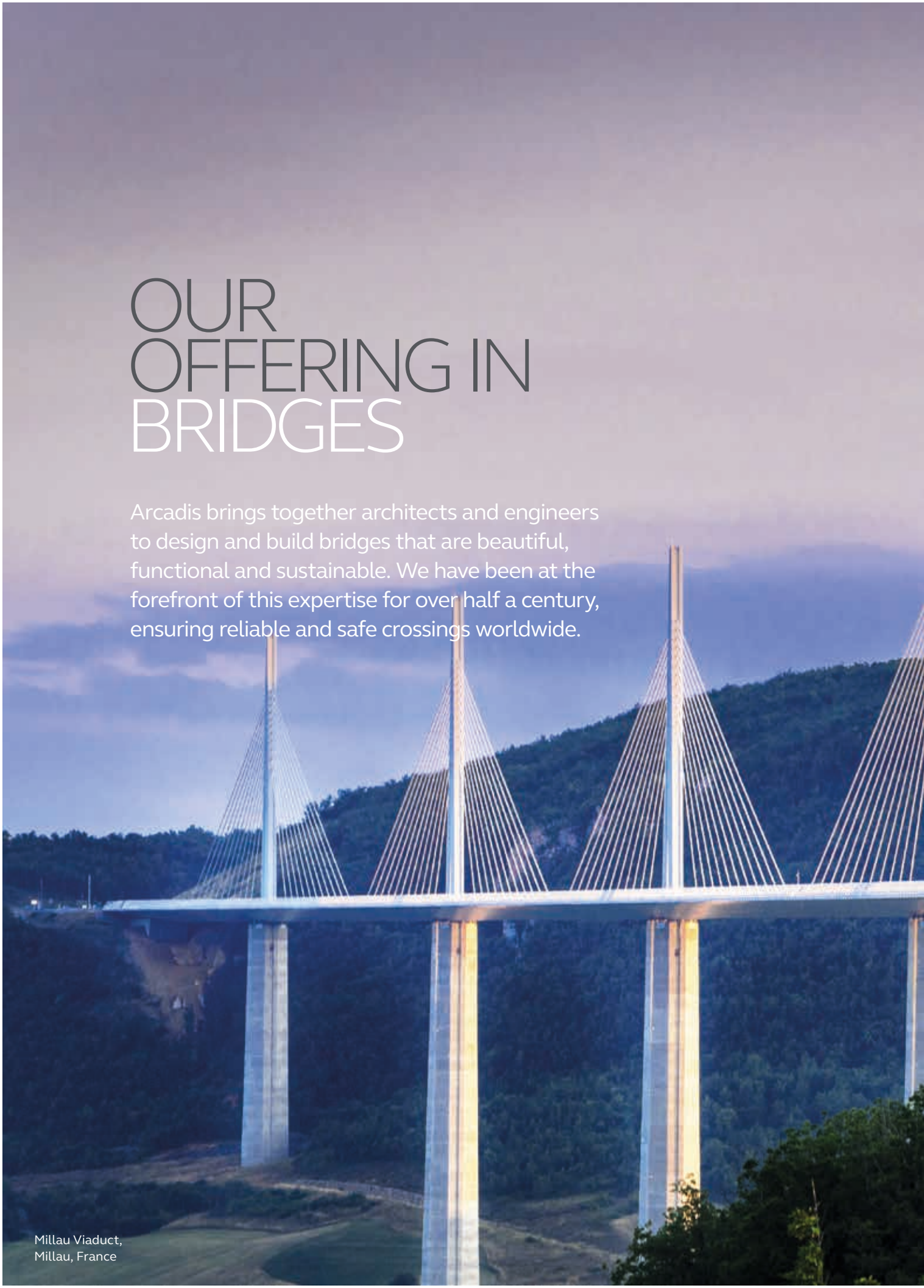
Bridges are increasingly important structures in the evolution of 21st century infrastructure, whether on a grand scale crossing vast areas or reducing congestion in densely populated urban settings. With our multidisciplinary approach, Arcadis has the expertise and experience to plan, design, build and manage even the most challenging of bridge projects. And with our global presence we have developed a deep understanding of all kinds of environments that enables us to bring fresh perspectives, innovative thinking and solutions to complex problems. In doing so, we deliver Total Mobility to billions of people worldwide.

CONNECTING COMMUNITIES NOW AND INTO THE FUTURE

Arcadis responds to these challenges by working in partnership with the public and private sectors to deliver the infrastructure that will connect communities now and into the Megacentury. All our activities embody the highest levels of safety, quality and effectiveness. Our designs are engineered to meet the world's most rigorous safety standards; when developing land we ensure there is balance with the natural habitat; and we measure success in long-term outcomes. Clients around the world look to us to build bridges that will be assets for their communities for generations to come.

OUR OFFERING IN BRIDGES

Arcadis brings together architects and engineers to design and build bridges that are beautiful, functional and sustainable. We have been at the forefront of this expertise for over half a century, ensuring reliable and safe crossings worldwide.



Millau Viaduct,
Millau, France

FACTS

The Millau Viaduct is the tallest bridge in the world: 343m (1122ft). It received the coveted International Association for Bridge and Structural Engineering Outstanding Structure Award in 2006.

INTEGRATING FORM AND FUNCTION

Communities have always needed bridges. Today, with the development of urban areas and wider regions, they require a vast range of bridges to carry road and rail traffic, to reduce congestion and environmental pollution, and – above all – to convey people and freight safely and sustainably. Bridges are often iconic landmarks, communities also care about the architectural quality of their bridges.

The Arcadis approach is to bring engineers and architects together right from the start of the project. More than any other type of civil engineering, bridges require close cooperation between engineers and architects, from concept through to commissioning. Only then is it possible to realize the solid structural, aesthetic and functional design that leads naturally to efficiently managed, successful projects. The bridges built by Arcadis around the world are testament to this approach.

Our track record of delivering complex bridge projects is exemplary. Our best known projects include the Millau Viaduct, Sydney Harbour Bridge and the First Severn Crossing.

We have contributed to the development of many innovative technologies, such as modern suspension bridges, cable-stayed bridges or precast segmental bridges. And sustainability is a key component of all our designs, which incorporate low carbon footprints, low maintenance and high durability.

As bridge builders we are faced with sites of all kinds – with historical importance, urban density or environmental sensitivity – and endless geographical and geological variation, almost every situation is a unique challenge that demands a carefully tailored solution.

FACTS
Bridge design, more than any other type of civic work, requires the complete collaboration of structural design and architecture at all stages of the process.

Arcadis has extensive experience of designing, adapting and building all major forms of contemporary bridges. We breathe new life into old bridges too, our expertise in diagnosis and rehabilitation ensures that treasured assets can continue to operate far into the future.

Our attention to both the desired end results and the detail means that right from the start of the planning phase we identify, mitigate and even avoid issues that could affect the construction and safe operation of our bridges. With forward thinking and excellence integrated into every phase of the project from planning to maintenance, clients trust us to deliver aesthetic quality, safety, durability and sustainability across every project.

LOCAL, GLOBAL AND INDEPENDENT

Our local presence helps us to maintain lasting relationships with our clients and to build in-depth understanding of local communities and environmental conditions. And our global network enables us to use our vast expertise to provide the best value added services and technologies to multinational, regional and local clients. By combining global expertise with local presence, the projects we deliver incorporate the highest levels of strategic consulting with the full range of technical services and solutions for designing, building and maintaining bridges.

And, as an independent company with no links to government, suppliers or bridge owners, Arcadis is best placed to advise clients objectively on the most appropriate solutions and suppliers.

Gustave Flaubert Lift Bridge,
Rouen, France

Vasco da Gama Bridge,
Lisbon, Portugal

OUR EXPERTISE

Clients need reliable design and engineering expertise that guarantees bridges of lasting value to their communities; safe, sustainable and aesthetically pleasing – especially bridges that are very large or in special places, because they become landmarks or icons. With experience in the design and construction of bridges across; Asia, Europe, the Middle East and the Americas, Arcadis has the proven ability to meet this need.

CASE STUDY

EXTENDING THE LIFE OF AN ICONIC LONDON BRIDGE

Project: Albert Bridge, London, United Kingdom

Date won/completed: 2008 / 2011

Client: Royal Borough of Kensington and Chelsea

OUR CLIENT'S CHALLENGE

Constructed in 1877, Albert Bridge's structure was not strong enough to cope with modern traffic loads, although it had been repaired and strengthened in the past. Traffic restrictions on the bridge led to traffic congestion and delays.

Our client needed a sustainable way of strengthening the bridge to sufficiently enhance its live load rating from 2.5t while preserving its historic appearance.

OUR APPROACH

- Arcadis assessed a complex structure consisting of a three-span hybrid-type suspension/cable-stayed bridge with a superstructure of wrought iron girders, and regular cross girders supporting a timber deck.
- We developed a detailed strengthening design and undertook the supervision of the construction work on site.
- Managed key constraints, including restrictions to water traffic and maintenance of pedestrian access.

THE OUTCOMES FOR THE CLIENT

- Arcadis' specialist expertise has enabled Albert bridge's operational life to be extended far into the future without compromising its historic appearance.
- Traffic rating of the bridge has been increased to an accepted modern standard for 7.5t vehicles, enabling smoother traffic flow across a busy Thames crossing.

CASE STUDY

A NEW MOBILE BRIDGE TO HELP REGENERATE AN OLD TOWN

Project: Vlasmarkt Bridge, Dendermonde, Belgium

Date won/completed: 2004 / 2010

Client: Department of Flemish Government

OUR CLIENT'S CHALLENGE

Construction of the mobile Vlasmarkt bridge is part of a phased project for the restoration and refurbishment of The Old Dender, a river that flows through the city center of Dendemonde. The key challenge was to create a bridge that connects the Vlasmarkt with the Grand Market and will be a memorable structure. A further priority was to restore navigability of the canal, which had not been possible since a fixed bridge replaced an older drawbridge.

OUR APPROACH

Arcadis's role included:

- The environmental study
- Architecture for the bridge
- Technical and preliminary design studies for the works
- The stability study (formwork and reinforcement plans)
- Foundations and implementation methods
- Supervision of the procurement procedure
- Construction supervision assistance.

THE OUTCOMES FOR THE CLIENT

- Design and delivery of a landmark bridge that the local community can be proud of.
- Helping to regenerate the old city center, including improved access to the canal.

Térénez Bridge,
Finistère, France

REDUCING POLLUTION AND CONGESTION ON A GRAND SCALE

Major problems with traffic flow on national highways require radical solutions, such as a high crossing over a large area. In these challenging large-scale situations Arcadis guarantees the highest quality and safety standards, while reducing environmental impacts.

HELPING TO REGENERATE HISTORIC CITY CENTERS

In heritage sites, bridges are often important elements with emotional significance for local people. Their restoration – or replacement – can be a catalyst for regenerating historic areas that have fallen into decline. Arcadis has extensive experience of recreating a high quality place sensitively, respecting the historic references.

PROVIDING SAFE CROSSINGS FOR PEDESTRIANS AND BICYCLE TRAFFIC

Cities and towns are increasingly encouraging low-carbon forms of transport, such as bicycles and walkways. Small-scale bridges help to connect people safely wherever there are roads or railway lines to navigate. Arcadis provides safe and aesthetically pleasing crossings that respect the local environment and the daily requirements of local residents.

ENSURING EFFICIENT OPERATION OF TRANSPORT HUBS

Asset owners require safe and efficient crossings in multi-modal transport hubs, with minimum disruption when needing expansion or updating. We are leaders in the specialized, integrated and innovative disciplines that guarantee these outcomes. With proven experience of phasing – managing and completing complex reconstruction works while transport systems remain in operation – Arcadis is able to offer all-round support in building and improving bridges serving transport hubs.

PUBLIC PRIVATE PARTNERSHIPS

Limited public funding means that public bridge owners and operators around the world are looking towards private sector funding to meet their investment goals. At the same time, investors are increasingly interested in assets that deliver a long-term guaranteed return.

Arcadis can identify and scope the possibilities for Public Private Partnerships (PPP), assess the value of assets and structure the outsourcing of operations to private parties. We can also play a role in the formation of PPP and BOT (Build Operate Transfer) projects, bringing our engineering expertise into consortia, and even take the lead in new project developments.

FACTS

Bridges can be categorized by the type of structural elements in their design, by how they are used, whether they are fixed or movable, and by the materials used in their construction.

EXTENDING THE OPERATIONAL LIFE OF ASSETS

With ever-increasing traffic volumes, and the increasing weight of heavy-goods vehicles, bridge owners and operators are often faced with unexpected structural problems and spiralling maintenance costs. Arcadis helps clients to respond to these challenges by diagnosing the underlying issues, repairing and replacing materials with more durable solutions.

ENABLING CROSSINGS FOR HIGH-SPEED RAILWAY TRAVEL

High-speed rail trains provide safe, comfortable and sustainable alternatives to short distance flights, but require special considerations to ensure that bridges can accommodate their weight and speed. Arcadis can draw on national and regional expertise to ensure that concerns about safety – and cost – are addressed through the most efficient and technologically appropriate solutions.

CASE STUDY

INNOVATION, EFFICIENCY AND QUALITY OF CONSTRUCTION TO MEET A CHALLENGING TIMETABLE

Project: Sea High-Speed railway between Tours and Bordeaux – Viaducts

Date won/completed: 2010 / 2015

Client: VINCI and RFF

OUR CLIENT'S CHALLENGE

The Southern Atlantic Europe High Speed Railway is currently under construction, the largest infrastructure project in Europe. It runs for 303km and will substantially reduce journey time between Paris and Bordeaux, extending a major rail corridor.

The main contractor VINCI's challenge for this part of the project was the construction of seven viaducts with a design that would meet the tough requirements of high-speed railway traffic and the tight construction schedule.

OUR APPROACH

We applied design and construction concepts that we had used earlier for roadway bridges, precast segmental deck incrementally launched with temporary cable stays and pylons. These were adapted to the high-speed railway requirements.

We standardized the design, thus allowing our client to precast all elements and to assemble them with the same set of equipment.

THE OUTCOMES FOR THE CLIENT

Speed of construction associated with high quality and durability, specifically designed to accommodate the constraints and loads of high-speed railways.

CONNECTING COMMUNITIES CASE STUDIES

CASE STUDY

A LANDMARK STRUCTURE AT THE MARITIME THRESHOLD OF BAHRAIN

Project: Shaikh Khalifa bin Salman Bridge, Bahrain

Date won/completed: 1998 / 2003

Client: Ministry of Roads & Agriculture, State of Bahrain

OUR CLIENT'S CHALLENGE

The Government of Bahrain was developing a new port at Hidd on the island of Muharraq. A new dual carriageway highway bridge was required to connect the port to the highway network in Bahrain whilst also providing a crossing route for major utilities including power transmission cables and water mains from the new electricity and water distribution plants being built on Hidd. The client required the concept for the crossing to be developed such that a landmark structure was created which would be both functional and architecturally outstanding.

OUR APPROACH

Arcadis was responsible for carrying out the design and supervision of the bridge.

Concept, preliminary and detailed design of the bridge. The concept stage involved considering alternative structural forms, costing each solution and assessing their constructability and whole life maintenance cost, taking into account the client need for a landmark structure.

Selecting the structural form finally chosen for the navigation span. This comprises two pairs of bowstring arches, fabricated from structural steel, with one pair on each side of the steel/concrete composite deck. The prefabricated arch and deck structure was floated into position supported on two barges.

THE OUTCOMES FOR THE CLIENT

- Arcadis's design expertise, combined with our engineering knowledge, has delivered a bridge of iconic design.
- The new bridge carries road traffic from the new port and conveys power and water from the Hidd Peninsular to mainland, whilst providing a landmark structure that identifies the maritime threshold of Bahrain.

CASE STUDY

MINIMIZING DISRUPTION WHILE CONSTRUCTING A STRATEGIC FLYOVER

Project: Utrechtboog, Amsterdam, the Netherlands

Date won/completed: 1994 / 2008

Client: ProRail B.V.

OUR CLIENT'S CHALLENGE

The rail network in the Netherlands is increasingly overloaded, so a number of major infrastructure improvements are underway. The Utrechtboog rail viaduct facilitates direct train connections between Utrecht and Schiphol airport, without passengers needing to change trains at Duivendrecht station.

This is a new section of rail 15m above ground consisting of two single-track flyovers, each measuring 1.5km in length.

The main challenge for the client was to ensure that train traffic and passenger handling could continue with as few disturbances and out-of-service periods as possible during the realization of the project. This was the client's first Design and Construct contract for a rail project in the Netherlands.

OUR APPROACH

Arcadis was responsible for the architecture, design, the integral project management, the building process supervision, site-management and the operational management. For this project we helped our client throughout each stage, ensuring that design and execution was optimized.

We applied a new technology for the construction of the flyovers, originally developed for mountainous areas – Movable Scaffolding System (MSS):

- With MSS, the construction of the flyovers, with a total length of approximately 3km, was almost an industrial process.
- This system consists of a 140m long steel sleeper to which the formworks are attached. The machine rests on the final columns – so that temporary support is not necessary – and can move itself across the columns
- MSS for the Utrecht Arch was unique because of the many adjustments and innovations and was developed especially for this project by the project contractor and the supplier, Bouwcombinatie Utrechtboog (BCU) and NRS from Norway respectively

THE OUTCOMES FOR THE CLIENT

- Expert support through each stage of the project, to help the client implement their first Design and Build rail contract.
- Specialist expertise in innovative technology (MSS) meant that the project was delivered with minimum disruption to train traffic and passengers, while addressing the challenges of a complex site.

CASE STUDY

A WORLD-CLASS BRIDGE, A UNIQUE BLEND OF ARCHITECTURAL AND STRUCTURAL DESIGN

Project: Millau Viaduct, Millau, France

Date won/completed: 1996 / 2004

Client: MEDDE

OUR CLIENT'S CHALLENGE

Local authorities had been trying for many years to solve the problem of acute traffic bottlenecks in the town of Millau, on the main north-south route between Paris and the Mediterranean. The situation worsened in the summer months when motorists took close to three hours to cross the steeply sloped valley. A radical solution to the traffic bottleneck was needed: a structure able to carry the A75 motorway safely "from Causse to Causse" (high plateaus) across the 250m deep and 2,5km wide Tarn Valley. They needed an outstanding design that would fit this environmentally beautiful site.

OUR APPROACH

With the architect Lord Norman Foster, Michel Virlogeux, SODETEG and SERF we designed a state-of-the art multi-span cable stayed bridge with pre-stressed high performance concrete for piers and high strength steel for decks and pylons.

It is the world's longest multi-pier cable-stayed bridge, at just 40m short of 2.5km, and the highest at 343m. Seven piers step across the valley over the River Tarn to support the deck. Its form perfectly fits functions and structural behaviour. The result is a striking and elegant structure. The bridge is intended to last for at least 120 years.

THE OUTCOMES FOR THE CLIENT

- An outstanding landmark bridge, taking only three years to complete, three months ahead of schedule and on budget.
- Opening up a direct route from Paris to Barcelona.
- Transforming traffic flow and eliminating bottlenecks in the town of Millau each year, nearly 4.8 million vehicles pass through the tolls, 10% of which are trucks.
- The so-called 'Millau effect' the bridge has been so successful worldwide that it has brought a new economic development to the town of Millau and its region.

One million visitors stop at the Millau viaduct site every year.

> "The Millau viaduct takes its place among our most shining works of civil engineering. It brilliantly embodies the verve of our research and technology. A monument to French daring and enterprise"
>
> **President Chirac, December 2004.**

CASE STUDY

LANDMARK SUSPENSION BRIDGE REHABILITATED TO LAST ANOTHER 50 YEARS AND BEYOND

Project: Anthony Wayne Suspension Bridge, Toledo, Ohio, United States

Date won/completed: 2009 / 2015

Client: Ohio Department of Transportation

OUR CLIENT'S CHALLENGE

The Anthony Wayne Bridge is a major 28-span 980m road bridge than traverses the Maumee River in Toledo, Ohio. This landmark bridge, built in 1931, serves three national state routes and is heavily used by freight traffic – but after more than 80 years' service it was in need of repair.

The client needed a design that would strengthen the historic bridge to support current loads and extend the life of the structure by eliminating details that lead to rapid deterioration.

OUR APPROACH

Arcadis coordinated a design team that collaborated to revise portions of an 85-year old bridge to extend its life and lower its life cycle costs.

We combined common bridge details with advanced analysis to eliminate joints, which were the primary cause of reducing the life of the structure.
A new span was designed and seamlessly integrated into the historic bridge to eliminate an unsafe steel deck truss approach.

THE OUTCOMES FOR THE CLIENT

- The rehabilitation solutions led to a construction cost that was well below the client's original estimate and allowed for the project to be completed on time.
- A landmark bridge will remain in operation for another 50 years or more.

CASE STUDY

STRIKING AND UNIQUE CABLE STAYED BRIDGE WITH TWIN OFF-SET PYLONS

Project: Yaojiang Airport Road, Ningbo, China

Date won/completed: Design: 2005 – 2008 Construction: 2007 – 2010

Client: Ningbo Urban Construction Investment Holding Company Limited

OUR CLIENT'S CHALLENGE

China's international port at Ningbo needed to be linked with its airport by a new road bridge, with a design worthy of the city's new international image. The key client requirements were that the design should be 'applicable to the site and be demonstrably safe, aesthetic, economic and durable'. The bridge also had to avoid potential flooding issues associated with the area, while providing essential public utility provision across the bridge and meeting the functional requirements of the bridge traffic.

OUR APPROACH

Arcadis was appointed to undertake the design study, concept and preliminary design of the bridge, and worked on the final scheme in conjunction with the architect.

After the preliminary design, Arcadis continued to support and advise HPDI (one of China's largest highway design institutes) in the detailed design and construction stages.

The final design, as constructed, is a 40m wide by 1069m long, cable-stayed steel box Girder Bridge which carries a dual three-lane highway.

It comprises a striking and unique arrangement of twin off-set pylons with fan cables, reflecting Ningbo's maritime and Silk Road history, but bringing it up-to-date to match the city's new international image.

THE OUTCOMES FOR THE CLIENT

- The design achieved the distinctive aesthetic appearance required by the client.
- Completed within the tight time frame needed for the client's overall programme.

CASE STUDY

A LANDMARK SCULPTURAL BRIDGE, HELPING TO REGENERATE AUCKLAND'S WATERFRONT

Project: Te Wero Bridge, Auckland, New Zealand

Date won/completed: 2008 / 2011

Client: Auckland City Council

OUR CLIENT'S CHALLENGE

The client wanted to support business development on Auckland's City Waterfront and to create an accessible area rich in character that links people to the city and the sea. A new bridge spanning the inner Viaduct Harbour entrance would be vital for the whole waterfront regeneration – but it would have to be an outstanding design, as it would be located in a site surrounded by tall structures. It would also have to be multi-functional, to carry cyclists, pedestrians, passenger transport and possibly light rail.

OUR APPROACH

The client selected the design submitted by a team of Arcadis, Denton Corker Marshall and Kenneth Grubb Associates as winner of its international design competition. The winning design is a twin leaf bascule bridge, with a mast structure that houses counter weights and a control room. Taking inspiration from images of closely tacking America's cup yachts, the form and motion of the bridge were developed to create a stunning efficient design that transforms a routine opening bascule into elegant choreography.

In March 2009 the Client made the decision to defer the construction of the Te Wero Bridge and awarded Arcadis and our associates a commission to undertake the design and supervision of an interim bridge (the Wynyard Crossing) for pedestrians and cyclists to operate until the permanent bridge is constructed.

Various bridge types were considered, including a pontoon bridge, retracting bridges, swing bridges and bascule bridges. The selected bridge design comprises a number of fixed spans and a double bascule opening span.

The bridge consists of 'lightweight' materials with construction of the bridge being sufficiently robust to meet its function whilst minimising structural mass and visual bulk.

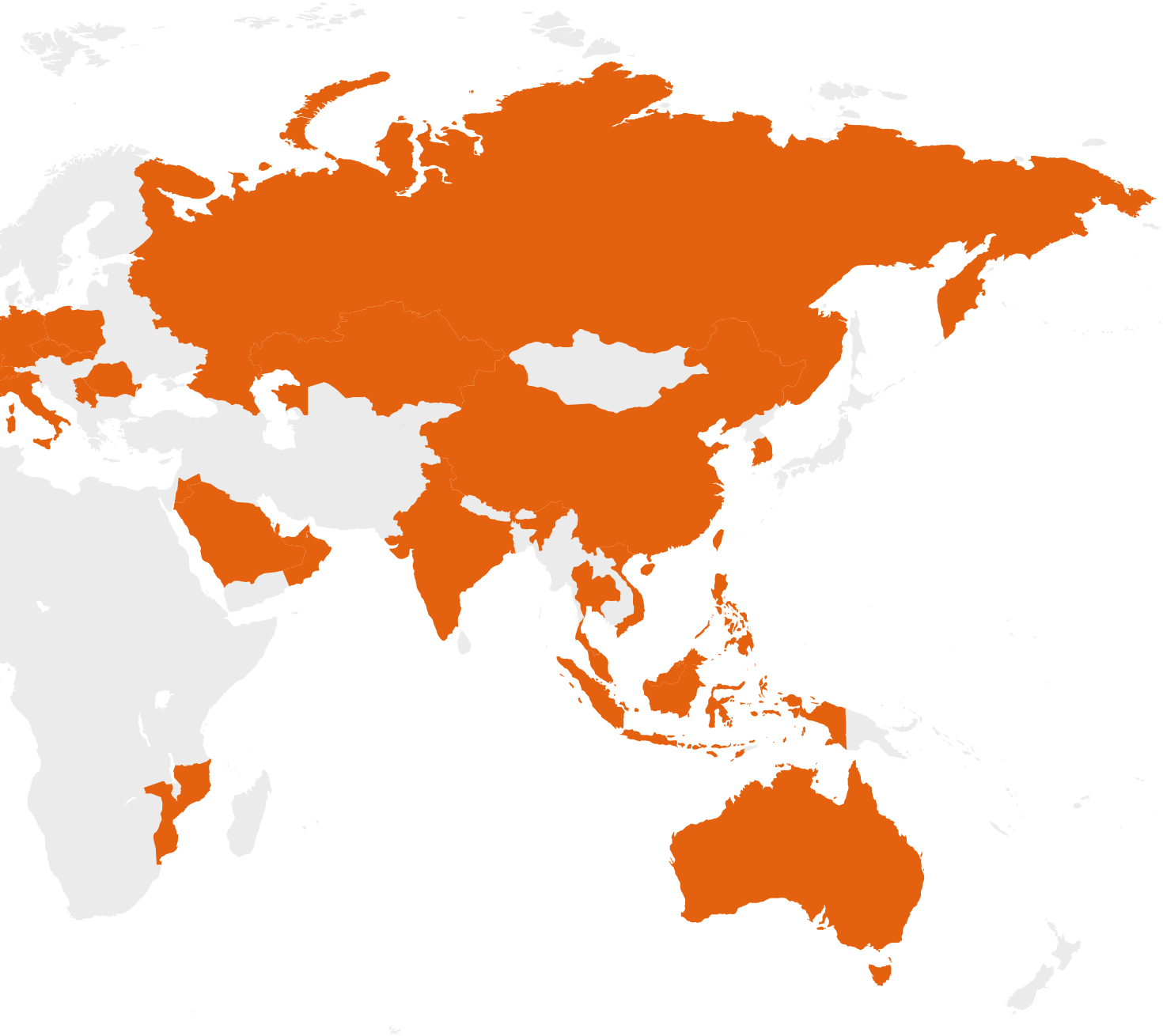
THE OUTCOMES FOR THE CLIENT

- The Arcadis multi-disciplinary team delivered two very efficient, sustainable and striking designs for a bridge which the client sees as vital to its plans for the future success of the wider waterfront and central business district regeneration.
- The Wynyard Crossing bridge was completed within budget and opened in time for the 2011 Rugby World Cup.

WHERE WE ARE IN THE WORLD

We have people and offices around the world. Our global network enables us to bring our knowledge and experience of projects worldwide and apply that expertise to specific local needs and situations. We are based in:

Australia
Bahrain
Belgium
Brazil
Brunei
Canada
Chile
China
Czech Republic
Dubai
France
Germany
Hong Kong
India
Indonesia
Italy
Jordan
Kazakhstan
Korea
Macau
Malaysia
Mexico
Mozambique
Netherlands
Oman
Peru
Philippines
Poland
Qatar
Romania
Russia
Saudi Arabia
Serbia
Singapore
Slovakia
Spain
Switzerland
Taiwan
Thailand
Turkey
United Arab Emirates
United Kingdom
United States
Vietnam



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