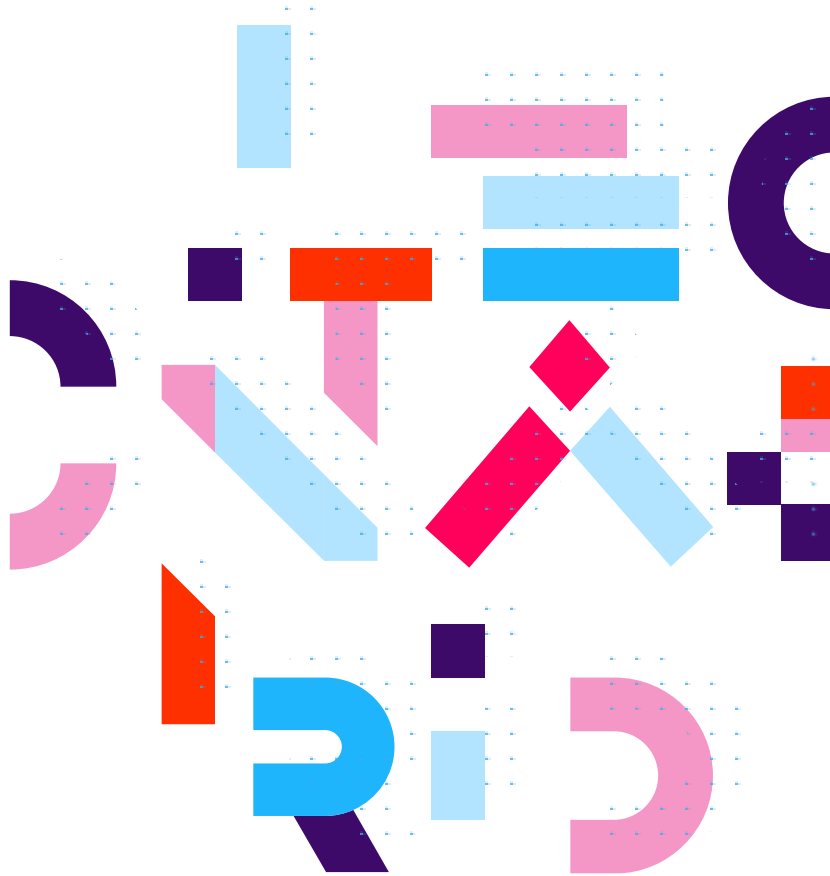
LEONARD

CATALOGUE OF CLIMATE ADAPTATION SOLUTIONS

VINCI Group solutions



together @ VINCI

INTRODUCTION

Dear colleagues,

The impact of the climate imbalance is already being felt across the world, so we must undertake the considerable challenge of adapting our infrastructure. As VINCI positions itself as a major provider of solutions to mitigate climate change – ways to reduce greenhouse gas emissions – it is crucial that VINCI steps forward with respect to **climate change adaptation**. It was with this in mind that in April 2023 we relaunched the forward-looking "Climate Change Adaptation" strategy with Leonard, the Group's foresight and innovation platform.

The Group's entities do everything they can to protect the environment!
This **catalogue presents a curated selection of the effective and tangible solutions developed by VINCI to respond to the climate challenges we are facing now and into the future.**

Much more than just a collection of solutions, this catalogue represents a practical guide for every one of you, presenting the necessary tools to integrate these innovations in your projects. **Let us also use this guide to promote our expertise among our clients and partners.**

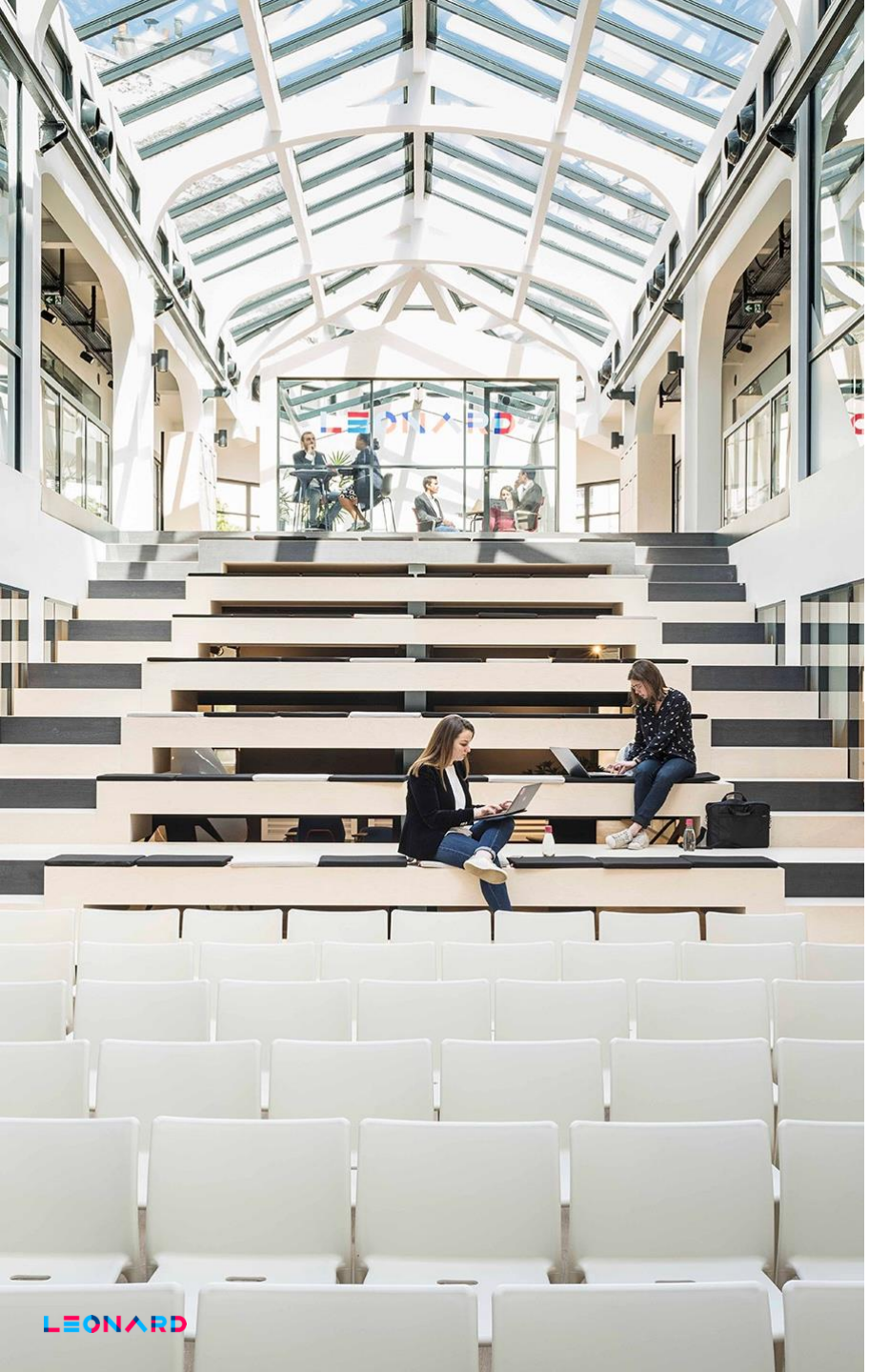
It is up to us to put these solutions in place, draw inspiration from one another by spreading best practice, and be integral in driving progress. We must leverage our dedication and creativity to build a world where our infrastructure and constructions are more resilient and ready to face the challenges that arise from climate change.

Let's be a force for good!

I do hope you enjoy reading through these solutions.

Isabelle Spiegel,
Global Head of Environment for VINCI, Vice-President and member of the VINCI Group Executive Committee

FOREWORD



METHODOLOGY

As part of the forward-looking “Climate Change Adaptation” strategy launched in April 2023 by Leonard, the VINCI Group's foresight and innovation platform, the members decided to **compile a selection of climate change adaptation solutions developed by VINCI** and present them in a single document. This catalogue provides **every employee with a practical tool that helps them find suitable solutions to respond to the challenges posed by climate change.**

This document:

- **Lists** a wide variety of recently developed solutions, but does not seek to include all VINCI solutions

- **Inspires** employees by highlighting the potential for replication at various scales

- **Offers ideas** about how to focus clients on the importance of adaptation and the need to develop solutions that are effective and fit for purpose to avoid misalignments

→ If you would like to put forward an idea for the next version of the catalogue, please fill out this form to share your idea/solution for climate adaptation with us: https://forms.office.com/e/7r9Em9fVeP

HOW TO USE THE CATALOGUE

The catalogue presents three types of solutions:
- **Diagnostic solutions**
- **Prevention solutions**
- **Repair solutions**

Split across the Group's four main business lines:
- **Buildings and energy renovation**
- **Transport and roads**
- **Energy infrastructure**
- **Water infrastructure**

SOLUTION

Quick overview of the solution/offer/ project

DEPLOYMENT

Client:

Budget:

Region:

Date:

DESCRIPTION

The section entitled "Description" sets out the solution in detail, focusing in particular on:
- *The problem it seeks to address*
- *The context in which it was implemented (especially as part of a project)*
- *A broad explanation of the solution (especially from a technical point of view)*

ADDED VALUE FOR CLIMATE ADAPTATION IN THE REGION

The section entitled "added value in housing" seeks to:
- *Highlight the competitive advantage of each solution*
- *Demonstrate how the solution/project helps adapt to climate change in the region*

KEY CONTACT

First name Surname

Job title

Email

The Deployment section presents the way in which the various solutions are rolled out, specifying:
- The **client or type of clients** concerned by the solution/project
- The **budget** associated with this kind of project
- The **market segment concerned by the solution** or, where relevant, the **project location**
- The **date** when the project/solutions were first implemented

The below pictograms are used to refer to the **climate hazards** addressed by the solution:

- Drought
- Rising temperatures
- Cyclones and storms
- Flooding
- Wildfires
- Coastal erosion
- Submersion
- More than two hazards concerned

Certain solutions can serve to adapt to several climate hazards → When this is the case, the "More than two risks concerned" pictogram appears

CONTENTS

CONTENTS | BUILDINGS AND ENERGY RENOVATION

Drought | Rising temperatures | Cyclones and storms | Flooding | Wildfires | Coastal erosion | Submersion | All climate risks

CONTENTS | BUILDINGS AND ENERGY RENOVATION

VINCI ENERGIES

VINCI IMMOBILIER

Drought | Rising temperatures | Cyclones and storms | Flooding | Wildfires | Coastal erosion | Submersion | All climate risks

CONTENTS | TRANSPORT AND ROADS

VINCI CONCESSIONS

VINCI CONSTRUCTION

Drought | Rising temperatures | Cyclones and storms | Flooding | Wildfires | Coastal erosion | Submersion | All climate risks

CONTENTS | TRANSPORT AND ROADS

VINCI CONSTRUCTION

Drought | Rising temperatures | Cyclones and storms | Flooding | Wildfires | Coastal erosion | Submersion | All climate risks

CONTENTS | ENERGY INFRASTRUCTURE

Drought | Rising temperatures | Cyclones and storms | Flooding | Wildfires | Coastal erosion | Submersion | All climate risks

CONTENTS | WATER INFRASTRUCTURE

Drought | Rising temperatures | Cyclones and storms | Flooding | Wildfires | Coastal erosion | Submersion | All climate risks

CONTENTS | WATER INFRASTRUCTURE

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VINCI CLIMATE HAZARD MODELLING TOOL

RESILENS

SOLUTION

ResiLens is an online platform used to visualise the climate risks involved in the Group's current and future projects. The tool harnesses a map of the world presenting the exposure to climate hazards (floods, etc.) and the criticality of infrastructure according to their type. Exposure is calculated using IPCC data for various timescales (2030, 2050, 2070). In 2024, the maps of zones experiencing water stress and biodiversity protection regions will be added

DEPLOYMENT

Available to all VINCI employees after a 2-hour online course, free access to all VINCI's collaborators

DESCRIPTION

In accordance with the Group's actions for the climate, the VINCI Environment Department sought to support its ambition to pick up the pace at which it is adapting its structures and operations by launching the ResiLens platform. ResiLens is the first platform developed and deployed globally by a major group to assess the criticality of its projects and activities with respect to climate risks. The platform was developed by RESALLIENCE, a group entity specialising in this area, in collaboration with VINCI business lines.

ADDED VALUE

- 14 climate hazards considered (drought, storm and cyclone, rising sea levels, heatwaves, etc.)
- 30 km graphic resolution worldwide; 8 km in Europe and 1 km in mainland France
- Potential to import projects that will be assessed with respect to climate risks to produce a preliminary diagnostic that identifies the risks and adaptation solutions that could be implemented
- Tool that helps raise awareness among employees about climate change adaptation
- Sharepoint integrating key information about environmental resilience

KEY CONTACTS

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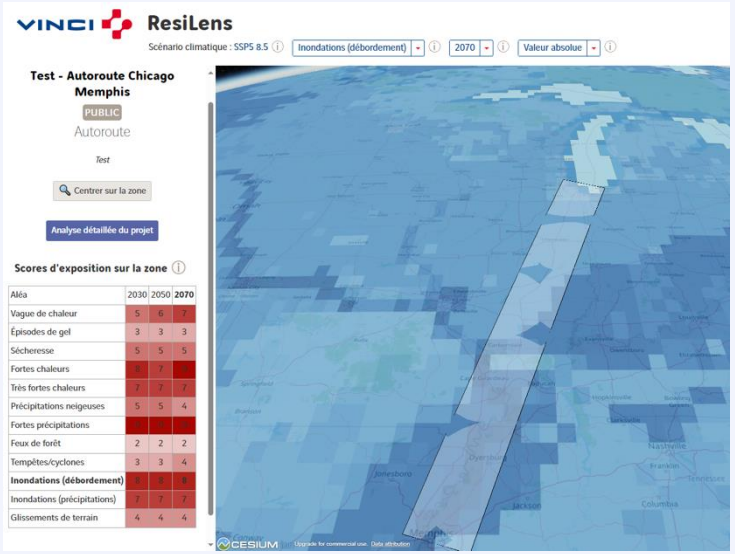

1. BUILDINGS AND ENERGY RENOVATION

1.1. DIAGNOSTIC SOLUTIONS

CALEDONIA

SOLUTION

CaledonIA is a piece of calculation software that uses artificial intelligence algorithms and integrates rainfall data from Météo-France to simulate urban flooding in real time

DEPLOYMENT

Client: Local authorities, towns, departmental councils, insurers, design offices

Region: France

DESCRIPTION

There is currently no software able to rapidly predict (hour by hour) 3D water flows following flooding in urban areas. National meteorological bodies only forecast rainfall a few days ahead of time, leaving local authorities and water design offices unable to study future scenarios to tackle flood risks arising due to climate change. The tool was used on the A9 to consider the vulnerability of the Gard area with respect to heavy rainfall as episodes in the Cevennes mountain region have already blocked the A9 network in the past. Climate change will only make such extreme weather events increasingly frequent. The study sought to assess the consequences of extreme precipitation along a stretch of the A9 motorway, including the road being submerged, and detect where water will pass and damage infrastructure.

ADDED VALUE

- Identify risks
- Anticipate impact, in particular on users, surrounding areas and infrastructure
- Improve prevention and raise awareness among users
- Prepare crisis management in line with potential impacts
- Support informed decisions regarding the investments required as a priority in a given area

KEY CONTACT

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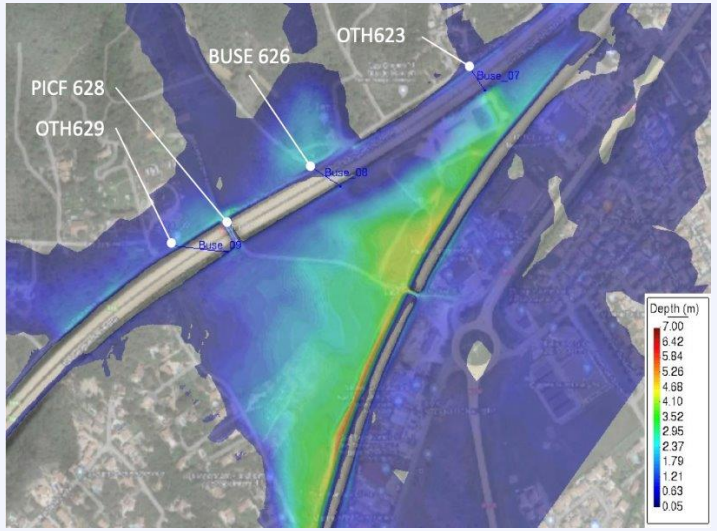
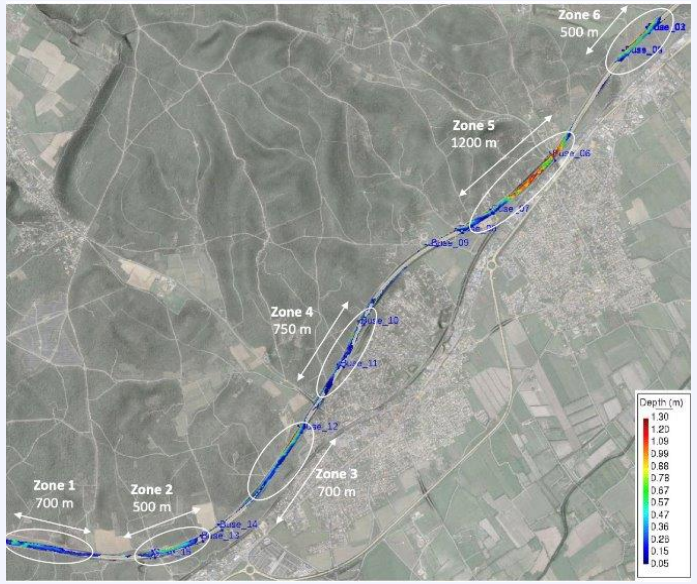
Impact analysis simulation for the A9





RESIL HEAT ISLAND

SOLUTION

Comprehensive simulation and modelling of climate hazards (extreme heat, flooding, coastal erosion, etc.) using climate data, ground measurements and airborne measurements, as well as high-precision satellite monitoring

DEPLOYMENT

Client: All

Region: Global

Budget: Dependent on the project

Date: 2021-22

DESCRIPTION

Climate data help simulate and model past and future climate hazards all throughout the world. Enriching these data with ground measurements or Earth observation techniques (satellite measurements) serves to calibrate and fine-tune modelling to better manage climate risks. This solution was successfully applied to rising sea levels and coastal flooding in Saint Louis in Senegal (OSS Saint Louis project with input from the Space Climate Observatory). It was also used to study erosion and sediment build-ups in Kazakhstan by putting in place nature-based adaptation solutions (planting saxauls) for an industrial client. This solution can be replicated and adapted to different geographic regions and hazards to help manage climate and environmental risks.

ADDED VALUE

- Precisely and comprehensively assess climate risks using a combination of multiple data sources
- **Anticipate future changes with r**eliable predictive modelling
- **More effectively manage climate risks by harnessing the d**ecision aid

KEY CONTACT

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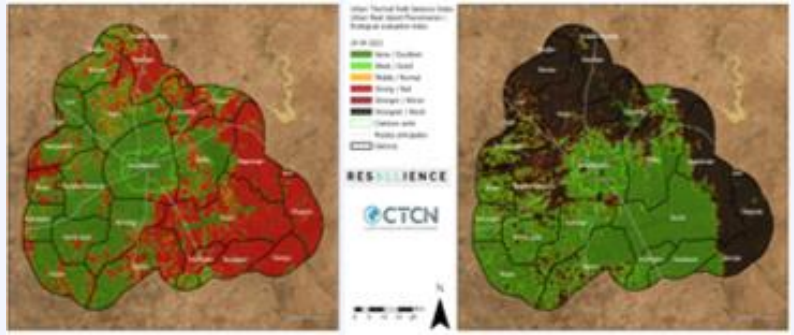
Modelling heat islands/RESALLIENCE



CLIMATE AUDIT OF BUILDINGS

SOLUTION

Climate audits of industrial and economic property

DEPLOYMENT

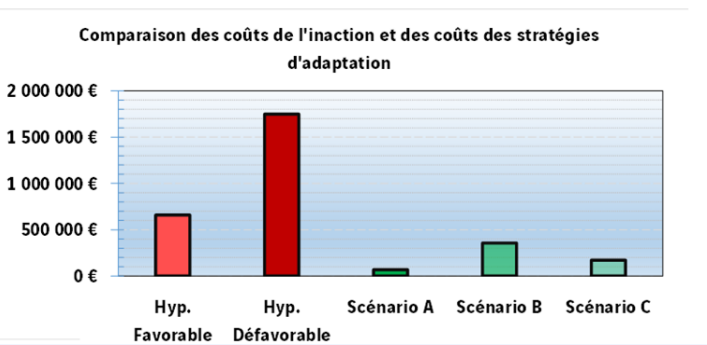
Client: All

Region: Global

Budget: Dependent on the project

DESCRIPTION

To make their buildings more climate resilient, property asset owners and managers need precise diagnostics and specific action plans adapted to their facilities and taking account of various constraints (structural, financial, organisational, economic and human). RESALLIENCE's "Climate Audit" service was designed to respond to this critical need. This service requires an in-depth assessment of an asset's climate vulnerability, drawn up using a set of criteria tailored to the asset and its purpose, as well as a detailed site visit. It leads to a customised action plan (with investment scenario and implementation timescales), designed to make the asset more resilient to the climate hazards identified. This approach was successfully applied to different types of building, including residential properties (CDC Habitat, PERIAL, SNCF Immobilier), industrial facilities (SNCF, AEW, StreemGroup) and tertiary assets (Perial, Paris city council, Orange Immobilier)



ADDED VALUE

- Comprehensive diagnostic including site visit, document analysis and assessment criteria tailored to the type of asset and its purpose
- Prioritised operational action plan complete with tangible recommendations, ranked by impact/cost with implementation timeline and estimated budgets

KEY CONTACT

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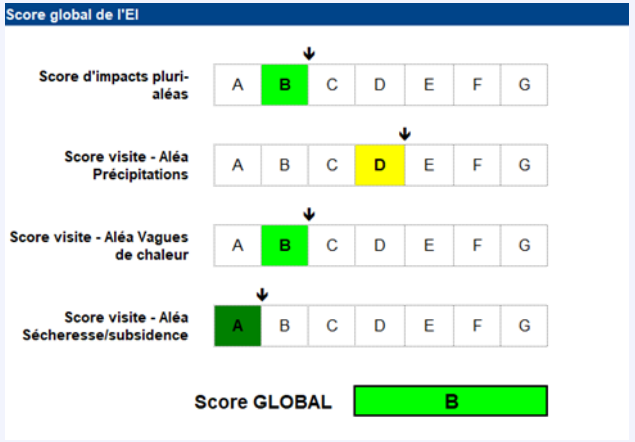

BIODI(V)STRICT

Biodi(V)strict
Urbalia & AgroParisTech

SOLUTION

Biodi(V)strict® is a diagnostic and decision-making tool that improves the biodiversity potential of urban and peri-urban development projects

DEPLOYMENT

Client: Property developers/urban planners/asset managers

Region: France

Budget: variable (type, surface)

DESCRIPTION

Biodi(V)strict® is a piece of computer software codeveloped by Urbalia and AgroParisTech, operating using Geographic Information System maps via QGIS. This tool helps assess the potential impact of a project on biodiversity, in comparison with the initial site and/or other development scenarios by calculating five indicators.

By considering these indicators and comparing the before/after scenarios, it is possible to identify the main sources of pressure on the site in terms of biodiversity, as well as its strengths.

ADDED VALUE

- A quantified measurement of urban biodiversity – before/after
- Easy-to-understand indicators
- Quantitative and spatial data of natural habitats
- A dynamic tool that rapidly simulates various scenarios

KEY CONTACT

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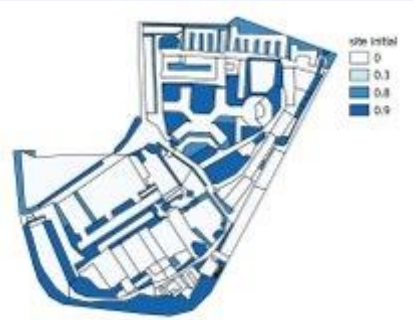

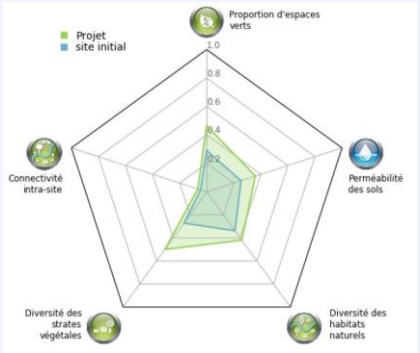

URBALIA – ECOLOGICAL ASSET DIAGNOSTIC

SOLUTION

Ecological diagnostic of built and landscaped assets, analysis of impact on biodiversity and implementation of an action plan to improve the ecological potential

DEPLOYMENT

Client: RIVP

Region: Paris

Budget: variable according to the missions and surface concerned

Date: 2021-2022

DESCRIPTION

Urbalia drew up an inventory of the assets owned by RIVP, a social housing organisation in Paris (with more than 450 sites around the French capital), to identify the areas of improvement with the greatest potential. The aim was then to launch new development/maintenance contracts to put in place tangible actions on the sites identified.

ADDED VALUE

- Implement relevant and effective "biodiversity" indicators
- Produce a comprehensive and quantified inventory
- An overall approach – from diagnostics to launching new contracts
- Three new contracts put in place (differentiated management of outdoor spaces, creation of new semi-intensive green roofs, maintenance of existing green roofs)

KEY CONTACT

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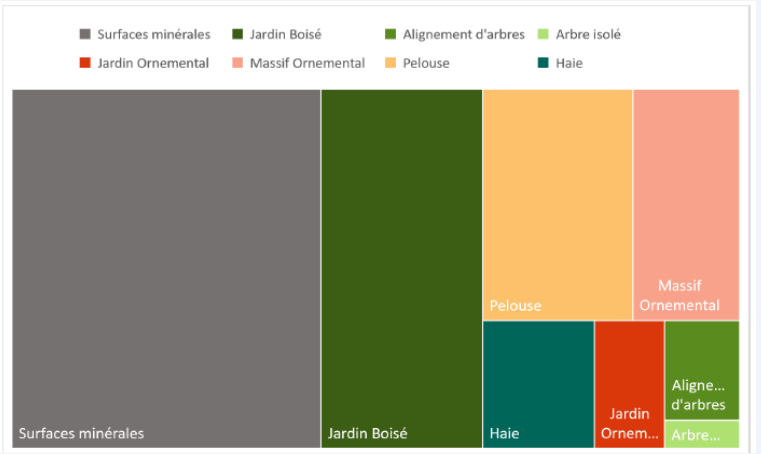

Surface proportions of landscaped developments

Green roof, RIVP asset

BI2O

SOLUTION

Bi2O is a tool that assesses and compares the environmental performance of development project

DEPLOYMENT

Client: All VINCI companies
Region: Primarily France
Budget: variable

DESCRIPTION

Bi2O assesses development projects by tracking and quantifying environmental improvements, particularly in terms of rainwater management, reduction in the urban heat island effect and biodiversity. The tool compares different versions of the same project with the existing situation. It can be used during the proposal stage as well as during the project design stage. Bi2O makes it possible to promote the Revilo service, as well as other products and processes, to clients.

ADDED VALUE

- Objective, intelligible indicators
- A distinguishing approach
- Rapid assessment

KEY CONTACT

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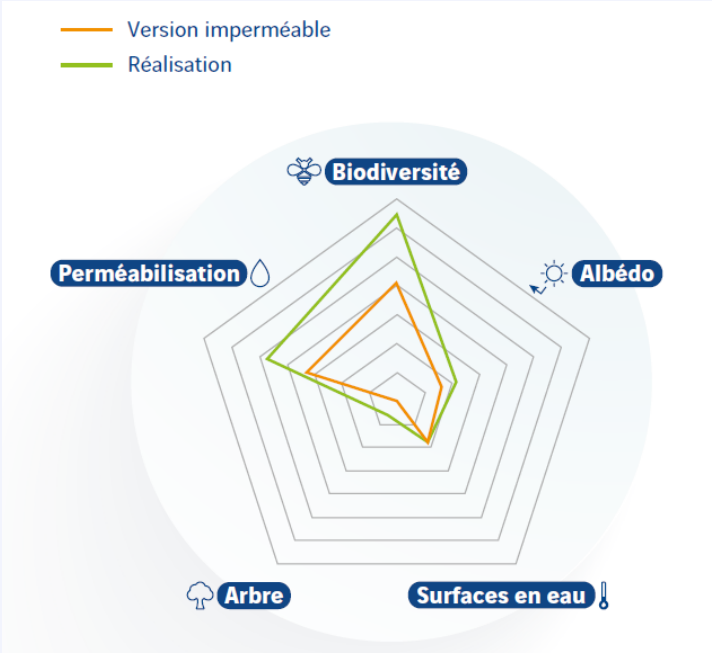

SURVEILLANCE AND MONITORING OF NATURAL AND BUILT ENVIRONMENTS

SOLUTION

Solutions to monitor and track climate risk management using ground measurements, airborne measurements, and satellite monitoring

DEPLOYMENT

Client: All
Region: Global
Budget: Dependent on the project
Date: 2019-22, 2021-23

DESCRIPTION

Technological surveillance solutions using remote detection or sensors are rolled out to monitor the impact of extreme weather conditions and track the variations over time in order to implement the right adaptation measures at the right time. They help steer the management of climate risks at a given point in time, check their prevalence over the medium term and plan adaptation strategies. This type of solution was applied to tackle the coastal erosion along the coast at Saint Louis in Senegal (OSS project supported by the French space agency and the United Nations) and is set to be replicated in neighbouring coastal countries. It was also used to study erosion and sediment build-ups in Kazakhstan by putting in place nature-based adaptation solutions, in particular by planting saxauls.

ADDED VALUE

- Assess changes in climate risks
- Bolster the most vulnerable adjustment variables
- Boost resilience across the region as a whole

KEY CONTACT

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Aerial view of Saint Louis, Senegal

Current readings for monitoring/RESALLIENCE

DPR (DIAGNOSIS OF RESILIENCE PERFORMANCE)

SOLUTION

Systematic modelling tool that studies all climate hazards affecting infrastructure, projects and the economy of a given region. It assess the losses and damage induced by climate hazards, as well as the investment required to reduce the losses and damage

DEPLOYMENT

Client: Regional authorities, property asset managers
Region: Global Date: 2021
Budget: Dependent on the project

DESCRIPTION

There are four versions of the DPR, depending on the area studied:

- The City, Area and Region DPR, which focuses on the critical infrastructure as well as the interconnections at play. The tool was applied to the city of Tetouan in Morocco.
- Island States DPR to systemically model climate risks across these states where critical zones (such as electricity grid, telecoms networks, water supply networks as well as airports) are studied in order to anticipate the social and economic impact. It was used in Dominica and Barbados.
- Building DPR, for asset and property managers interested in the interconnections within a building and its surrounding environment. This version was rolled out for CDC-Habitat (France) and AEW (France and Europe).

ADDED VALUE

- Understanding of interconnections in a given space
- Visibility of areas for improvement
- Decision aid

KEY CONTACT

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Exposure of buildings in the capital of a Caribbean island state to flooding/RESALLIENCE

WILDFIRE PREVENTION

SOLUTION

Advanced analytics to prevent wildfires

DEPLOYMENT

Client: All
Region: Global

DESCRIPTION

Prevent fires caused by vegetation coming into contact with medium voltage power lines. The solution detects fault currents from electrical substations, thereby reducing the risk in the event of high temperatures, low humidity or strong winds. These faults, often caused by falling branches or other conductors, are identified using a high impedance detection system and sophisticated algorithms.

ADDED VALUE

- Identify subtle variations that generally go unnoticed, making the grid safer

KEY CONTACT

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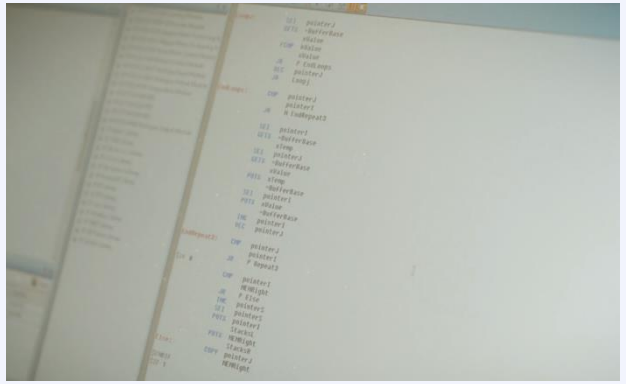


MODELLING AND MONITORING WILDFIRE RISKS

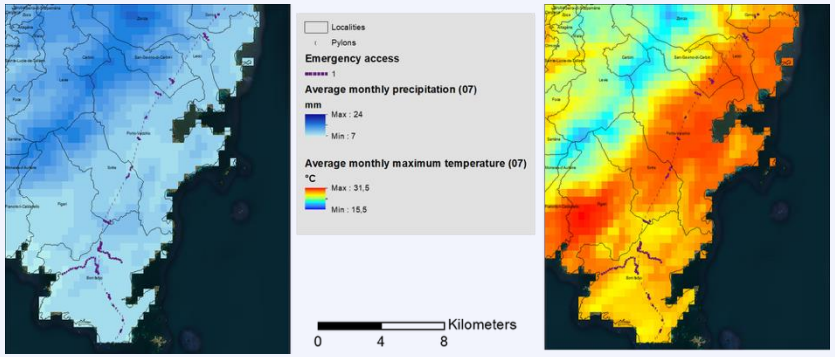
SOLUTION

Solution developed in collaboration with VINCI Energies to track and model the risk of wildfires

DESCRIPTION

This solution was developed to identify the breakout of fires using video surveillance technology, enabling electric grid managers to rapidly implement actions to avoid damage to the network. It makes it possible to model the most critical routes to then put in place suitable solutions.

This solution won the second edition of the RTE Suppliers Awards in 2022 and was rolled out in Corsica.



Modelling wildfire risks and implementing a monitoring system/RESALLIENCE

DEPLOYMENT

Client: Regional authorities, businesses and manufacturers
Region: Global

Budget: Dependent on the project

Date: 2022

ADDED VALUE

- Monitor the state of forests in real time and the breakout of wildfires
- Enable localised prevention of wildfire risks
- Provide a more rapid, targeted response to areas likely to see fires break out

KEY CONTACT

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1.2. PREVENTION SOLUTIONS

RENOVAITE

SOLUTION

For property managers facing climate challenges, RenovAite assesses and suggests adaptation solutions that integrate tailored rehabilitation plans to protect their assets and thereby reducing losses

DEPLOYMENT

Client: Landowners

Region: National

DESCRIPTION

By 2070, each property complex will be affected by at least one climate hazard that will carry a risk to people, property or finances. Building managers struggle to effectively assess the climate risks and energy performance using simply time-consuming manual diagnostics and local tools, which complicates the rehabilitation process. The solution is an integrated platform that automates the assessment of climate and energy risks for buildings by providing preliminary diagnostics and tailored rehabilitation solutions.

ADDED VALUE

This diagnostic solution helps reduce costs and accelerate the rehabilitation process by combining climate resilience, effectiveness and energy performance in a single tool.

KEY CONTACT

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- The Environment Awards
- Intrapreneurs Programme

UXEL'EAU

SOLUTION

Dynamic filtration system for water tanks and systems designed to protect against the risk of frosts

DESCRIPTION

Current fire regulations in France require the 11,000 water tanks to be regularly drained, which leads to over 3 billion litres of drinking water being wasted each year. It is a major challenge in water management to address such wastage, which also represents a considerable financial loss. Uxel'Eau provides a compact, standalone dynamic filtering system that connects to water tanks, using magnetic filtration and solar panels.

DEPLOYMENT

Client: All

Region: National

ADDED VALUE

Uxel'Eau helps to save up to 95% of the water wasted during draining and 11% of electricity used by fire protection systems.

KEY CONTACT

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REVILO

SOLUTION

A solution to combat urban heat islands and bring more nature back into the city through a four-pronged approach: vegetation, water, soils and surfaces

DEPLOYMENT

Client: Primarily local authorities
Region: Primarily France
Budget: Variable
Date: 2022

DESCRIPTION

Climate change means all urban areas will need to tackle the urban heat island effect, where high temperatures can provoke risks for human health. Revilo represents one solution to cool built-up areas during the hot summer months, in particular during heat waves.

Revilo combines and optimises four approaches in which Eurovia is proficient:

- Using vegetation to create shaded areas, facilitate evapotranspiration and enhance wellbeing for the community
- Channelling rainwater to water the vegetation
- Maximising soils and their ability to store and absorb water
- Modifying surfaces to make them more permeable and lighter coloured

ADDED VALUE

- A comprehensive solution
- An answer to political ambitions, public expectations as well as the priorities for cities and technical services
- The potential to redesign public spaces requiring investment and work
- Many successful applications

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Parc de la Loubière, Toulon (southern France)

OASIS gardens, Paris

ADAPTATION OF EXISTING CONSTRUCTIONS TO THE DAMAGED CLIMATE – ACDC

SOLUTION

Adaptation of existing Constructions to the Damaged Climate

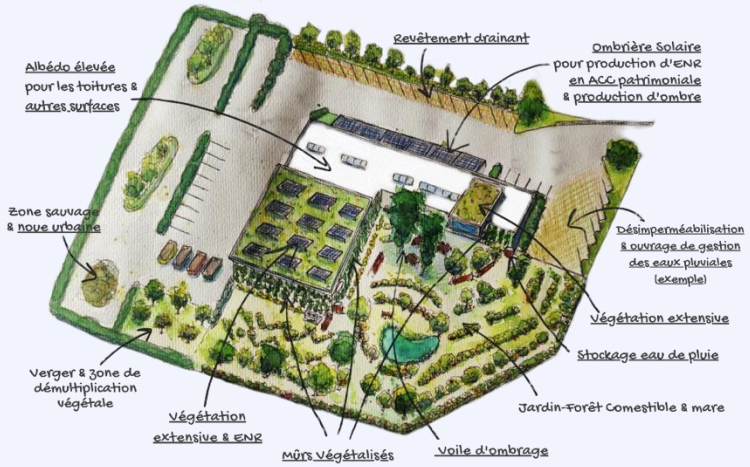
DEPLOYMENT

Client: **All**
Region: **Global**

DESCRIPTION

The team has developed a design process to adapt existing buildings to the new reality imposed by climate change, known as ACDC. The process is as follows:

1. Study of the needs and constraints of the site, the building and its occupants
2. Risk assessment and impact of those risks on our operations using Resilens® (Resallience, VINCI Group) and Biodibat® (Observatoire de l'Immobilier Durable).
3. Choice of adaptation solutions (based on steps 1 and 2 of the process)
4. Quantification of the project (tCO_2eq. avoided, main co-benefits and cost of inaction and solutions in €)



ADDED VALUE

- VINCI Facilities South Centre-East supports its clients with their MITIGATION strategies (avoid the unmanageable) with low-carbon and circular economy solutions, but is also keen to support them with their ADAPTATION strategies (manage the unavoidable) opting wherever possible for Nature-based Solutions for climate change adaptation in order to maximise the co-benefits, such as rich biodiversity, urban cool islands, better management of water, a more pleasant atmosphere and a better workplace experience for occupants.

KEY CONTACT

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PRIMATICE

SOLUTION

Primatice is a patented macro technical works package solution for renovation projects that uses radiant ceiling panels harnessing air as the sole energy vector for heating and climate control

DESCRIPTION

The Primatice radiant ceiling solution contains phase change material in the form of a saline solution able to change its state from liquid to solid and vice versa.

By day, excess thermal energy is absorbed when the outside temperature exceeds the melting point of around 20 °C. At night, when the temperature lowers, the solution solidifies, releasing the accumulated energy.

ADDED VALUE IN HOUSING

- Reduction of energy consumption
- Reduction of the number of accidents and maintenance interventions
- Modular and easy to install, with a slim profile (only 6 cm)
- Homogeneous temperatures and above-standard air quality

KEY CONTACT

Guillaume Rabut

Project Manager – VINCI Energies Building Solutions

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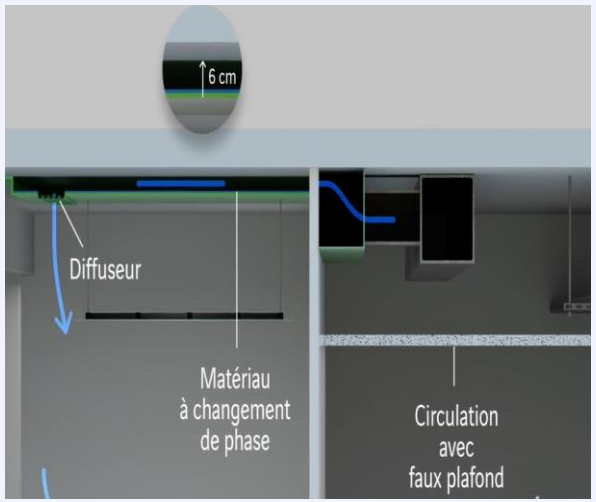
DEPLOYMENT

Client: Property developers, social housing organisations
Type of housing: Multidwelling
Region: Global
Date: NS



BIOCLIMATIC RENOVATION OF AN OFFICE BUILDING – WOW

SOLUTION

WOW is an office block spanning 11,356 m² in which bioclimatic design was applied, cutting the carbon footprint by 22% compared with conventional designs. The building envelope and technical components were upgraded, especially with regards comfort during the summer period

DEPLOYMENT

Region:Paris, 18th arrondissement
Date: 2019-2024

DESCRIPTION

This building, located in the heart of the Montmartre district of Paris, was acquired by VINCI Immobilier in 2019. It housed the Magasin Dufayel, a former department store similar to Galeries Lafayette at the time. Construction on the building began in 1856. Given the building's new purpose as offices, "The Better Way" approach was taken as it will help to make the building more flexible with modular spaces and adapt the thermal design depending on the area and the needs. The building's Eiffel structure was brought out in the works, leaving it exposed, along with other technical elements.

ADDED VALUE

- Reassert the value of an exceptional piece of architecture to give it a new lease of life
- Cut the carbon impact of the work
- Create a living space in this building steeped in history

KEY CONTACT

Laetitia Riedigner
Programme Manager

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Facade, Rue de Clignancourt

Office floor

Rooftop

RENOVATION AND DESIGN OF A RESILIENT MIXED-USE NEIGHBOURHOOD – UNIVERSEINE PROJECT

SOLUTION

Rehabilitation of 6.4 hectares of former industrial brownfield, where the land was polluted and impervious, to design a new neighbourhood taking advantage of urban recycling, urban cool islands and thermal comfort in 2050

DEPLOYMENT

Developer: SOLIDEO
Client: French Ministry of the Interior, PCH, CDCH, COOP IMMO, individuals
Region: Saint-Denis
Date: 2018-2025

DESCRIPTION

The future residential and office district (3,000 residents and 4,300 employees) in Saint-Denis will first accommodate the Athletes' Village in 2024.

2024
5,856 beds for athletes

2025
65,333 m² of residential space
57,029 m² of office space
3,060 m² of retail space

ADDED VALUE

- Build resilient buildings designed to stay cool in summer in 2050 and withstand heat waves
- Create urban cool islands by forming a biodiversity corridor to combat the urban heat effect
  - 13,000 m² of land desealed to better manage rainwater
  - 20% of land in the new neighbourhood renatured
- Reduce carbon emissions and preservation of resources

KEY CONTACT

Paul De Rosny
Programme Manager

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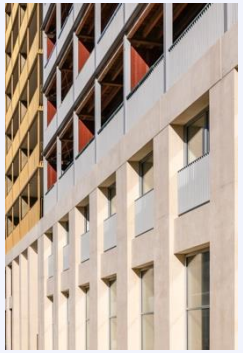

Labels and certifications for a sustainable building

DESIGN OF A DUAL PURPOSE, REVERSIBLE DEVELOPMENT PROJECT – UNIVERSEINE PROJECT

SOLUTION

The Universeine project is unique due to the reversibility of the buildings, with delivery in two phases: The 2024 Athletes' Village was primarily designed for the Heritage phase as a mixed-use, sustainable neighbourhood in Saint-Denis

DEPLOYMENT

Developer: SOLIDEO
Client: French Ministry of the Interior, PCH, CDCH, COOP IMMO, individuals
Region: Saint-Denis
Date: 2018-2025

DESCRIPTION

Design of a property development project split into two phases across a district that spans a total 125,422 m² of buildings that will accommodate housing units and offices after the 2024 Games phase.

- A unique project that has received dual purpose planning permission, the first such project in France.
- The buildings are designed to optimise reconversion, using construction techniques to facilitate the change in purpose and reuse materials, such as employing mushroom slab construction and reusing partitions from the Games phase.
- Optimises transformation in three areas – cost, materials used and timescales, as the office campus is scheduled to be delivered less than one year after the end of the Games.

ADDED VALUE

- For the first time in history, a portion of the Athletes' Village will be transformed into offices
- Limit the impact of a one-off event by making the facilities highly reversible
- Capitalise on skills for application on future projects

KEY CONTACT

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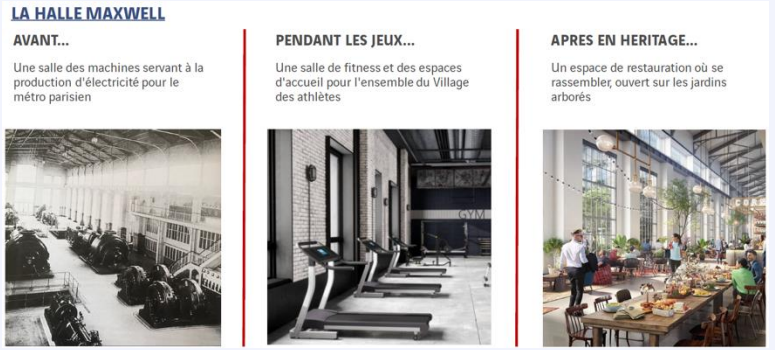
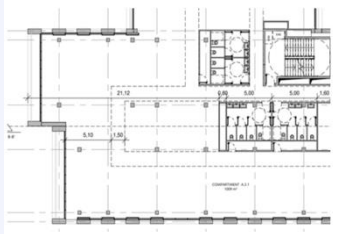


During the Games phase
Athlete rooms



During the Heritage phase
Office floor

LILLE METROPOLITAN SQUARE

SOLUTION

Steering a development project in the heart of Lille that involves rehabilitating urban brownfield to create a mixed-use district while also preserving the existing elements, increasing biodiversity and renaturing the area

DEPLOYMENT

Developer: VINCI Immobilier/BNP Paribas Real Estate
Client: RTE, individuals
Region: Lille
Date: 2019-2029

DESCRIPTION

Lille Metropolitan Square strives to achieve environmental efficiency, especially by reusing and recycling materials from the site (including excavated earth and crushed concrete) and maximise the space where vegetation may be planted in open ground. Trees will cover almost all free ground space to create an ecological corridor to optimise water management and cool the area.

280 homes	67,000 m² of office space	2,000 m² of retail space

ADDED VALUE

- Intention to preserve the trees already present in the area before work began to exploit their ability to capture greater volumes of carbon
  - 250 trees planted and 30 trees preserved
  - 8,000 m² of landscaped terrain, of which 6,000 m² in open ground
- Rainwater management considered at an early stage
- An urban microforest to create cool islands

KEY CONTACT

Aurore Laignel
Urban Project Manager

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View of the pedestrian walkway

View inside the neighbourhood

View of the Jardin des Géants

BREST – ENGIE

SOLUTION

Recycling and developing brownfield while taking account of biodiversity in the area and creating an appealing destination

DEPLOYMENT

Developer: VINCI Immobilier/ Brownfields
Client: Individuals
Region: Brest
Date: 2019-2028

DESCRIPTION

The primary aim of this project is to convert and capitalise on this former ENGIE gas plant while also furthering VINCI Immobilier's target to achieve No Net Landtake (ZAN) by 2030. The project is especially impressive due to the dramatic landscape, cliffs and location in a completely impervious zone with high levels of pollution, right next to the ocean. To prevent any additional pollution and properly understand the environmental factors to be taken into consideration, a block plan was drawn up before work began to take account of all biodiversity concerns as far upstream as possible. The project won the 2021 Environment Awards.

ADDED VALUE

- Consider the need to protect wildlife in the area
- Depollute the site without affecting the surrounding area to avoid any negative impact

KEY CONTACT

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Urban Project Manager

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Axonometric representation of the project

View from the Melville roundabout

FOREVA® TFC COMPOSITE REINFORCEMENT ADAPTS TO NEW CLIMATE REALITIES

SOLUTION

Composite carbon fibre strengthening system specially formulated to maintain performance in rising temperatures caused by climate change AND developed to adapt to the widest possible range of structures

DEPLOYMENT

Client: Public and private sector
All infrastructure (engineering structures, public buildings, industrial facilities); concrete, stone, wood
Region: All

DESCRIPTION

- In the early 1990s, Freyssinet introduced the first composite structural strengthening system in France using carbon fibre applied by adhesion to the external cladding of concrete or stone buildings in order to increase their load bearing capacity.
- Epoxy resins used as adhesives generally only conserve their mechanical properties up to a continuous temperature of around 35°C, which is insufficient in light of climate change, especially for the external surfaces of buildings that are often exposed to solar and UV rays.
- In order to reduce the environmental impact, extending the life of buildings and infrastructure often goes hand in hand with requalification, for which structural repairs and reinforcement are necessary (loss of capacity due to ageing materials, construction defects, shrinking/swelling clays, increase in loads, creation of shafts, etc.).

ADDED VALUE

- By reformulating the epoxy resins used as both matrix and adhesive for the Foreva® TFC composite, Freyssinet has significantly expanded the scope of application of this strengthening technology, guaranteeing mechanical stability and durability of adhesion, even in temperatures exceeding 45 °C.
- The Foreva® TFC solution is approved for earthquakes, fire protection and an optimised design to tackle various hazards.
- By adapting its composite strengthening systems to extreme heats and the widest possible range of structures, it stands out as a robust, lasting solution that is ideally compatible with current considerations regarding building and infrastructure resilience.

KEY CONTACT

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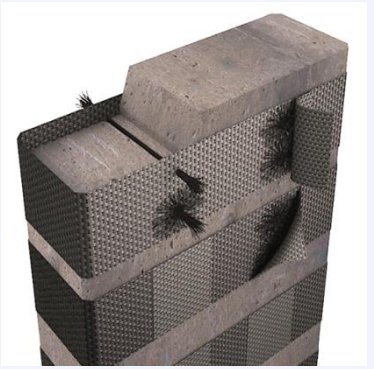
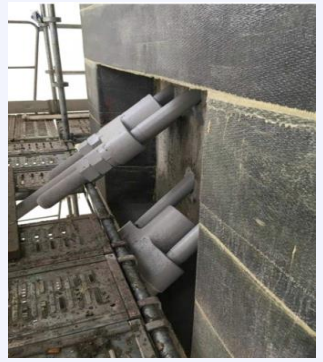




Foreva TFC

PRESTRESSED SLAB/BALCONY ADAPTED TO CLIMATE CHANGE

SOLUTION

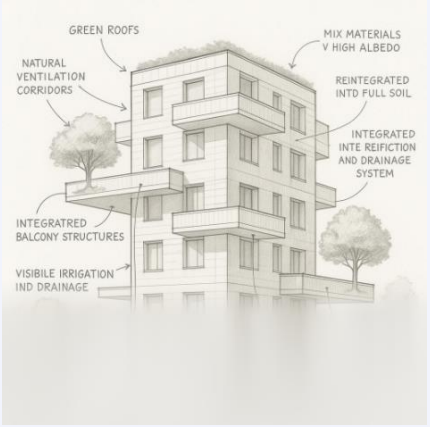
Prestressed slab/balcony for living spaces adapted to climate change (heat islands)

DEPLOYMENT

Client: Public and private sector
Region: Global

DESCRIPTION

- The need to combat urban heat islands has become central to town planning policies and criteria for new-build constructions in France.
- Urban heat islands are caused in particular by:
  - a lack of vegetation
  - the structure of built-up areas that obstructs the flow of air
- Freyssinet is putting prestressed materials back at the heart of the need (using less materials) to build structures shaped in such as way as to facilitate air flow, avoiding creating urban canyons, and make it possible to plant real trees to increase the leaf area index.
- The French Code of Construction and Housing has gradually integrated these standards via the RE2020 environmental regulation, which imposes maximum threshold temperatures for summer.



ADDED VALUE

- Real trees planted at the edges of cantilevered balconies:
  - Between 1,500 and 2,000 kg of substrate
  - Wind moment

Trees planted in open ground have a far superior transpiration capacity than those planted in pots. They are therefore far more effective in cooling the surrounding air, especially in summer.

They create microclimates that are beneficial for residents and their close neighbours.

KEY CONTACT

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FOREVA ULTRA HIGH-PERFORMANCE FIBRE REINFORCED SHOTCRETE TO STRENGTHEN CULVERTS WHILE MAINTAINING TUNNEL GAUGING AND THE WATER CHANNEL

SOLUTION

Adaptation of existing Constructions to the Damaged Climate

DEPLOYMENT

Client: **Public and private sector**
Region: **Global**

DESCRIPTION

A large number of metal pipes were built around 50 years ago, which now need strengthening due to corrosion. This is especially the case for culverts, built so roads may cross over waterways. Standard reinforcement practices involve lining the structures, which significantly reduces their diameter, potentially meaning they are no longer able to handle the water flow in the event of flooding.

Climate change has made it necessary to upscale the potential capacity and scale of certain hydraulic structures. There are metal culverts that are not wide enough to sustain structural reinforcement by thick lining, without a second structure having to be built in parallel.

Lining by ultra high-performance fibre reinforced shotcrete involves lining the structure with a thin layer of concrete around 5 cm deep, an insignificant impact given the diameter of the structure generally lies between 2 and 6 m.

ADDED VALUE

Compared with conventional solutions using reinforced concrete or fibre-reinforced polymers (FRP), lining using ultra high-performance fibre reinforced shotcrete makes it possible to:

- Maintain the gauging of the structure and therefore its capacity
- Reduce the volume of materials required by 75%
- Complete the work over a shorter timescale
- Cut the total carbon footprint for the project by around 40%
- Improve the durability of the reinforcement compared with conventional reinforced concrete lining
- Avoid raising the waterbed, which would make it necessary to modify the structure both upstream and downstream

KEY CONTACT

Arnaud Floquet

Business Development Manager
Ultra high-performance fibre reinforced shotcrete

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USE OF COMPOSITE REINFORCEMENT

SOLUTION

Adding external reinforcement using adhesive fabric (fibre-reinforced or glass) for repair/reinforcement work

DEPLOYMENT

Client: GTMM Travaux spéciaux
Region: France
Budget: partially covered by Research Tax Credit (CIR)
Date: Since 2004

DESCRIPTION

Many structures require reinforcement either because of changes in the purpose they serve (such as increased loads, addition of shafts, or upgrades to modern earthquake standards), or because they have deteriorated over time (including corrosion, losses in prestress systems and excessive cracks).

Existing processes (such as girders, accretion and prestressing) are often heavy or unsuitable, leading to work that has a significant impact on the way the building works.

ADDED VALUE

- Enhanced durability (resistant to corrosion and degradation), weather resistance, lightweight (compared with conventional materials) while maintaining high levels of mechanical resistance
- Flexibility in design (can easily adapt to anticipated consequences of climate change such as rising sea levels or changes in precipitation models)
- Reduction of emissions (made using recycled or recyclable materials, helping to reduce the carbon footprint of the construction and maintenance of the structure)

KEY CONTACT

Emmanuel Lacaux

Technical Director

Engineering Structures
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Reinforcing the girders on the Reyran viaduct/Escota

Reinforcement of girders in an occupied building/Cité de la musique

BIOCALCIS® TREATMENT TO CONSOLIDATE SOILS, BACKFILL AND STONES

SOLUTION

The Biocalcis® process involves injecting bacteria and a calcifying solution into the structure to trigger the formation of calcite in-situ. Biocalcification consolidates treated soils and strengthens structures while also combating the risk of internal erosion and liquefaction. It is able to withstand extreme forces (including floods and earthquakes) and does not reduce the initial permeability of the materials

DEPLOYMENT

Client: Greater Orléans– Engineering Structures Department
Project management: Ingerop – Geos
Date: 2022

DESCRIPTION

This solution was used as part of the work on the René Thinat bridge in Orléans. The northern abutment of the bridge is made up of a reinforced soil wall, however monitoring in 2019 identified significant corrosion on the bridge's steel structure.

The Biocalcis process made it possible to repair a section of the wall with grouting, where nails could not be used because the bridge deck is positioned in front of the retaining wall.

ADDED VALUE

- Non-intrusive and quick, the solution involves drilling small holes, so can be used without risk of increasing pressure on the structure and in areas that are hard to access. The reaction takes just a few days to be complete.
- Consolidated materials retain their initial characteristics, as the calcium carbonate does not create any obstruction and the permeability remains unchanged after treatment.
  - ➢ Asset management case study: promising characteristics for heritage restoration as the treated stone continues to breathe and the calcite formed is the same as the surrounding stone, so there is no change in colour.
- Improved carbon footprint compared with cement-based processes.

KEY CONTACT

Annette Esnault Filet
R&D Project Manager

Soletanche Bachy
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Consolidation work on the René Thinat bridge

Biocalcis® used to restore a heritage building

BUILDING MANAGEMENT SYSTEM

SOLUTION

Offloading thermal systems

DEPLOYMENT

Client: Tertiary buildings
Region: Europe
Budget: All budgets

DESCRIPTION

In extreme heat (e.g. exceeding 35°C), it may be necessary to offload certain non-critical zones to prioritise critical areas. The solution uses a remote centralised control system to steer electricity distribution equipment.

ADDED VALUE

- This solution makes it possible to adopt a fail-soft operating plan. The building resumes "normal" operations when the outside temperature falls below a given level.

KEY CONTACT

Pierre Megret
Smart Building Project Manager

VINCI Energies Building Solutions
pierre.megret@vinci-energies.com

AIR QUALITY FORECASTING IN URBAN AREAS

SOLUTION

Integration of micro air pollution sensors into urban equipment

DESCRIPTION

Integrating micro air pollution sensors into urban equipment and a system to transfer the sensor data to the urban traffic regulatory hypervisor control system.

Integrated micro air pollution sensors

ADDED VALUE

- The aim is to leverage air quality readings in real time and weather data (temperature, wind speed and direction, atmospheric pressure) to build a model able to predict air quality, creating a very short-term, highly reliable forecast in order to inform and develop reactive scenarios.

KEY CONTACT

Jean-Marc Raymond

Director

VINCI Energies – CITEOS Rouen
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DEPLOYMENT

Client: Greater Rouen Normandy
Region: Greater Rouen Normandy
Budget: €2.2 M
Date: 2019-2022

SHORT-CIRCUIT EV CHARGING

SOLUTION

A solution for renewable energy production and storage for commercial buildings

DEPLOYMENT

Client: Tertiary buildings
Region: France
Date: 2022

DESCRIPTION

This solution to produce and store renewable energy for commercial buildings was designed to enable users to become less reliant on the conventional electric grid by generating green energy directly in the tertiary building via photovoltaic panels. The solution demonstrator was installed at the Demouselle Tertiaire Pas-de-Calais site in Boulogne-sur-Mer, with the following characteristics: 125 m² of rooftop photovoltaic cells, equating to 70 panels producing 23 kW of power. The panels weigh 15 kg per m². In order to avoid losing the energy produced, it is stored in used car batteries (Nissan LEAF), offering capacity of 20 kW. Installation of an EV charging point in the car park to recharge the corporate EV fleet, as well as visitor EVs. Smart management to steer energy via the WAVE platform operated by VINCI Energies Smart Building Energies.

ADDED VALUE

- This self-sufficient production/consumption loop makes it possible to take advantage of a constant energy source thanks to the storage solution. Indeed, this system covers 80% of total consumption. The solution has had a **direct benefit,** cutting the electricity bill at the site by 80%.

KEY CONTACT

Francois Carlu

Business Manager

VINCI Energies Building Solutions
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Example of a solution for renewable energy production and storage for commercial buildings

PHOTOVOLTAIC INSTALLATIONS FOR SELF-SUFFICIENCY

SOLUTION

Automatic photovoltaic installations

DESCRIPTION

The client wished to become self-sufficient in electricity in order to operate a sanding system on a site that was off grid. They also wanted to reduce their dependency on fossil energy while improving their carbon footprint. The project involved installing a photovoltaic system combined with the existing diesel generator and a set of systems to regulate energy distribution and storage in batteries.

ADDED VALUE

- The photovoltaic panels produce energy when the sun shines, while any surplus is stored in batteries. It may then be used by the facility at a later stage, as required, and the diesel generator is only used during extreme peaks in demand.
- As solar-powered systems generate less energy during the winter months, the management system automatically regulates and activates the system (PV panels + generator).

KEY CONTACT

Luc Herbrecht

Account Manager

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DEPLOYMENT

Client: Tertiary buildings
Region: Alsace
Date: 2022

PHOTOVOLTAIC AWNING

SOLUTION

Installation of an awning composed of photovoltaic panels in order to avoid offices from overexposure to the sun and produce green energy

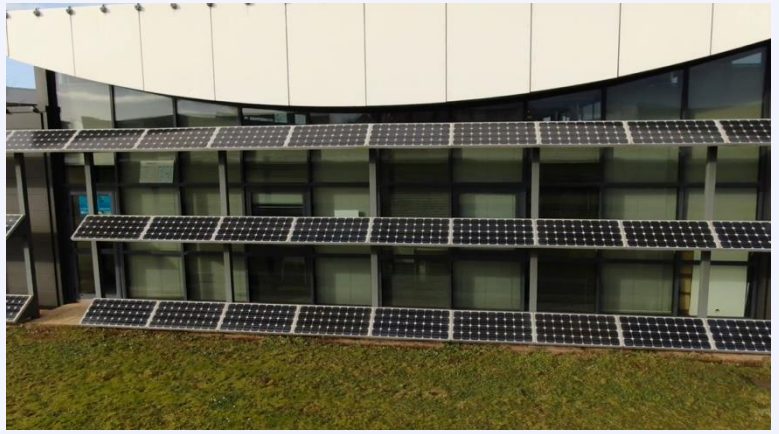
DEPLOYMENT

Client: Tertiary buildings
Region: France

DESCRIPTION

To address the problem caused by office windows receiving too much sunlight, a set of photovoltaic panels were installed as an awning.

This initiative has made it possible to sell €40,000 worth of electricity back to EDF. At the same time, it has saved 6 tonnes of CO_2 from being emitted into the atmosphere.



ADDED VALUE

- Project amortisation over 7 years, as forecast, due to the system generating an average revenue of €4,000 per year

KEY CONTACT

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QSE Correspondent/Lead

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GREENFLOOR®: ACTIVE FLOOR

SOLUTION

GREENFLOOR® involves channelling air through sheaths integrated into a very low carbon concrete slab of average thickness

DEPLOYMENT

Client: All
Region: All

DESCRIPTION

GREENFLOOR® involves channelling air through sheaths integrated into a very low carbon concrete slab of average thickness. Air, which serves as a heat transfer fluid, heats or cools the concrete, which itself acts as a radiant ceiling. As such, the ventilated active slab GREENFLOOR smoothly regulates temperature, providing ventilation, air conditioning and heating in one system while also ensuring maximum comfort for occupants and improving air quality throughout the building.

ADDED VALUE

- The advantages of GREENFLOOR® are threefold:
  - Optimised installation: The GREENFLOOR® concept
  - Improved environmental performance
  - Occupant wellbeing

KEY CONTACT

Guillaume Rabut

Project Manager

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REVERSIBLE CEILINGS

SOLUTION

Installation of reversible ceilings

DESCRIPTION

Renovation and vast extension of the CIC Nord Ouest head office, a four-storey building with two basement levels located in the heart of Lille. Construction of a substation with 750 kW heating power (urban heating) and 1,000 kW cooling power (three refrigeration units and air coolers). The project served to heat and cool the office space using over 5,000 m² of radiant ceilings.
Surface covered: 15,000 m²
Labels: Effinergie and BBC rénovation

ADDED VALUE

- Integrated heating and cooling system
- The radiant ceilings help cut carbon emissions by around 15% compared with conventional convertible fan coil units

DEPLOYMENT

Client: CIC Nord Ouest
Region: France

KEY CONTACT

Franck Bassail
Major Project Division Manager

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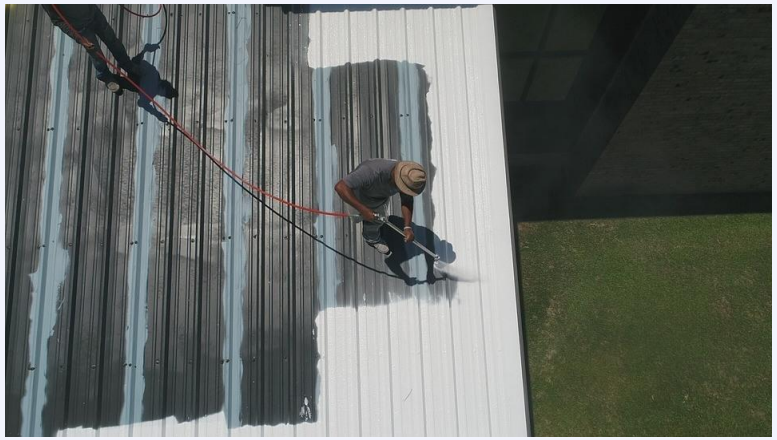
COOLROOFING

SOLUTION

Coolroofing provides a light-coloured regulated envelope that reduces the amount of heat a roof absorbs

DESCRIPTION

Solar rays absorbed by rooftops aggravate the urban heat island effect and increase temperatures inside the premises. It is essential to design materials better suited to covering roof surfaces. VINCI Facilities, as part of its low-carbon performance contracts, offers reflective "coolroofing" paint.



ADDED VALUE

- Threefold reduction in the need for cooling and no increase in the demand for heating
- Indirectly helps to reduce the heat around the building

KEY CONTACT

Nicolas Galet

Low-Carbon Development Manager

VINCI Energies Building Solutions
nicolas.galet@vinci-facilities.com

DEPLOYMENT

Client: All
Region: All

WATER MANAGEMENT AND MONITORING USING IOT

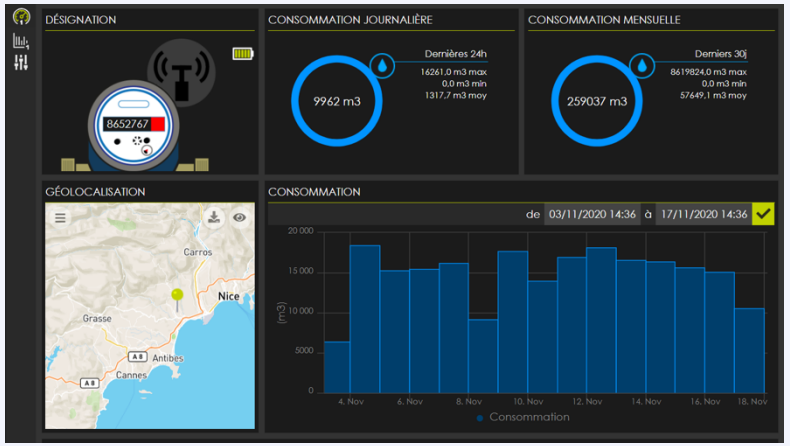
SOLUTION

Effective water management, essential for healthcare establishments

DESCRIPTION

Effective water management is essential for healthcare establishments, enabling them to ensure good sanitation and save water.

The company was entrusted with the contract to manage the water resources for the Timone hospital and the APHM Nord hospital by providing a comprehensive water management solution that includes supplying, installing and configuring water meters, defining a water consumption target and an IoT surveillance system based on the IOThink solution, as well as installing sensors to monitor temperature and water consumption.



ADDED VALUE

- Two thirds of establishments say they pursue a policy to reduce the volume of water they consume. Of these establishments:
  - 85% use water saving equipment
  - 72% inform their staff about the issue

KEY CONTACT

Nicolas Baudier

Business Manager

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DEPLOYMENT

Client: Hospitals
Region: Marseille

NIGHT TRACKING

SOLUTION

Night tracking identifies ways in which energy is being wasted in buildings during periods when they are not being used

DEPLOYMENT

Client: BNP IMEX IDF property assets
Date: 2023

DESCRIPTION

Night tracking involves going to a facility outside standard operating hours (during the night or over the weekend) to check systems that use timers and BMS are working as intended and understand office user behaviour (lighting, screens, computers, printers). This solution was put forward for a number of reasons – in new builds, it serves to ensure initial settings are appropriate; it also represents a way of identifying areas in which the facility can optimise energy performance; once night-time lighting has been disabled, it reassures clients lights in the buildings are properly turned off when no-one is on the premises in order to reduce light pollution; and it raises awareness among users (including employees, security personnel and technicians).

ADDED VALUE

- Optimise the amount of time facilities are running operational
- Eliminate unnecessary energy wastage
- Identify inconsistencies between the BMS setup and the way the facility actually works
- Seek areas of improvement to optimise energy performance at the facility

KEY CONTACT

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Business Development Director

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STEERING HVAC SYSTEMS REMOTELY USING IOT

SOLUTION

Implementation of predictive maintenance to steering HVAC systems remotely using IoT

DEPLOYMENT

Client: All
Region: All

DESCRIPTION

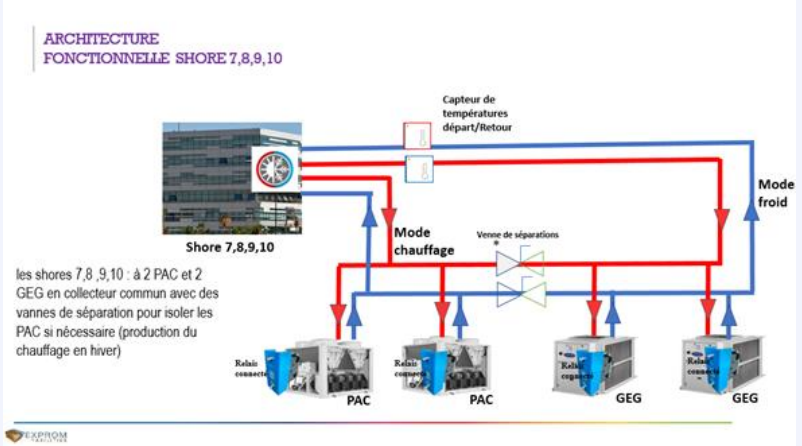
For large sites with over 25 buildings

A technician needs to go up to the roof daily to check the technical shafts of HVAC equipment, identifying any anomalies and ensuring all heat pumps and cold-water generators are in proper working order.

Not only does this approach not help to anticipate energy or gas losses, it is also extremely time consuming (considerable workload).

ADDED VALUE

- The solution involves:
  - Installing temperature and contact IoT to communicate the energy performance of HVAC equipment in real time and signal any slip in technical performance.
  - Introducing a strategic shift in the maintenance policy for HVAC equipment, moving from systematic technical checks to predictive maintenance led by messages sent from IoT technology and read directly by the mobile technician computerised maintenance management system.



KEY CONTACT

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WAVE

SOLUTION

WAVE is a platform developed by Smart Building Energies for smart, connected buildings, designed so that users may manage their comfort and energy footprint

DEPLOYMENT

Client: All
Region: All

DESCRIPTION

We have developed an IoT platform, Waveplatform, that combines IT and automation. It enables users to manage the various building services and features. They can thereby manage energy consumption (such as water, gas and electricity), comfort (including temperature, lighting and shutters) and services (for example booking services for parking and meeting rooms).

ADDED VALUE

- WAVE enables users to manage a wide range of building services via a single secure interface on their smartphone.
- Energy monitoring: gas, water, electricity and more
- Booking systems: meeting rooms and parking
- Comfort management: temperature, lighting, and shutters
- Building security: setting the alarm and opening doors from within the building

KEY CONTACT

Frédéric Thouot

Business Manager

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INJECTION OF FOREVA® SOL EXPANSIVE RESIN

SOLUTION

Improve load-bearing capacities, fill empty spaces, stabilise soils (including clay soils) under foundations and flagging for homes, multidwelling buildings and industrial facilities

DEPLOYMENT

Client: **Public and private sector**
Region: **Global**

DESCRIPTION

Using the patented **Foreva® Sol Resin**, Freyssinet provides a lasting solution to all structural issues caused by **geotechnical instabilities and natural catastrophes** such as:

- Droughts
- Flooding
- Landslides
- Shrinking or swelling clay soil
- Leaks in supply and drainage pipes
- Design and construction defects

ADDED VALUE

Injecting expansive resin:

- Increases the load-bearing capacity of the soil by modifying its mechanical properties
- Fills voids and cavities (caused by water leakages)
- Reduces the permeability of soils as well as their sensitivity to shrinking and swelling

Primary advantages of Foreva® Sol Resin:

- Inexpensive, quick and relatively non-invasive
- Helps to check the extent to which soils have been improved over a large area
- Suitable for all types of soil*

KEY CONTACT

Luc Systchenko
Business Development Manager

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** In the particular case of clay soils, which are subject to shrinking/swelling, resin may only be used if certain criteria are met with respect to the plasticity index (PI) and methylene blue (MB) stain test, as indicated in the G5 geotechnical study.*

UNDERPINNING FOUNDATIONS USING PRELOADED FOREVA® SOL MICROPILES

SOLUTION

Underpinning foundations using preloaded micropiles (metallic reinforcement cement grout injected then hydraulically driven) to stabilise and reinforce the foundations of all structures and buildings

DEPLOYMENT

Client: **Public and private sector**
Region: **Global**

DESCRIPTION

Using the patented **Foreva® Sol Preloaded Micropiles**, Freyssinet provides a lasting solution to all structural issues caused by **geotechnical instabilities, natural catastrophes and structural changes** such as:

- Extensions and elevation
- Landslides
- Droughts
- Shrinking or swelling clay soil
- Design and construction defects

ADDED VALUE

The Foreva Sol® patented, preloaded micropile is a solution used to **underpin foundations** developed and implemented by Freyssinet that makes micropiles **active** (bored or auto-drilled bars) by **using a hydraulic cylinder.**

Preloading the micropiles serves to:

- Immediately transfer the weight of the building onto the micropiles
- Instantly check the quality of the installation and capacity of the micropiles
- Straight away begin work to consolidate the superstructure and finishing
- Eliminate risk of aggravating any subsequent accident due to varying subsidence
- Adapt the solution to all types of soil, whatever its characteristics

KEY CONTACT

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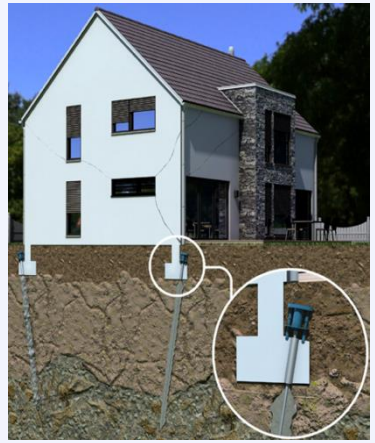

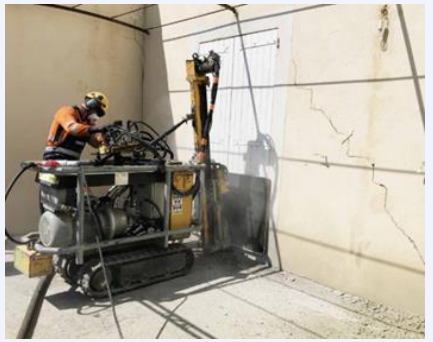

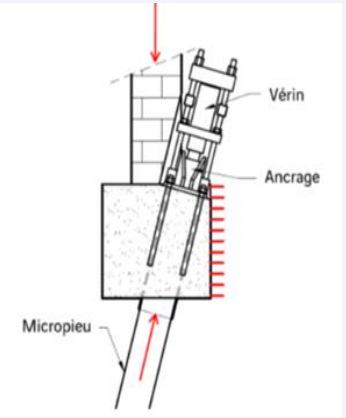

BIOTS PROCESS TO DEAL WITH EXPANSIVE CLAY SOILS

SOLUTION

Improve load-bearing capacities, stabilise soils (including clay soils) under foundations and flagging for homes, multidwelling buildings and industrial facilities through biocalcification

DEPLOYMENT

Client: **Public and private sector**
Region: **Global**

DESCRIPTION

Using the **BioTS** process, Freyssinet provides a lasting solution to all structural issues caused by **geotechnical instabilities and natural catastrophes** such as:

- Droughts
- Flooding
- Landslides
- Shrinking or swelling clay soil
- Leaks in supply and drainage pipes
- Design and construction defects

ADDED VALUE

Biocalcification by Electro-Injection:

- Increases the load-bearing capacity of the soil by modifying its mechanical properties
- Reduces the sensitivity of soils to shrinking and swelling

Primary advantages of BioTS:

- Environmentally friendly (resources used, environmental impact, etc.)
- Inexpensive, long-lasting and relatively non-invasive
- Helps to check the extent to which soils have been improved over a large area
- Suitable for all types of soil

KEY CONTACT

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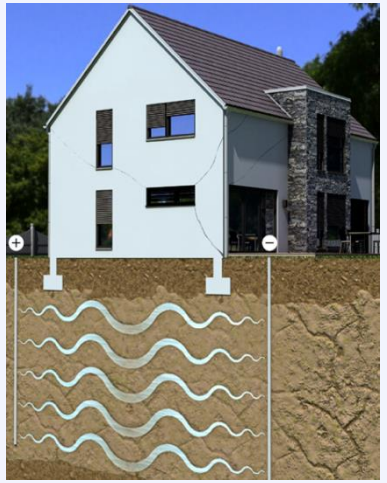

2. TRANSPORT AND ROADS

2.1 DIAGNOSTIC SOLUTIONS

CALEDONIA

SOLUTION

CaledonIA is a piece of calculation software that uses artificial intelligence algorithms and integrates rainfall data from Météo-France to simulate urban flooding in real time

DEPLOYMENT

Client: Local authorities, towns, departmental councils, insurers, design offices

Region: France

DESCRIPTION

There is currently no software able to rapidly predict (hour by hour) 3D water flows following flooding in urban areas. National meteorological bodies only forecast rainfall a few days ahead of time, leaving local authorities and water design offices unable to study future scenarios to tackle flood risks arising due to climate change. The tool was used on the A9 to consider the vulnerability of the Gard area with respect to heavy rainfall as episodes in the Cevennes mountain region have already blocked the A9 network in the past. Climate change will only make such extreme weather events increasingly frequent. The study sought to assess the consequences of extreme precipitation along a stretch of the A9 motorway, including the road being submerged, and detect where water will pass and damage infrastructure.

ADDED VALUE

- Identify risks
- Anticipate impact, in particular on users, surrounding areas and infrastructure
- Improve prevention and raise awareness among users
- Prepare crisis management in line with potential impacts
- Support informed decisions regarding the investments required as a priority in a given area

KEY CONTACT

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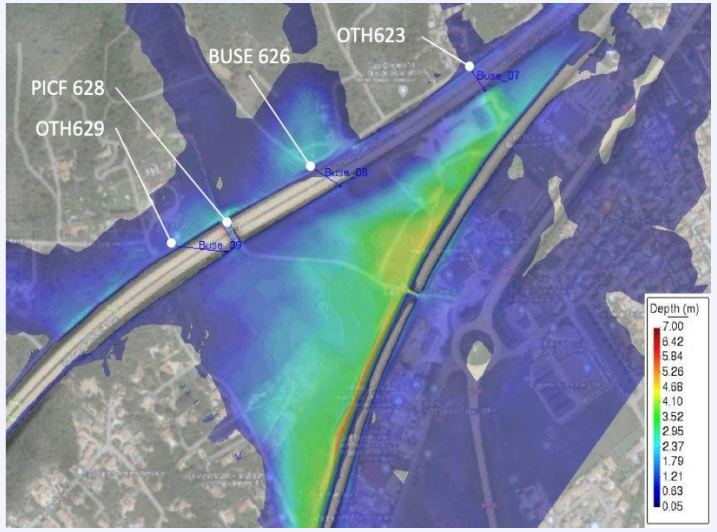
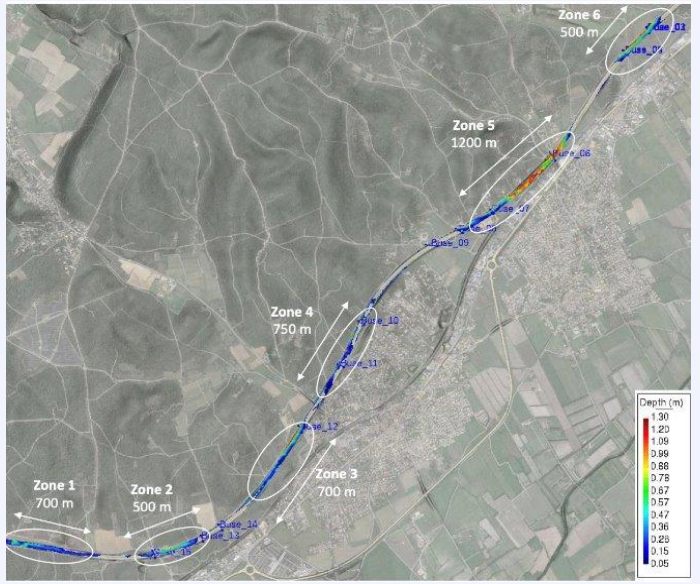
Impact analysis simulation for the A9





ASSESSMENT OF MOTORWAY INFRASTRUCTURE CRITICALITY WITH RESPECT TO CLIMATE CHANGE

SOLUTION

Physical vulnerability study of 4,400 km of motorway infrastructure across the ASF, COFIROUTE and ESCOTA networks to the exacerbation of climate events

DEPLOYMENT

Client: Vinci AUTOROUTES
Region: ESCOTA – COFIROUTE – ASF networks
Budget: €70K Date: 2020

DESCRIPTION

Due to the intensification of climate change, it was decided to carry out study with the Carbone 4 design office to assess how vulnerable motorway infrastructure is to climate change. The aim was to identify the stretches of motorway that were most functionally susceptible to be affected by climate hazards in order to effectively prepare and safeguard these portions against the growing challenges to keep users safe, maintain operational continuity and bolster the long-term durability of these assets.

ADDED VALUE

- Identify the exposure of the motorway network to climate hazards
- Calculate the physical vulnerability of the infrastructure components
- Define critical zones to better anticipate future changes

KEY CONTACT

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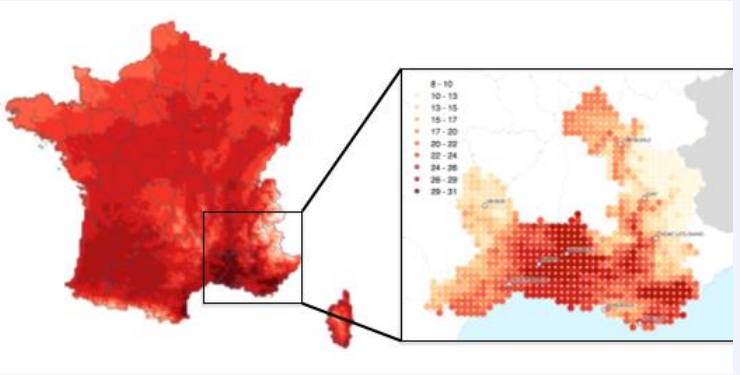

Evolution of hazards and illustration of the criticality – VINCI Autoroutes and Carbone 4 study

DIAGNOSIS OF RESILIENCE PERFORMANCE (DPR)

SOLUTION

Systematic modelling tool that studies all climate hazards affecting infrastructure, projects and the economy of a given region. It assess the losses and damage induced by climate hazards, as well as the investment required to reduce the losses and damage

DEPLOYMENT

Client: Regional authorities, property asset managers
Region: Global Date: 2021
Budget: Dependent on the project

DESCRIPTION

There are four versions of the DPR, depending on the area studied:

- The City, Area and Region DPR, which focuses on the critical infrastructure as well as the interconnections at play. The tool was applied to the city of Tetouan in Morocco.
- Island States DPR to systemically model climate risks across these states where critical zones (such as electricity grid, telecoms networks, water supply networks as well as airports) are studied in order to anticipate the social and economic impact. It was used in Dominica and Barbados.
- Building DPR, for asset and property managers interested in the interconnections within a building and its surrounding environment. This version was rolled out for CDC-Habitat (France) and AEW (France and Europe).

ADDED VALUE

- Understanding of interconnections in a given space
- Visibility of areas for improvement
- Decision aid

KEY CONTACT

Didier Soto

Team Leader and Expert in DPR

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Exposure of buildings in the capital of a Caribbean island state to flooding/RESALLIENCE

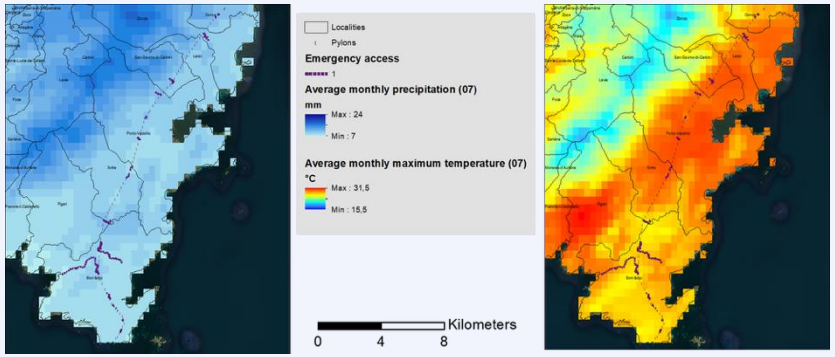
MODELLING AND MONITORING WILDFIRE RISKS

SOLUTION

Solution developed in collaboration with VINCI Energies to track and model the risk of wildfires

DESCRIPTION

This solution was developed to identify the breakout of fires using video surveillance technology, enabling electric grid managers to rapidly implement actions to avoid damage to the network. It makes it possible to model the most critical routes to then put in place suitable solutions. This solution won the second edition of the RTE Suppliers Awards in 2022 and was rolled out in Corsica.



Modelling wildfire risks and implementing a monitoring system/RESALLIENCE

ADDED VALUE

- Monitor the state of forests in real time and the breakout of wildfires
- Enable localised prevention of wildfire risks
- Provide a more rapid, targeted response to areas likely to see fires break out

KEY CONTACT

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Team Leader and Expert in DPR

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DEPLOYMENT

Client: Regional authorities, businesses and manufacturers
Region: Global Date: 2022
Budget: Dependent on the project

ADAPTATION INVESTMENT DECISION SUPPORT

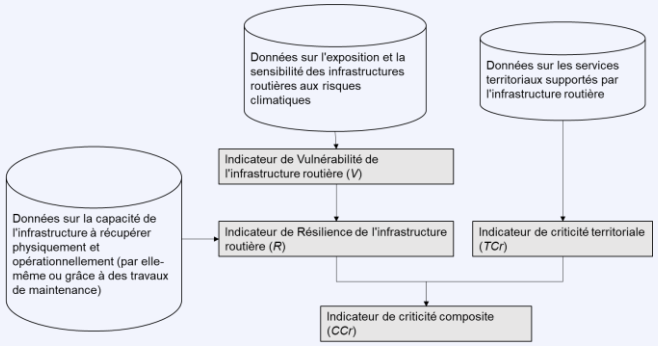
SOLUTION

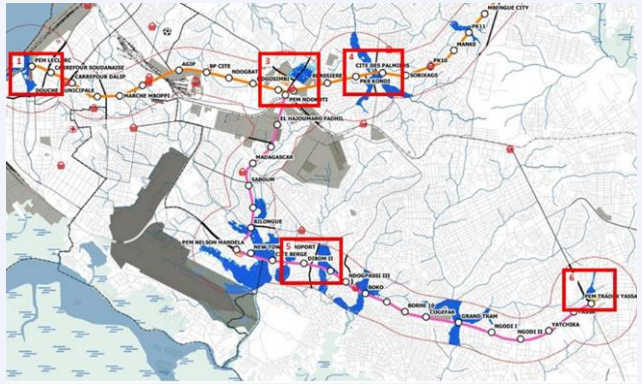
Support in decision making to prioritise critical motorway stretches for investment to enhance climate resilience across transport networks

DESCRIPTION

To optimise investment in climate change adaptation, transport infrastructure designers and managers need to identify the priority stretches and components to target investment in bolstering resilience. RESALLIENCE developed a service to support decision making based on a robust methodology that won the PIARC award in 2021 to identify the critical sections in a network using data on climate hazards, infrastructure, mobility services and land occupation. This approach has helped assist many clients, including:

- The World Bank and the urban Douala community to prioritise flood resilience measures for the town's future bus rapid transit network (2022)
- The World Bank and the Albanian roads service to prioritise the bridges to include in the renovation and upgrade programme (2022)
- VINCI Autoroutes to identify the stretches of motorway to prioritise in its network in carrying out detailed flood risk studies (2025)





Methodology/critical stretch of the Douala bus rapid transit project

ADDED VALUE

- Identify the exposure of the motorway network to climate hazards
- Calculate the physical vulnerability of the infrastructure components
- Define critical zones to better anticipate future changes

KEY CONTACT

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DEPLOYMENT

Client: Vinci AUTOROUTES
Region: ESCOTA – COFIROUTE – ASF networks
Budget: €70K Date: 2020

ASSESSMENT OF THE RESILIENCE OF THE SOUTH EUROPE ATLANTIC HSL TO CLIMATE CHANGE

SOLUTION

Assess the resilience of the South Europe Atlantic HSL to climate change over 302 km of high-speed rail line

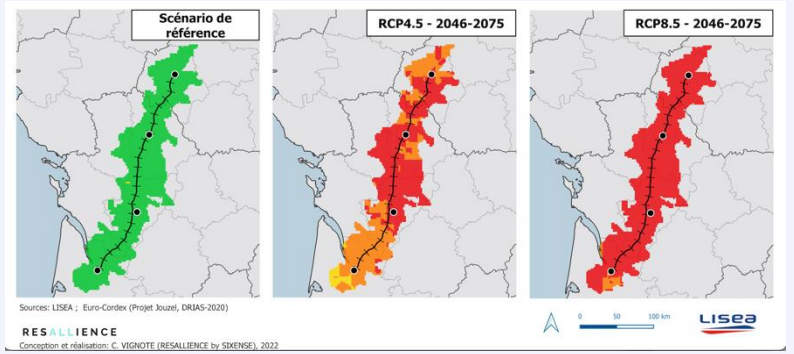
DEPLOYMENT

Client: **LISEA**
Region: SEA HSL
Budget: €103 K

DESCRIPTION

The study involves assessing the potential impact of climate hazards on infrastructure, as well as its operation and maintenance. The study framework was built on:

- Two scenarios identified by the IPCC (one realistic and one pessimistic scenario) along with one short-term (before 2050) and one medium-term (before 2075) timescale:
  - The first part of the CEREMA methodology "vulnerabilities and risks: transport infrastructure and the climate", 2019, to draw up the vulnerability diagnosis
  - The second part involved implementing the adaptation programme (study planned for 2024/25)
- The technical departments of the operator/maintenance provider (MESEA) and the concession company (LISEA)



ADDED VALUE

- Identify the exposure to climate hazards over the entire length of the infrastructure over the short and long term
- Assess and prioritise physical vulnerabilities of the line (infrastructure components)
- Assess and prioritise functional vulnerabilities of the line (maintenance, availability)

KEY CONTACT

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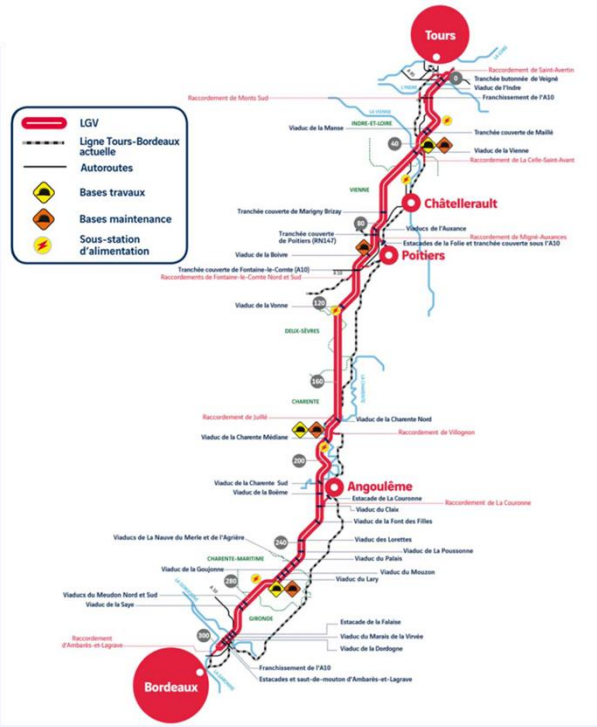

ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE – HS2

SOLUTION

Study the impact of climate change on HS2 and identify the measures to implement during the design/build and maintenance phases in order to factor in the impact climate change may have in the future

DEPLOYMENT

Client: HS2
Region: N1 N2 BBV JV
Budget: 2022

DESCRIPTION

The general approach pursued by HS2 Ltd is to design a High-Speed Rail line (HSL) that is climate resilient and stands the test of time. This study shows how the HS2 design/build project maximises climate resilience as well as adapts to future climate change while also minimising the risk of operational performance losses caused by the impact of climate change on interdependent infrastructure.

ADDED VALUE

- Maximise the resilience of HS2 to climate change
- Minimise operational performance losses in the future
- Anticipate the effect of climate change right from the design/build phase and maintenance on the line
- Put forward alternative approaches wherever possible

KEY CONTACT

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Environment Manager

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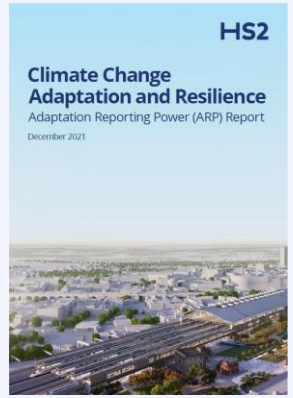
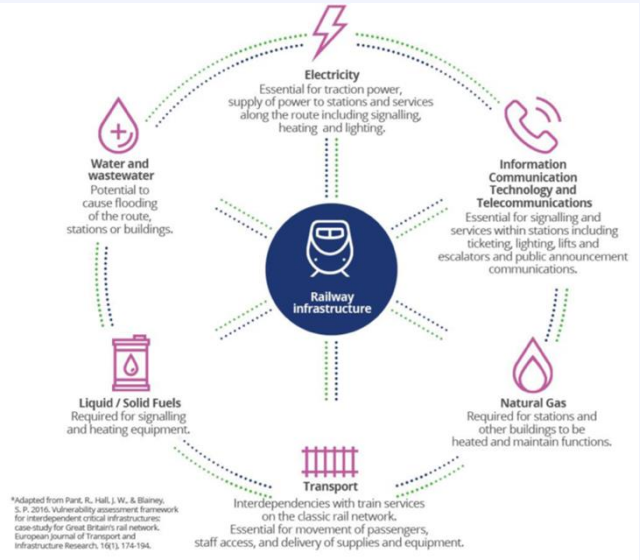
HS2 Climate Change Objectives:
- Adaptation
- Resilience



HS2 Climate Change Adaptation and Resilience Report



SURVEILLANCE AND MONITORING OF NATURAL AND BUILT ENVIRONMENTS

SOLUTION

Solutions to monitor and track climate risk management using ground measurements, airborne measurements, and satellite monitoring

DESCRIPTION

Technological surveillance solutions using remote detection or sensors are rolled out to monitor the impact of extreme weather conditions and track the variations over time in order to implement the right adaptation measures at the right time. They help steer the management of climate risks at a given point in time, check their prevalence over the medium term and plan adaptation strategies. This type of solution was applied to tackle the coastal erosion along the coast at Saint Louis in Senegal (OSS project supported by the French space agency and the United Nations) and is set to be replicated in neighbouring coastal countries. It was also used to study erosion and sediment build-ups in Kazakhstan by putting in place nature-based adaptation solutions, in particular by planting saxauls.

Aerial view of Saint Louis, Senegal

ADDED VALUE

- Assess changes in climate risks
- Bolster the most vulnerable adjustment variables
- Boost resilience across the region as a whole

KEY CONTACT

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Team Leader and Expert in DPR

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DEPLOYMENT

Client: All Region: Global

Budget: Dependent on the project

Date: 2019-22, 2021-23

Current readings for monitoring/RESALLIENCE

RESIL'SPACE

SOLUTION

Flow management across transport infrastructure

DESCRIPTION

Using satellite data, Resil'Space is a logistic management tool that models the impact of climate hazards on transport infrastructure (river, sea, rail and road) in order to effectively manage supply logistics for necessity goods in times of climate catastrophes. This pilot project has been implemented across the entire Seine basin covering the Greater Paris region and Normandy to put in place a warning system almost in real time, also providing forecasts according to various climate scenarios. This project, which involves collaboration and financing between the public and private sector, is destined to be rolled out in other regions across France and Europe.

Congestion of transport network in the event of a crisis caused by the climate/The considerable impact of road transport externalities/the Transalpine road

ADDED VALUE

- Optimal management of logistics flows in accordance with the impact of climate hazards in a crisis situation
- Decision-making aid regarding facts in almost real time

KEY CONTACT

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DEPLOYMENT

Client: All, especially regional authorities
Region: Global
Budget: Dependent on the project
Date: 2021-2023

2.2 PREVENTION SOLUTIONS

REFRESH

SOLUTION

In-situ recycling of low traffic roads

DEPLOYMENT

Clients: Subcontracted to local Eurovia branches
Directly with local authorities
Region: National

DESCRIPTION

Local authorities must deal with falling budgets to manage secondary roads and are searching for green solutions. Cold-mix asphalts are widely used but have their limits in competitive markets. The Refresh solution reused existing road materials to repair low traffic roads using bitumen emulsion on site. This approach joins the Recyclovia machine developed by Eurovia, which recycles the busiest stretches of road in situ. A single machine is used to reprocess and lay the product.

ADDED VALUE

This method makes it possible to reduce greenhouse gas emissions, material transport and energy consumption while improving the quality and durability of roads at an optimised cost. The REFRESH solution is already operational, having been used to resurface several thousands of kilometres of roads. Drawing inspiration from Eurovia's tried and tested Recyclovia machine, it targets a segment of the market that has so far been overlooked and for which a mechanised solution does not yet exist.

KEY CONTACT

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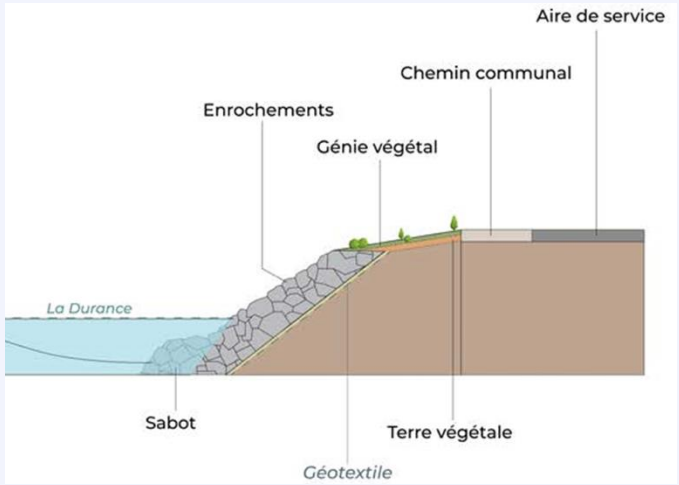
PREVENTIVE ACTIONS TO TACKLE CLIMATE CHANGE ON THE A51

SOLUTION

Bolstering riverbanks with riprap to protect the A51 from the Durance flooding and conducting vulnerability studies and risk assessments

DESCRIPTION

The flow of the Durance river, an affluent of the Rhône, is influenced by the rain of the Mediterranean climate and melting snow from the southern Alps. In the past, the Durance has been the location of many hydroelectric developments, as well as solutions exploiting the water and aggregate. For several years, the river management policy strives to achieve more natural characterisation, which changes the morphology of the riverbed. The effects of climate change and hydromorphological modifications to the riverbed cause ever-more severe and aggressive flooding to occur increasingly frequently, affecting in particular the A51 motorway, part of which runs alongside the Durance. Several localised areas of erosion were threatening the stability of the motorway and so required work to consolidate the riverbanks with riprap. Such work took place in particular in Manosque, consolidating 210 m of existing banks in 2023. Moreover, an overall vulnerability study and risk assessment of the A51 with respect to the Durance flooding, taking account of changes in the climate and the hydromorphology of the river, was carried out by the project manager Artelia.



ADDED VALUE

- Enhance security, sustainability, and long-term resilience of the infrastructure
- Anticipate risks for the infrastructure

KEY CONTACT

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DEPLOYMENT

Client: VINCI-Autoroutes
Region: Escota network
Budget: €1.1 M pre-tax (val June 2010) (Manosque work) Date: 2023

Consolidating the riverbanks alongside the A51 in Manosque - 2023

ENVIRO MAT GEOTEXTILE – PROTECTION AGAINST EROSION ALONG COASTS AND RIVERS

SOLUTION

Geoquest provides a range of solutions to protect coastlines and waterway banks from erosion caused by rising water levels and increasingly frequent extreme weather events. It involves a geotextile formwork mattress filled on site with concrete and/or geotubes pumped full of sand

DEPLOYMENT

Client: **Local authorities, transport and industrial infrastructure concession companies**
Region: Global
20 or so projects

DESCRIPTION

The flexible formwork mattress is made of high tenacity polyester woven geotextile, which helps to shape and enhance the look of the slope. The geotubes are also made from woven geotextile to create embankments or rebuild coastlines or riverbanks. It offers an alternative, sustainable solution to protect against erosion that can be used in many situations, for example to protect areas against erosion including riverbanks, as well as embankments, coastal defence structures, as well as impervious surfacing work for reservoirs and canals. The formwork mattress has for example been used to protect an industrial platform against erosion from waves off the coast of Moheshkhali, Bangladesh.

ADDED VALUE

- Reduce soil erosion and limit water speed
- Certain solutions help to promote biodiversity by creating an environment that supports vegetation and ecological diversity while also improving the aesthetic of the space
- This solution is less expensive, requires fewer resources to install and boasts a lower carbon footprint compared with conventional solutions (riprap or precast concrete blocks)

KEY CONTACT

Thomas Joussellin
Chief Technical Officer

Geoquest
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PROTECTION AGAINST THE RISK OF GRAVITY

SOLUTION

Geoquest provides a range of solutions to protect from rock falls, rockslides, avalanches and landslides caused by rising levels of permafrost in mountainous areas and increasingly frequent extreme weather events. The systems put forward involve either protective metal nets or reduced footprint earth mound barriers for significant energies

DEPLOYMENT

Client: **Local authorities, transport and industrial infrastructure concession companies**
Region: Global
10 or so projects

DESCRIPTION

This solution stands out for its simplicity, durability and effectiveness, making it especially suitable as a climate change adaptation strategy. Each component is designed to ensure safety and adequacy, facilitating installation and maintenance given the changing climate. The iterative design process integrates feedback from clients and contractors, thereby creating a high value product and performance able to adapt to climate challenges. The reinforced backfill solution was put in place against avalanches on a road in Samuelsberg, Norway.

ADDED VALUE

- Avert accidents by preventing rocks from falling that may potentially be dangerous for people or property
- Safeguard high risk areas by protecting infrastructure and inhabited areas from damage caused by falling rocks
- Bolster infrastructure resilience against falling rocks, aggravated by extreme weather events caused by climate change

KEY CONTACT

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Chief Technical Officer

Geoquest
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POWER ROAD

SOLUTION

Power Road is a solution to decarbonise building heating and air conditioning by exploiting heat captured by asphalt surfaces (roads, streets, car parks and pavements)

DEPLOYMENT

Client: All
Region: France and Global
Budget: variable, depending on the heating needs
Date: Since 2018

DESCRIPTION

Heat accounts for half of our total energy demand and 80% is generated using fossil fuels (gas or fuel oil), which emit high levels of greenhouse gases. It has become essential to phase out fossil energies. Power Road helps achieve this goal by exploiting a "zero carbon" renewable source of heat by making it possible to use the solar energy captured by road surfaces and stored as geothermal energy.

ADDED VALUE

- Five remarkable strengths: decarbonisation, profitability, adaptability, acceptability and performance
- Geothermal energy boosted by recharging the field of probes with the Power Road surface to optimise costs (investment and operation) and performance
- Reduction of the urban heat island effect by capturing heat and injecting it into a field of probes
- A turnkey solution to produce low-carbon heat and cooling, with or without financing

KEY CONTACT

Loic Bernard

Business Development Manager

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Saint-Pol-de-Léon: the water in the swimming pool is heated by the 860 m² car park

A selection of example projects in France

Fleury-sur-Orne: 61 homes heated by 1,420 m² of car park equipped by Power Road

REVILO

SOLUTION

A solution to combat urban heat islands and bring more nature back into the city through a four-pronged approach: vegetation, water, soils and surfaces

DEPLOYMENT

Client: Primarily local authorities
Region: Primarily France
Date: 2022
Budget: Variable

DESCRIPTION

Climate change means all urban areas will need to tackle the urban heat island effect, where high temperatures can provoke risks for human health. Revilo represents one solution to cool built-up areas during the hot summer months, in particular during heat waves. Revilo combines and optimises four approaches in which Eurovia is proficient

- Using vegetation to create shaded areas, facilitate evapotranspiration and enhance wellbeing for the community
- Channelling rainwater to water the vegetation
- Maximising soils and their ability to store and absorb water
- Modifying surfaces to make them more permeable and lighter coloured

ADDED VALUE

- A comprehensive solution
- An answer to political ambitions, public expectations as well as the priorities for cities and technical services
- The potential to redesign public spaces requiring investment and work
- Many successful applications

KEY CONTACT

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Parc de la Loubière, Toulon (southern France)

OASIS gardens, Paris

WASTEWATER RESERVOIR DURING PERIODS OF HEAVY RAIN

SOLUTION

Structure to avoiding discharging wastewater from a Paris sewer system into the Seine after heavy rainfall.

DEPLOYMENT

Client: Paris city council
Region: Paris
Date: 2021

DESCRIPTION

Soletanche Bachy and Bessac were involved in the consortium that built the water storage tank (the Austerlitz reservoir) as well as two water recovery structures from storm drains either side of the river Seine. The reservoir was built with a 1.2-m thick moulded wall with plunge columns installed in barrettes 60 m deep. The shaft built to launch the micro TBM next to the reservoir made it possible to start work on the tunnel independently of the progress of work on the reservoir.

ADDED VALUE

- Stop discharging wastewater from the Paris sewer system after heavy rainfall
- Improve water quality in the Seine ahead of the 2024 Games and create permanent zones where people can swim in the river
- Tightly control deep diversions for the moulded walls and bored piles made with high resistance low-carbon concrete

KEY CONTACT

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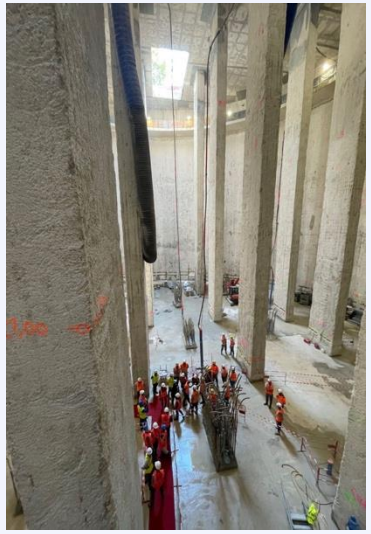
Aerial view of the Austerlitz reservoir worksite



View inside

LIFE COOL & LOW NOISE ASPHALT PROJECT

SOLUTION

Puma (Eurovia): light coloured, pervious hot mix asphalt. It combines the ability to reflect light due to its colour with pervious aggregates to absorb water used to water plants during periods of extreme heat and reduce noise

DEPLOYMENT

Client: Paris city council and EU
Region: Paris city council
Budget: €2.3 M
Date: 2016-2021

DESCRIPTION

The Paris city council led this project, which came from a beneficial partnership between Colas, Eurovia and the Greater Paris technical and noise assessment centre, Bruitparif. The project was developed following the widespread acknowledgement that urban areas need to tackle the issues of noise and heat. By designing new surface materials to reduce noise and facilitate cooling, the LIFE COOL & LOW NOISE ASPHALT project has developed a tangible solution to provide a genuine lasting improvement in wellbeing for Parisians, implemented as part of a wider package.

ADDED VALUE

- The use of light-coloured aggregates helps reflect light (the albedo effect) and reduce the urban heat island effect
- The pervious aggregate makes it possible to better absorb water, facilitating evaporation and thereby cooling the air during heatwaves
- The pervious surface also helps reduce noise pollution as it traps the sound of traffic

KEY CONTACT

Florent Gazaniol

Technical Manager VCSP roads

Eurovia IDF
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Photo credit Joachim Bertrand

Photo credit Joachim Bertrand

HYDROVIA®

SOLUTION

HYDROVIA® is a range of pervious solutions to deal with rainwater run-off in urban areas. Depending on the intended use, the level of expected exposure and the desired aesthetic, a number of solutions exist: Hydrovia® Soft for environmentally friendly mobility, Hydrovia® Park for light vehicle parking and roads, as well as Hydrovia® Roc and Hydrovia® Print, two complementary alternatives.

DEPLOYMENT

Client: All
Region: France
Budget: All budgets
Date: Since 2022

DESCRIPTION

Integrated management of rainwater is a major concern for urban development and resilience projects. One solution is to use pervious surfaces able to absorb rainwater close to where it falls while also conserving the properties required for the intended purpose (safety, durability, integration into the landscape). The solutions in the HYDROVIA® range seek to limit rainwater run-off and facilitate rapid absorption.

ADDED VALUE

- Versatility of solutions across the range: resistance to rutting and cracking (degradation caused by light vehicle parking), integration of vegetation and into the surrounding landscape
- Possibility to take advantage of the colour of the aggregate, using translucent binder (Solis®), improving light reflection and helping to limit rising ground temperatures
- Simple to implement, these solutions are particularly well suited to environmentally friendly mobility lanes and light vehicle parking

KEY CONTACT

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Technical engineer

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Hydrovia® Soft – Nancy (eastern France)

Hydrovia® Park

Hydrovia® Print

Hydrovia® Roc

RESERVOIR PAVEMENTS

SOLUTION

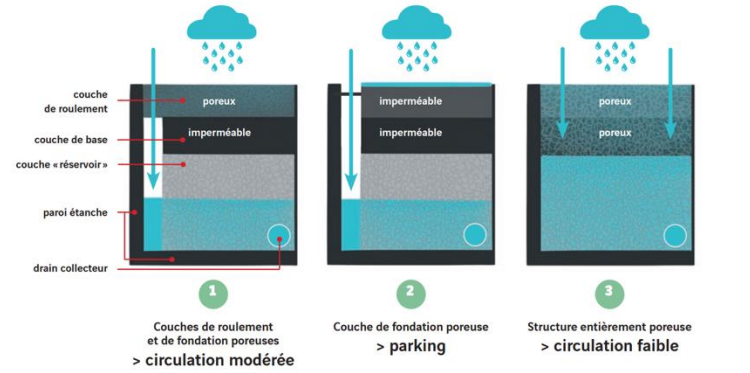
Reservoir pavements are road surfaces that boast significant water infiltration capacity. They are composed of layers of material that, given their high level of porosity, allow rainwater to infiltrate the pavement before it is returned to the environment, either via direct infiltration and/or the rainwater network

DEPLOYMENT

Client: All
Region: France and Global
Budget: All budgets
Date: Over 30 years' experience

DESCRIPTION

Integrated management of rainwater is a major concern for urban development and resilience projects. One way of addressing this matter is harnessing comprehensive structures such as reservoir pavements wherever project footprints make it possible to do so. By absorbing significant volumes of rain that falls during storms, the water can then be returned to the environment (depending on the absorption capacity of the road) or the water supply at a controlled pace, depending on the configuration.



The different types of structures

ADDED VALUE

- High capacity for infiltration/retention over a relatively small surface area
- Particularly adapted to car parks
- Adaptability of performance depending on project constraints

KEY CONTACT

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Technical engineer

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Building a reservoir pavement

AGREVIA®

SOLUTION

AGREVIA® is a surface course asphalt mix that showcases the natural colour of aggregates through mechanical surface treatment (hydrostripping and grit-blasting)

DEPLOYMENT

Client: All
Region: France and Global
Budget: All budgets
Date: Over 20 years' experience

DESCRIPTION

Urban developers often distinguish spaces using different surface coatings. Using a simple surface treatment process and selecting aggregates for their colour, AGREVIA® makes it easier to demarcate structures while maintaining similar levels of service to conventional surfaces. The use of light-coloured aggregates significantly improves the amount of light reflected and help mitigate the rise in temperature of the surface course.

ADDED VALUE

- Showcase the natural colour of aggregates without using synthetic translucent binder
- Adaptability of performance depending on project constraints
- Easy to apply, it suits all types of traffic

KEY CONTACT

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Technical engineer

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Village road

Boulevard Mayer in Tours (western France)

Plestant town centre (northwestern France)

Distinguishing traffic lanes

LIGHT-COLOURED SURFACES USING SOLIS® BINDERS

SOLUTION

Viacolor® is a family of asphalt mixes for light and coloured surface courses, used alongside translucent, pigmentable SOLIS® binders. It naturally finds its place in all road environments, whether or not they are used by traffic

DEPLOYMENT

Client: All
Region: France and Global
Budget: All budgets
Date: Since 2021 for SOLIS and over 20 years for Viacolor

DESCRIPTION

In a pleasant, communal space, colours serve as distinguishing markers. Occasional visitors and regular users must be able to easily see a clear, secure path. The SOLIS® range of binders enable Viacolor® asphalt mixes to naturally find their place in all road environments. The use of light-coloured aggregates significantly improves the amount of light reflected and help mitigate the rise in temperature of the surface course.

ADDED VALUE

- Improved understanding of the road layout, distinguishing between spaces by colour to help users better understand public facilities
- Enhanced visual comfort for users and local residents
- Binder performance adapted to suit usage level
- Minimisation of the surface temperature by using highly reflective surfaces

KEY CONTACT

Sabine Le Bec
Technical engineer

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Distinguishing traffic lanes

Cycle lane

DECOVIA®

SOLUTION

Decovia® is a range of cold mix asphalts using non-bituminous translucent binders that showcase the natural colour of aggregates used. Decovia® does not suit car traffic and primarily serves for environmentally friendly modes of transport. Decovia® particularly suits pedestrian spaces (pavements, public spaces, squares and tourist sites) and cycle lanes (in urban areas, forests or alongside riverbanks)

DEPLOYMENT

Client: All
Region: France and Global
Budget: All budgets
Date: Since 2019 (28,000 m² laid)

DESCRIPTION

Lanes for pedestrians and cyclists must be distinguished to ensure safety and comfort. Colour often reflects quality development and helps to distinguish between lanes and spaces dedicated to different uses. Integrated management of rainwater and mitigation of the urban heat island effect are major concerns for urban development and resilience projects. Decovia®'s porous or semi-permeable formulation makes it effective in limited the extent to which the land is sealed during developments. This light-coloured surface is particularly effective in combating the urban heat island effect and also helps to better distinguish between urban spaces.

ADDED VALUE

- 100% cold mix asphalt
- Mitigation of the urban heat island effect
- Natural colour of aggregates **offers enhanced** visual comfort for users and local residents
- Permeable surface enables rainwater infiltration

KEY CONTACT

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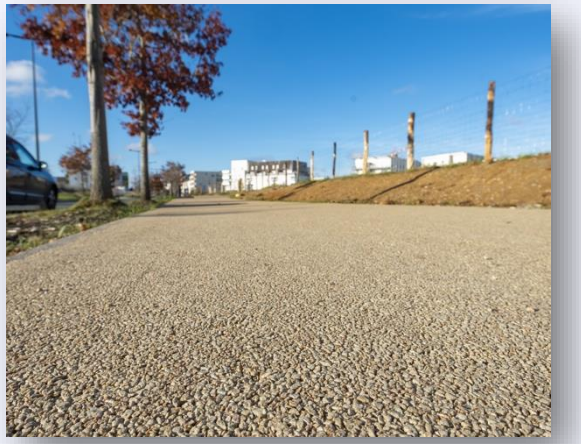

THERMALIA®

SOLUTION

Thermalia® is a single-component water-based paint designed to cover all black or dark-coloured surfaces (such as asphalt mixes, pavement asphalt, etc.) to increase the proportion of light reflected from surfaces for environmentally friendly modes of transport (pedestrian areas, cycle lanes, squares and school playgrounds). Made without titanium dioxide (TiO_2), Thermalia® paint integrates charges minimising heat absorption with infrared with a choice of coloured pigment limiting glare during the day and maintaining effective heat reduction

DEPLOYMENT

Client: All
Region: France and Global
Budget: All budgets
Date: Since 2019 (28,000 m² laid)

DESCRIPTION

Lanes for pedestrians and cyclists must be distinguished to ensure safety and comfort. Colour often reflects quality development and helps to distinguish between lanes and spaces dedicated to different uses. Integrated management of rainwater and mitigation of the urban heat island effect are major concerns for urban development and resilience projects. Decovia®'s porous or semi-permeable formulation makes it effective in limited the extent to which the land is sealed during developments. This light-coloured surface is particularly effective in combating the urban heat island effect and also helps to better distinguish between urban spaces.

ADDED VALUE

- 100% cold mix asphalt
- Mitigation of the urban heat island effect
- Natural colour of aggregates offers enhanced visual comfort for users and local residents
- Permeable surface enables rainwater infiltration

KEY CONTACT

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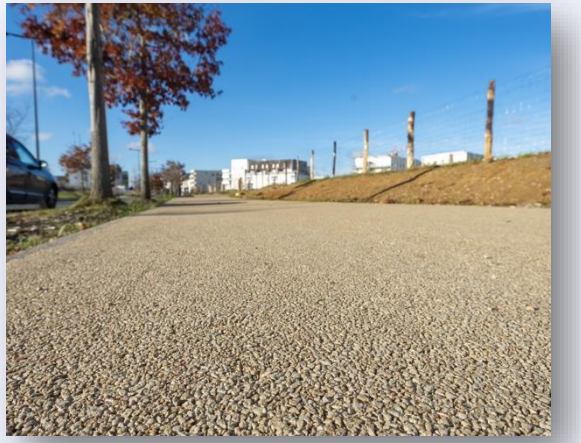


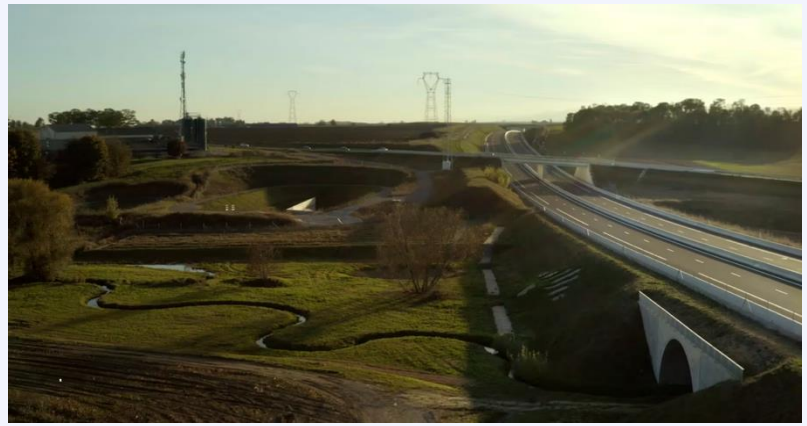
FLOOD PREVENTION SOLUTIONS ON THE A355 MOTORWAY

SOLUTION

Implementation of special storage systems to collect water from natural drainage basins and thereby contain exceptional rainfall

DESCRIPTION

The A355 is a next-generation motorway that sets an example in terms of ecological transparency and environmental integration. Benefiting from innovative environmental measures, this new motorway was also the first road infrastructure project in France to have integrated offset measures, even before construction began. Overall, 1,315 hectares of environmental offset were deployed alongside the construction of this major bypass project. Equating to more than 4.5 times the project footprint! These measures primarily concerned forests and wetlands. Several waterways located along or near the motorway were thereby redirected with the addition of a water offset zone in order to restore their original character, regulate water flow and make them more favourable to the development of biodiversity. At the same time, the bridges were all designed to take account of swelling in the event of exceptional flooding.



ADDED VALUE

- Minimise impact on infrastructure operations
- Enhance security, sustainability, and long-term resilience of the infrastructure
- Eliminate the infrastructure barrier effect and protect villages downstream from flooding

KEY CONTACT

Arnaud Guillemin

Environment Manager

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DEPLOYMENT

Client: VINCI Autoroutes
Region: ARCOS network
Budget: Included in the construction of the A355
Date: 2021

HS2 SUSTAINABLE FLOOD RISK MANAGEMENT

SOLUTION

Alternative approach for flood mitigation based on ecology and nature, using natural flood management techniques around the drainage basin, while also taking account of the ecological value at the design stage (nature-based solutions)

DEPLOYMENT

Client: HS2

Region: N1 N2 BBV JV

Date: 2022

DESCRIPTION

HS2 will pass through many waterways and the surrounding flood plains, meaning that if the project failed to include mitigation measures, it would potentially increase the risk of flooding in the neighbouring areas. Ordinarily, flood mitigation involves replacement floodplain storage. However, such conventional flood mitigation measures require changes to ground levels, leading to the loss of arable land and vegetation, making it difficult to uphold the pledges made to achieve No Net Loss in biodiversity.

ADDED VALUE

- Maximise the resilience of HS2 to climate change
- Minimise the impact on natural environments and improving biodiversity
- Reduce greenhouse gas emissions
- Reduce the cost of flood management

KEY CONTACT

Marvin Danvers

Environment Manager

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Grazing in wetlands

Canley Brook: Design of replacement floodplain storage

River Cole: Design of replacement floodplain storage

THAMES TIDEWAY TUNNEL

SOLUTION

Design and construction of a tunnel to store sewage and diverting it from central London to a treatment centre. The project involves the main 5.5 km long tunnel (7.2 m diameter wide), as well as a 4.6 km long connection tunnel (5 m diameter wide), five shafts with internal structure and electromechanical work

DEPLOYMENT

Client: Bazalgette Tunnel Limited
Region: London, UK
Budget: €1.2 bn
Date: 2015-2024

DESCRIPTION

The Thames Tideway Tunnel is a vast project stretching 25 km in length, at depths of between 35 and 66 m. It can hold up to 1.6 million cubic metres of wastewater and was built to operate over a 120-year timescale, based on climate models published by the Met Office Hadley Centre (UKCP09). Modelling the future scenario based on a typical year, climate change and demographic growth will significantly aggravate the frequency of spillages from the Thames sewer system by 2080.

ADDED VALUE

- Explore uncertainties for 2050 and 2080 using climate forecasts and build for the future
- Make a key contribution to the essential verifications and improvements to the quality of the Thames in the near future with resilient infrastructure
- Combat the risk of rising water by building new anti-flood structures, especially at the King Edward Memorial Park along the Thames, which were studied with a view to rising their level in the future, in line with the forecast rise in water levels as published by the UK Environment Agency (TE2100)

KEY CONTACT

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Deputy Project Director

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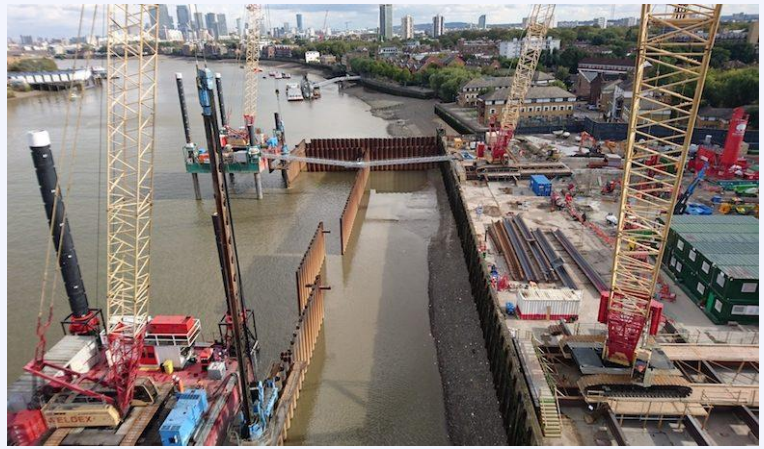
Tideway East view from inside



Tunnel worksite in London

FARO AIRPORT'S CLIMATE CHANGE ADAPTATION PLAN

SOLUTION

Comprehensive climate change action plan in place at Faro airport (Portugal) built via a participative approach

DEPLOYMENT

Client: Aeropuertos de Portugal

Region: Faro

DESCRIPTION

After having drawn up a diagnostic of the climate vulnerabilities and risks facing Faro airport, a comprehensive action plan was built in collaboration with the various stakeholders over a four-phased process: (1) identification of current vulnerabilities, (2) future vulnerabilities, (3) assessment of adaptation and mitigation solutions, (4) definition of an action plan, monitoring and training.

The action plan covers the following aspects:
Risk of flooding (e.g. tracking rainfall, protocols with stakeholders to inspect and regularly clean water pipes outside the airport), drought (e.g. reusing treated wastewater), high temperatures (e.g. shading over terminals, considering the impact of heatwaves when resurfacing runways, vehicle lanes and new HVAC systems), risk of exhaustion for airport employees in extreme heat, (e.g. providing specific employee training, implementing new working hours, supplying suitable equipment and clothing), risk of extreme heat for employees and passengers (e.g. tracking energy needs, simulating energy needs for terminals), prevention of emerging tropical illnesses (e.g. tracking, installing a system to capture insects, providing PPE, running awareness campaigns), and extreme winds (e.g. tracking extreme weather events and a strategic action plan).

ADDED VALUE

- Systematic early consideration of climate risks
- Risk prevention and enhanced resilience
- Optimisation of investment and costs

KEY CONTACT

Andreia Ramos

Director of Sustainable Development

Aeropuertos de Portugal

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Workshop with employees, in-house and external stakeholders

HELYS PROJECT – SOLAR CARPORTS

SOLUTION

Working with Neoen and Sunmind (subsidiary of VINCI Concessions) deployment of solar carports at Lyon-Saint Exupéry airport in order to decarbonise its Scope 3 emissions, capitalise on its land, anticipate future regulatory requirements and improve passenger comfort. Third-party investor project, formalised with a temporary occupation permit (AOT)

DEPLOYMENT

Client: Lyon airport

Region: Colombier-Saugnieu

Budget: 0 (investor portion)

Date: 2021-2025

DESCRIPTION

Lyon airport has a vast expanse of overground parking space. The idea is to take advantage of a portion of this space to install a photovoltaic production unit and inject 20 MWp of power, over around 14 hectares of car park space.

ADDED VALUE

- Annual production of around 25,000 MWh of renewable electricity injected into the ENEDIS network
- Annual payments received by the airport
- Net addition of parking spaces by redesigning the car parks
- Help to meet future regulatory requirements (anticipation)
- Limit the urban heat island effect caused by car park asphalt
- Protect vehicles and pedestrians (from rain and sun), improving the passenger experience

KEY CONTACT

René Vatoux

Decarbonisation Manager

Lyon airport

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Aerial view (result) – HELYS solar plant

Pedestrian view (result) – HELYS solar plant

ASSESSMENT OF RISK/VULNERABILITY TO CLIMATE CHANGE

SOLUTION

Study carried out with Resallience, in association with Greek-based TT&E consultant S.A, to assess the vulnerability to climate change of the extension to the Olympia Odos motorway, over a 75 km stretch between Patras and Pyrgos (PaPy)

DEPLOYMENT

Client: Olympia Odos
Region: Greece (Patras–Pyrgos stretch)
Budget: €36 K (excl.tax)
Date: 2021

DESCRIPTION

Climate change could aggravate long-term climate parameters involved in operating and maintaining the Patras–Pyrgos stretch, as well as the frequency, intensity and duration of climate shocks (such as floods, heatwaves, etc.). The study sought to assess the risks and/or opportunities of climate change in order to identify whether certain parts of the infrastructure are exposed to any natural hazards.

ADDED VALUE

- Identify and assess climate-related risks including climate change (flooding, landslides, and wildfires) over the duration of the concession in sufficient detail to identify the critical points along the stretch
- Draw up a map summarising the areas at risk to illustrate the infrastructure vulnerability and exposure
- Check the performance of hydraulic structures with respect to daily data on extreme rainfall and reassess peak flows in light of climate change

KEY CONTACT

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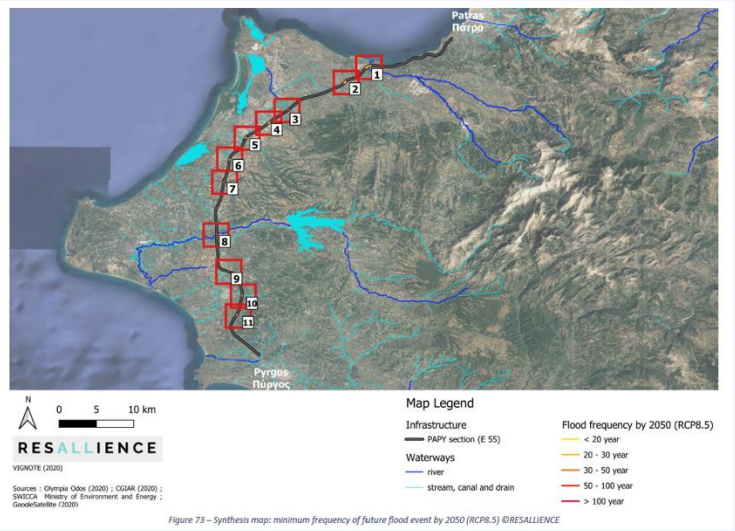

Figure 73 – Synthesis map: minimum frequency of future flood event by 2050 (RCP8.5) ©RESALLIENCE

Simulation and analysis of impact of the infrastructure

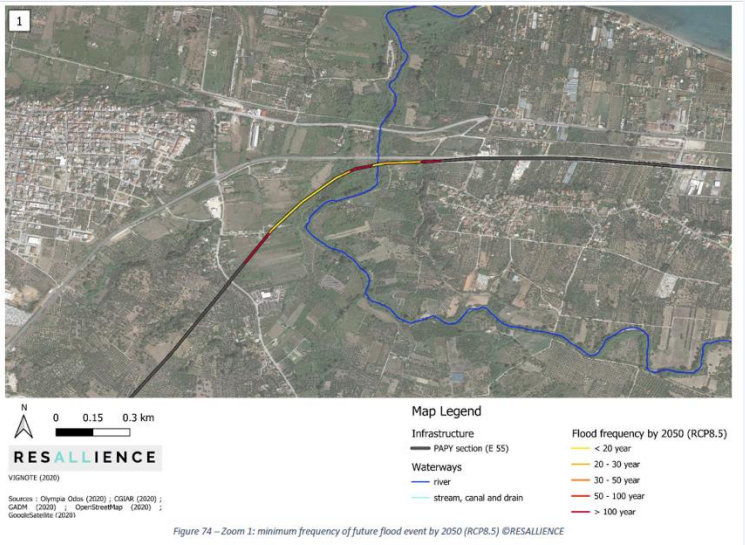

Figure 74 – Zoom 1: minimum frequency of future flood event by 2050 (RCP8.5) ©RESALLIENCE

BIOCALCIS® TREATMENT TO CONSOLIDATE SOILS, BACKFILL AND STONES

SOLUTION

The Biocalcis® process involves injecting bacteria and a calcifying solution into the structure to trigger the formation of calcite in-situ. Biocalcification consolidates treated soils and strengthens structures while also combating the risk of internal erosion and liquefaction. It is able to withstand extreme forces (including floods and earthquakes) and does not reduce the initial permeability of the materials

DEPLOYMENT

Client: Greater Orléans– Engineering Structures Department
Project management: Ingerop – Geos
Date: 2022

DESCRIPTION

This solution was used as part of the work on the René Thinat bridge in Orléans. The northern abutment of the bridge is made up of a reinforced soil wall, however monitoring in 2019 identified significant corrosion on the bridge's steel structure. The Biocalcis process made it possible to repair a section of the wall with grouting, where nails could not be used because the bridge deck is positioned in front of the retaining wall.

ADDED VALUE

- Non-intrusive and quick, the solution involves drilling small holes, so can be used without risk of increasing pressure on the structure and in areas that are hard to access. The reaction takes just a few days to be complete
- Consolidated materials retain their initial characteristics, as the calcium carbonate does not create any obstruction and the permeability remains unchanged after treatment
- Asset management case study: promising characteristics for heritage restoration as the treated stone continues to breathe and the calcite formed is the same as the surrounding stone, so there is no change in colour
- Improved carbon footprint compared with cement-based processes

KEY CONTACT

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Consolidation work on the René Thinat bridge

Biocalcis® used to restore a heritage building

LIMA EXPRESA

SOLUTION

Consolidation work and exercises along the Lima Expresa

DEPLOYMENT

Region: Peru

Date: 2024

DESCRIPTION

VINCI Highways, concession company operating two motorways in Lima via its Lima Expresa subsidiary, is investing to improve climate resilience across its infrastructure. The teams are currently carrying out work to consolidate the banks of the Rímac river that runs alongside the motorway to prevent the risk of flooding, in particular in anticipation of El Niño. It involves shoring up both banks of the Rímac river by installing earth anchors between 6 and 8 m deep and covering the backfill with shotcrete to stabilise the structure. Overall, 100 m of banks either side of the river will be consolidated in this way. The second phase of the project will begin in summer 2024, after the rainy season. It will continue consolidating the backfill by injecting concrete into the piles 2 m below the riverbed and will protect the base of the backfill by laying wear resistant metal plates.

ADDED VALUE

- Minimise the potential impact of flooding, in particular in anticipation of El Niño

KEY CONTACT

Luis Zapata

Manager

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2.3 REPAIR SOLUTIONS

MAINTAINING NOMINAL HYDRAULIC CONDITIONS ON A RIVER-SPANNING STRUCTURE

SOLUTION

Intervention in the event of intense rainfall forecast in order to remove logjams and debris that reduce the capacity of a culvert below its nominal capacity

DEPLOYMENT

Client: VINCI Autoroutes

Region: Escota network

Budget: €3 K (excl.tax)

Date: Recurrent

DESCRIPTION

In southeast France, the A8 motorway cross the Brague coastal river in a series of culverts. This structure was initially designed in the 1950s to be able to handle a 30-year flood. Beyond this level, the motorway finds itself inundated and can no longer be used.

Insufficient maintenance of the riverbanks along the Brague upstream of the motorway can, in the event of flooding, lead to logjams at the entrance to the culverts. When the size of the debris exceeds the diameter of the culverts, they become blocked, reducing their capacity to below their nominal capacity and thereby increasing the probability and frequency with which the motorway is closed due to flooding.

When heavy rain is forecast, a mobile crane is positioned over the culverts and removes the debris and logjams as they accumulate.

ADDED VALUE

- Keep a motorway open, particularly important during extreme weather events to enable emergency services to get around

KEY CONTACT

Blaise Rapior

Chief Executive Officer

ESCOTA VINCI Autoroutes

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Flooding of the A8 motorway when the Brague breaks its banks

Removal of logjams

ENERGY INFRASTRUCTURE

3.1 DIAGNOSTIC SOLUTIONS

CALEDONIA

SOLUTION

CaledonIA is a piece of calculation software that uses artificial intelligence algorithms and integrates rainfall data from Météo-France to simulate urban flooding in real time

DEPLOYMENT

Client: Local authorities, towns, departmental councils, insurers, design offices

Region: France

DESCRIPTION

There is currently no software able to rapidly predict (hour by hour) 3D water flows following flooding in urban areas. National meteorological bodies only forecast rainfall a few days ahead of time, leaving local authorities and water design offices unable to study future scenarios to tackle flood risks arising due to climate change. The tool was used on the A9 to consider the vulnerability of the Gard area with respect to heavy rainfall as episodes in the Cevennes mountain region have already blocked the A9 network in the past. Climate change will only make such extreme weather events increasingly frequent. The study sought to assess the consequences of extreme precipitation along a stretch of the A9 motorway, including the road being submerged, and detect where water will pass and damage infrastructure.

ADDED VALUE

- Identify risks
- Anticipate impact, in particular on users, surrounding areas and infrastructure
- Improve prevention and raise awareness among users
- Prepare crisis management in line with potential impacts
- Support informed decisions regarding the investments required as a priority in a given area

KEY CONTACT

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Scientific Director

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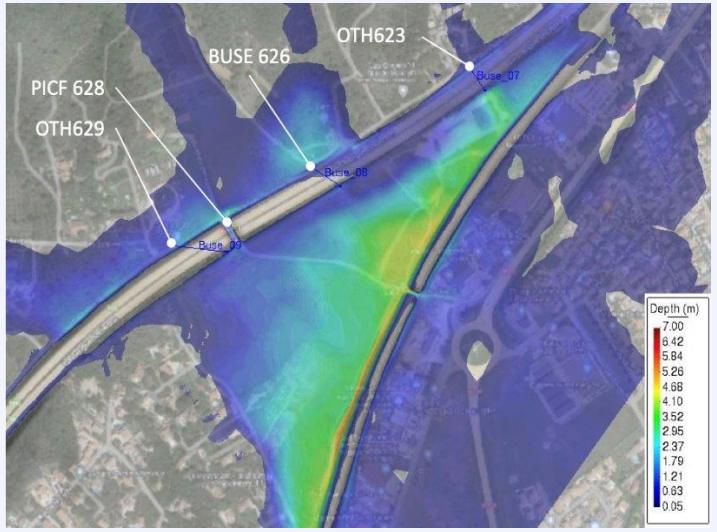
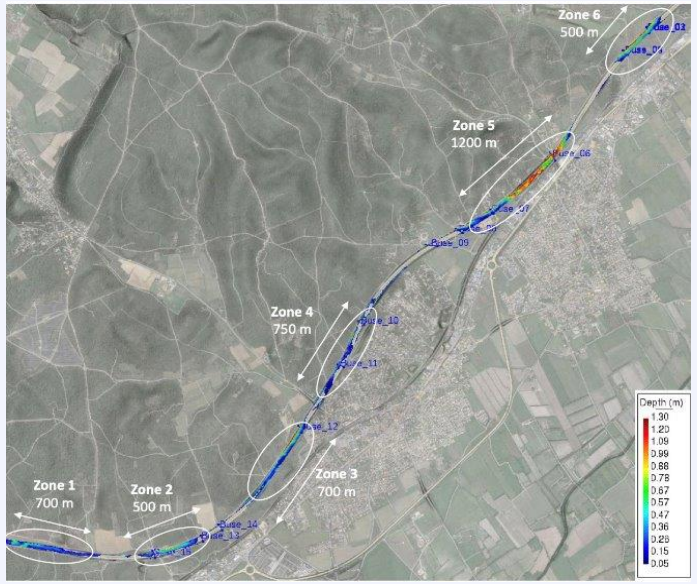
Impact analysis simulation for the A9





SURVEILLANCE AND MONITORING OF NATURAL AND BUILT ENVIRONMENTS

SOLUTION

Solutions to monitor and track climate risk management using ground measurements, airborne measurements, and satellite monitoring

DEPLOYMENT

Client: All
Region: Global
Budget: Dependent on the project
Date: 2019-22, 2021-23

DESCRIPTION

Technological surveillance solutions using remote detection or sensors are rolled out to monitor the impact of extreme weather conditions and track the variations over time in order to implement the right adaptation measures at the right time. They help steer the management of climate risks at a given point in time, check their prevalence over the medium term and plan adaptation strategies. This type of solution was applied to tackle the coastal erosion along the coast at Saint Louis in Senegal (OSS project supported by the French space agency and the United Nations) and is set to be replicated in neighbouring coastal countries. It was also used to study erosion and sediment build-ups in Kazakhstan by putting in place nature-based adaptation solutions, in particular by planting saxauls.

ADDED VALUE

- Assess changes in climate risks
- Bolster the most vulnerable adjustment variables
- Boost resilience across the region as a whole

KEY CONTACT

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Team Leader and Expert in DPR

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Aerial view of Saint Louis, Senegal

Current readings for monitoring/RESALLIENCE

DIAGNOSIS OF RESILIENCE PERFORMANCE (DPR)

SOLUTION

Systematic modelling tool that studies all climate hazards affecting infrastructure, projects and the economy of a given region. It assess the losses and damage induced by climate hazards, as well as the investment required to reduce the losses and damage

DEPLOYMENT

Client: Regional authorities, property asset managers
Region: Global Date: 2021
Budget: Dependent on the project

DESCRIPTION

There are four versions of the DPR, depending on the area studied:

- The City, Area and Region DPR, which focuses on the critical infrastructure as well as the interconnections at play. The tool was applied to the city of Tetouan in Morocco.
- Island States DPR to systemically model climate risks across these states where critical zones (such as electricity grid, telecoms networks, water supply networks as well as airports) are studied in order to anticipate the social and economic impact. It was used in Dominica and Barbados.
- Building DPR, for asset and property managers interested in the interconnections within a building and its surrounding environment. This version was rolled out for CDC-Habitat (France) and AEW (France and Europe).

ADDED VALUE

- Understanding of interconnections in a given space
- Visibility of areas for improvement
- Decision aid

KEY CONTACT

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Exposure of buildings in the capital of a Caribbean island state to flooding/RESALLIENCE

PLATFORM TO ASSIST WITH PREDICTIVE MAINTENANCE DECISIONS IN INDUSTRIAL FACILITIES

SOLUTION

Development of a platform and an operational tool to anticipate and manage climate risks as well as predictive maintenance for infrastructure and industrial facilities

DEPLOYMENT

Client: Businesses and manufacturers
Region: Global
Date: 2021/2022-2023
Budget: Dependent on the project

DESCRIPTION

Two examples of where this solution was put in place include: 1) developing the STORM tool for AXIONE to anticipate needs for predictive or curative maintenance as well as investments in the fibre optic network across several departments 2) modelling the impact of KATCO pipelines in Kazakhstan being covered in sand (see monitoring solution).

Businesses and manufacturers can be assisted if based in areas potentially affected by climate risks.

ADDED VALUE

- Assess changes to infrastructure and industrial facilities with respect to climate change
- Anticipate and plan maintenance and investment required

KEY CONTACT

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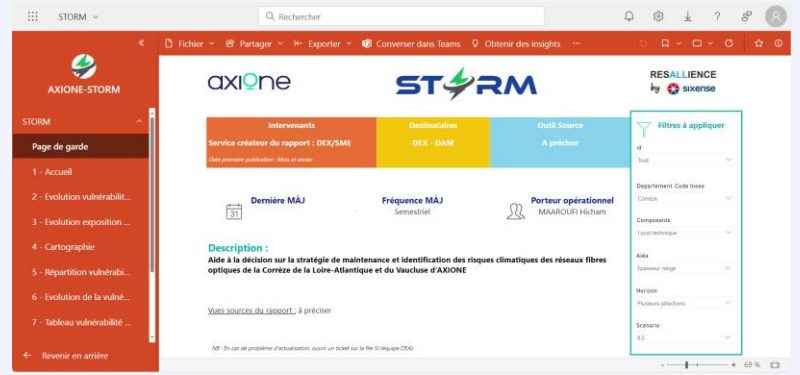


STORM/RESALLIENCE platform

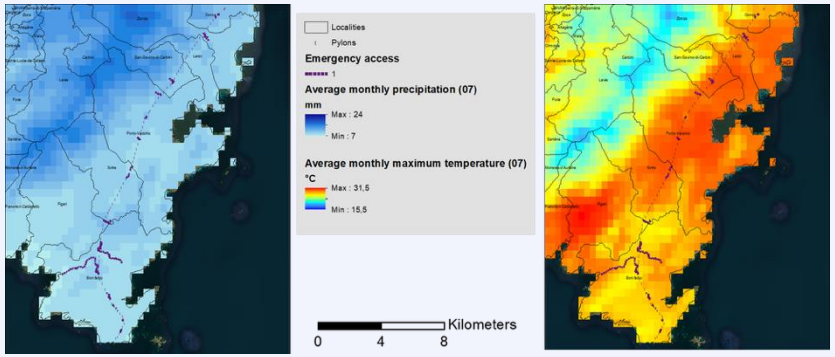
MODELLING AND MONITORING WILDFIRE RISKS

SOLUTION

Solution developed in collaboration with VINCI Energies to track and model the risk of wildfires

DESCRIPTION

This solution was developed to identify the breakout of fires using video surveillance technology, enabling electric grid managers to rapidly implement actions to avoid damage to the network. It makes it possible to model the most critical routes to then put in place suitable solutions. This solution won the second edition of the RTE Suppliers Awards in 2022 and was rolled out in Corsica.



Modelling wildfire risks and implementing a monitoring system/RESALLIENCE

ADDED VALUE

- Monitor the state of forests in real time and the breakout of wildfires
- Enable localised prevention of wildfire risks
- Provide a more rapid, targeted response to areas likely to see fires break out

KEY CONTACT

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DEPLOYMENT

Client: Regional authorities, businesses and manufacturers
Region: Global Date: 2022
Budget: Dependent on the project

3.2 PREVENTION SOLUTIONS

OCEAN THERMAL ENERGY

SOLUTION

Exploiting heat energy from the sea to heat buildings

DEPLOYMENT

Client: **Public and private sector**

Region: **Global**

DESCRIPTION

Conventional air source and geothermal heat pumps used to power heating, air conditioning and hot water in buildings present certain limitations. These systems often face challenges such an unsuitable geology, limited space or regulatory restrictions, especially in densely populated urban areas and coastal regions. Ocean thermal energy recovers energy from the sea near ports using heat pumps to heat and cool neighbouring buildings.

ADDED VALUE

A submerged heat exchanger provides an effective, sustainable source of energy with minimal impact on the environment.

The aim is to decarbonise and eliminate visual and noise pollution from air and water source heat pumps.

KEY CONTACT

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Energy Project Manager

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RAISING ELECTRIC CHARGING POINTS

SOLUTION

Installation of public direct current charging facilities in a flood zone

DEPLOYMENT

Client: **Circle K Norge AS**
Region: **Lillehammer, Norway**
Budget: €1 M
Date: **01/04/2022**

DESCRIPTION

The client wished to install direct current rapid charging facilities, with 12 charging points each able to supply up to 300 kW of power in a location exposed to flooding in Lillehammer, Norway. Despite the risk of flooding, the client wished to go ahead because of the high visitor density in the area. We therefore chose to raise the level of the ground where the infrastructure was installed, using autonomous chargers and a ditch at the base to make the facilities easier to dismantle and move if necessary. The entire system was put to the test during a flood in autumn 2023, and the results were published in the second edition of the Omexom magazine.

ADDED VALUE

- Enable charging facilities to be built in popular areas subject to flooding, increasing profits and the client's market share
- Protect expensive equipment from damage caused by flooding while reducing the impact on the environment and avoiding having to replace the facilities
- Reduce CO_2 emissions by installing charging infrastructure in areas where it would otherwise not be possible

KEY CONTACT

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Project and Service Manager

VINCI Omexom E-mobility Oslo

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Flooding in 2023, the facilities remained safe

BIOCLIMATIC RENOVATION OF AN OFFICE BUILDING – WOW

SOLUTION

WOW is an office block spanning 11,356 m² in which bioclimatic design was applied, cutting the carbon footprint by 22% compared with conventional designs. The building envelope and technical components were upgraded, especially with regards comfort during the summer period

DEPLOYMENT

Region: Paris, 18th arrondissement
Date: 2019-2024

DESCRIPTION

This building, located in the heart of the Montmartre district of Paris, was acquired by VINCI Immobilier in 2019. It housed the Magasin Dufayel, a former department store similar to Galeries Lafayette at the time. Construction on the building began in 1856.
Given the building's new purpose as offices, "The Better Way" approach was taken as it will help to make the building more flexible, with modular spaces, and adapt the thermal design depending on the area and the needs. The building's Eiffel structure was brought out in the works, leaving it exposed, along with other technical elements.

ADDED VALUE

- Reassert the value of an exceptional piece of architecture to give it a new lease of life
- Cut the carbon impact of the work
- Create a living space in this building steeped in history

KEY CONTACT

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Programme Manager

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Facade, Rue de Clignancourt

Office floor

Rooftop

HELYS PROJECT – SOLAR CARPORTS

SOLUTION

Working with Neoen and Sunmind (subsidiary of VINCI Concessions) deployment of solar carports at Lyon-Saint Exupéry airport in order to decarbonise its Scope 3 emissions, capitalise on its land, anticipate future regulatory requirements and improve passenger comfort. Third-party investor project, formalised with a temporary occupation permit (AOT)

DEPLOYMENT

Client: Lyon airport

Region: Colombier-Saugnieu

Budget: 0 (investor portion)

Date: 2021-2025

DESCRIPTION

Lyon airport has a vast expanse of overground parking space. The idea is to take advantage of a portion of this space to install a photovoltaic production unit and inject 20 MWp of power, over around 14 hectares of car park space.

ADDED VALUE

- Annual production of around 25,000 MWh of renewable electricity injected into the ENEDIS network
- Annual payments received by the airport
- Net addition of parking spaces by redesigning the car parks
- Help to meet future regulatory requirements (anticipation)
- Limit the urban heat island effect caused by car park asphalt
- Protect vehicles and pedestrians (from rain and sun), improving the passenger experience

KEY CONTACT

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Aerial view (result) – HELYS solar plant

Pedestrian view (result) – HELYS solar plant

DRINKING WATER PRODUCED USING AIR AND SOLAR ENERGY

SOLUTION

Production of cool drinking water without any connection to the water supply or electricity grid

DESCRIPTION

System producing cool drinking water (between 10 and 15 l/day with two hydro-panels) using only condensation and solar energy

ADDED VALUE

Autonomous and sustainable system:

- Zero greenhouse gas emissions
- Zero underground water take
- >90% of materials used to produce the unit can be mass recycled

KEY CONTACT

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Technical Director

Olympia Odos

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DEPLOYMENT

Client: Olympia Odos

Region: Greece

Budget: €10 K pre-tax/unit

Date: 2021

FLOATING OFFSHORE WIND PROJECT STUDY

SOLUTION

Solutions to build floating wind turbines: 100/200 m tall, quadruped, each branch 90 m long, with the intention to do everything possible to minimise weight by limiting the use of excess material

DEPLOYMENT

Client: VCGP

Region: Le Havre, France

Date: 2022

DESCRIPTION

The sheer scale of offshore wind turbines means the infrastructure to support them are also gigantic. This needs to be taken into account when they are being built on land, along with the marine environment, while also reducing the size of production facilities. This study was carried out to address the relative lack of land available and to avoid affecting the seabed.

ADDED VALUE

Reduction in land use conflicts, improved energy performance (offshore winds are generally stronger and more consistent than on land, meaning more constant, higher levels of electricity generation), flexibility as more vast potential locations, and reduction on the impact on the seabed.

KEY CONTACT

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Technical Director

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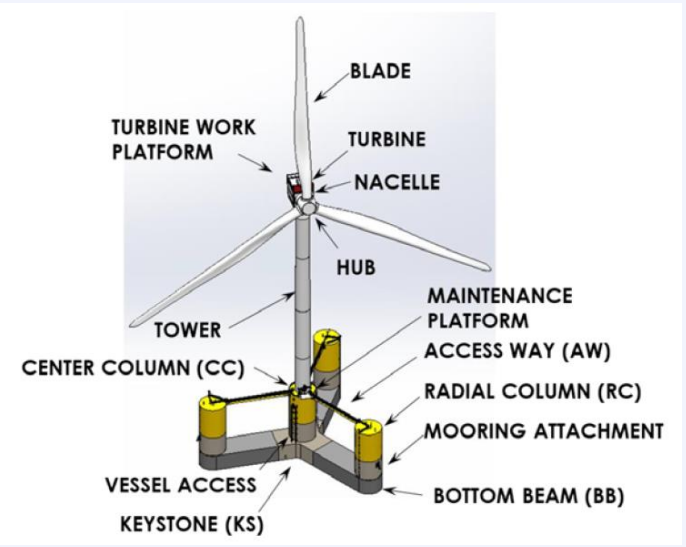
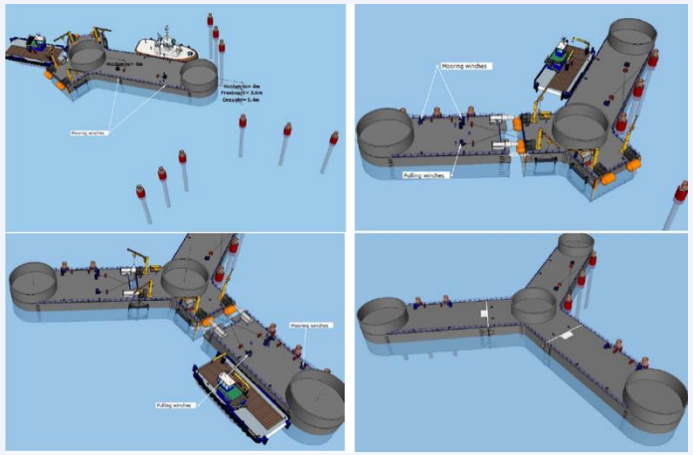


Overview



Assembly of floating components

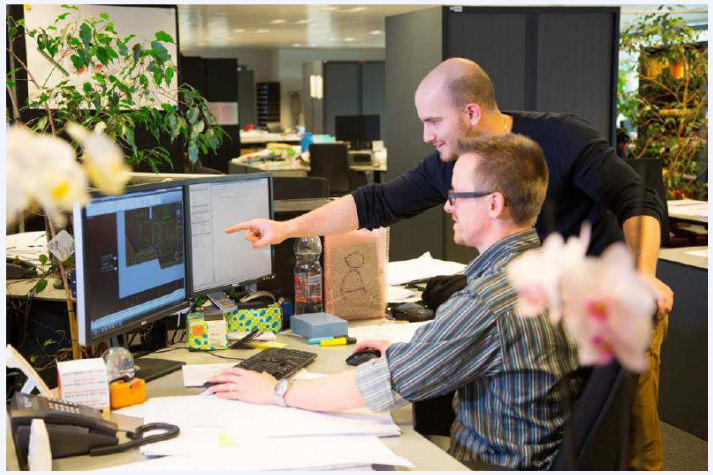
ENGINEERING TO MECHANICALLY SECURE THE RTE NETWORK

SOLUTION

Mechanically secure the RTE network

DESCRIPTION

As part of efforts to mechanically secure the RTE network, Omexom carries out studies on widening forest trenches, erecting anti-cascading towers and bolstering existing structures.



ADDED VALUE

- Bolster the climate resilience of electric transmission lines across the entire RTE network over a 15-year period

KEY CONTACT

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DEPLOYMENT

Client: RTE

Region: France

BURYING THE GRID

SOLUTION

Burying cables to secure the grid

DESCRIPTION

Work to bury the grid in urban and rural areas.
Creation of a 63 kV underground connection over 6 km.

After storm Martin in 1999 and Klaus in 2009, RTE has pursued efforts to secure the grid, which involves burying cables.

DEPLOYMENT

Client: RTE

Region: Landes, France

Budget: €2.2 M

Date: 2017-2019

ADDED VALUE

- Increase safety
- Reduce disruption
- Enhance electricity resilience during hazards

KEY CONTACT

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Account Manager

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EVE™, NON-INTRUSIVE VIBRATION ANALYSIS TO ASSESS STRUCTURAL CONDITION

SOLUTION

EVE™, non-intrusive vibration analysis to assess structural condition

DESCRIPTION

The EVE™ method, which involves measuring dynamic parameters of a structure using ambient noise and assessing the condition of the structure (ageing, damage) as well as how it interacts with the ground.

ADDED VALUE

- The EVE™ method helps assess structures subject to intense winds without damaging the structure.

KEY CONTACT

Charles Govin

Business Development Manager

VINCI Energies Omexom

DEPLOYMENT

Client: Swissgrid

Region: Auvergne-Rhône Alpes, France

Budget: €30 K

Date: 2017

BUILDING MANAGEMENT SYSTEM

SOLUTION

Offloading thermal systems

DEPLOYMENT

Client: Tertiary buildings

Region: Europe

Budget: All budgets

DESCRIPTION

In extreme heat (e.g. exceeding 35°C), it may be necessary to offload certain non-critical zones to prioritise critical areas. The solution comprises a central remote command system operating electric distribution equipment.

ADDED VALUE

- This solution makes it possible to adopt a fail-soft operating plan. The building resumes "normal" operations when the outside temperature falls below a given level.

KEY CONTACT

Pierre Megret

Smart Building Project Manager

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SHORT-CIRCUIT EV CHARGING

SOLUTION

A solution for renewable energy production and storage for commercial buildings

DEPLOYMENT

Client: Tertiary buildings
Region: France
Date: 2022

DESCRIPTION

This solution to produce and store renewable energy for commercial buildings was designed to enable users to become less reliant on the conventional electric grid by generating green energy directly in the tertiary building via photovoltaic panels.

The solution demonstrator was installed at the Demouselle Tertiaire Pas-de-Calais site in Boulogne-sur-Mer, with the following characteristics: 125 m² of rooftop photovoltaic cells, equating to 70 panels producing 23 kW of power. The panels weigh 15 kg per m². In order to avoid losing the energy produced, it is stored in used car batteries (Nissan LEAF), offering capacity of 20 kW. Installation of an EV charging point in the car park to recharge the corporate EV fleet, as well as visitor EVs. Smart management to steer energy via the WAVE platform operated by VINCI Energies Smart Building Energies.

ADDED VALUE

- This self-sufficient production/consumption loop makes it possible to take advantage of a constant energy source thanks to the storage solution. Indeed, this system covers 80% of total consumption. The solution has had a direct benefit, cutting the electricity bill at the site by 80%.

KEY CONTACT

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Example of a solution for renewable energy production and storage for commercial buildings

WASTE HEAT RECOVERY FROM A REFRIGERATION UNIT

SOLUTION

Recovering waste heat from refrigeration systems

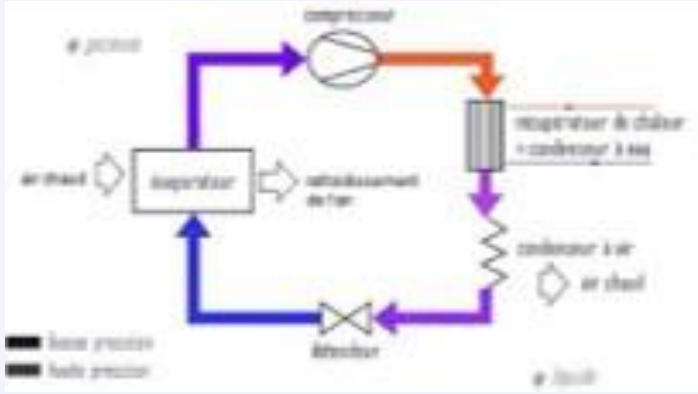
DEPLOYMENT

Client: manufacturing, data centers, hospitals, swimming pools and large retail spaces
Region: France

DESCRIPTION

It is in the evaporator of a refrigeration system that the liquid refrigerant absorbs heat and cools the enclosed environment. This waste heat is evacuated using a condenser. Large quantities of waste heat could be recovered using several effective processes well-known to refrigeration engineers. Financial support (i.e. CEE, CPE) is available.

The solution involves putting in place an air-cooled or water-cooled refrigeration unit with a heat recovery system, where the unit consumes electricity to produce a cooling effect, thereby emitting heat, which can be recovered rather than being allowed to dissipate. This heat can then be reinjected into the building heating network.



ADDED VALUE

- In manufacturing, the processes often operate continuously, and buildings and domestic water are heated
- In data centers, energy is recovered and directed towards heat networks
- In hospitals, swimming pools, large retail spaces, and ice rinks, the potential for internal recovery is assessed

KEY CONTACT

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Operations Coordinator

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AUTOMATIC PHOTOVOLTAIC INSTALLATIONS

SOLUTION

Automatic photovoltaic installations

DEPLOYMENT

Client: Tertiary buildings
Region: Alsace
Date: 2022

DESCRIPTION

The client wished to become self-sufficient in electricity in order to operate a sanding system on a site that was off grid. They also wanted to reduce their dependency on fossil energy while improving their carbon footprint. The project involved installing a photovoltaic system combined with the existing diesel generator and a set of systems to regulate energy distribution and storage in batteries.

ADDED VALUE

- The photovoltaic panels produce energy when the sun shines, while any surplus is stored in batteries. It may then be used by the facility at a later stage, as required, and the diesel generator is only used during extreme peaks in demand.
- As solar-powered systems generate less energy during the winter months, the management system automatically regulates and activates the system (PV panels + generator).

KEY CONTACT

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Account Manager

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PHOTOVOLTAIC AWNING

SOLUTION

Installation of an awning composed of photovoltaic panels in order to avoid offices from overexposure to the sun and produce green energy

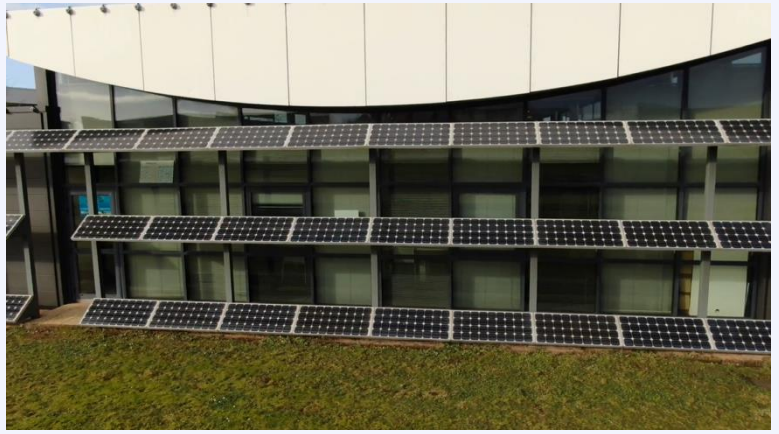
DEPLOYMENT

Client: Tertiary buildings
Region: France

DESCRIPTION

To address the problem caused by office windows receiving too much sunlight, a set of photovoltaic panels were installed as an awning.

This initiative has made it possible to sell €40,000 worth of electricity back to EDF. At the same time, it has saved 6 tonnes of CO_2 from being emitted into the atmosphere.



ADDED VALUE

- Project amortisation over 7 years, as forecast, due to the system generating an average revenue of €4,000 per year

KEY CONTACT

Alexis Davou

QSE Correspondent/Lead

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KABERTENE – WIND FARM

SOLUTION

Construction of a wind farm able to resist extreme temperatures

DESCRIPTION

Turnkey delivery of the first wind farm in Algeria in the Sahara desert. Integration of 12 850 kW GAMESA wind turbines operating in temperatures of 50°C. This means power electronics need to be of a specific size and integrate electrical equipment (medium-voltage units, transformer and main generator panel) in air-conditioned buildings.

ADDED VALUE

- Resistance of facilities to extreme temperature conditions
- Resilient infrastructure able to handle extreme heat

DEPLOYMENT

Client: SONELGAZ
Region: Adrar region, Algeria
Budget: €20 M
Date: 2011-2014

KEY CONTACT

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FACILITATING ACCESS TO ELECTRICITY USING MICRO-GRIDS

SOLUTION

Facilitating access to electricity using micro-grids

DESCRIPTION

Design, construction, operation and maintenance of 1,360 off-grid systems. Each site is equipped with 1.28 kWp photovoltaic panels, 3 kWh batteries and solar inverters. Each home is equipped with 3 lamps and 2 power sockets. Each system can generate up to 45 kWh per month. This solution has brought electricity to 1,353 homes and 7 community centres that are not connected to the grid.

Ilumina Pantanal, a micro-grid project in Brazil, was recognised at the Solar & Storage Live Awards 2021 that took place in Birmingham (UK) as one of the "International Solar and/or Storage Project of the Year".

DEPLOYMENT

Client: CELPA – CENTRAIS ELÉTRICAS DO PARÁ S.A.

Region: Tucuruí – state of Pará, Brazil

Budget: €5.3 M

Date: 2018-2020

ADDED VALUE

- Low cost
- Environmentally friendly

KEY CONTACT

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PROTECTING ELECTRICAL SUBSTATIONS

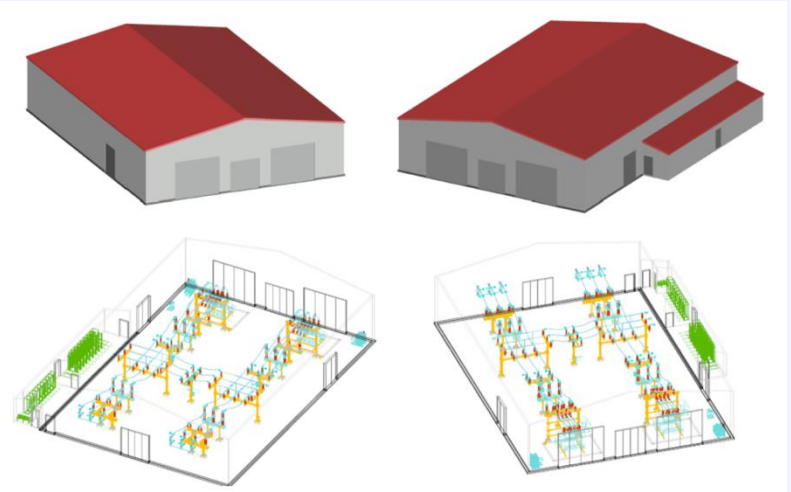
SOLUTION

Electrical substation protected under a wood structure to cause the least impact possible on the environment

DESCRIPTION

A 50/10kV (72.5/12 kV) substation from the 1950s and fitted with equipment from the 1960s is deemed to have reached the end of its useful life and needs to be replaced by a new substation.

This wooden weather protection means we can reduce the amount of dynamite, backfill and concrete used. When the substation is protected against bad weather, maintenance can be reduced and the climate has a lesser impact on equipment, thereby likely extending their useful life. Moreover, the resistance of the metal structure may be reduced as it is less exposed to the wind and bad weather, and therefore less metal is required in the foundations.



ADDED VALUE

- Use fewer materials
- Natural insulation
- Protection against climate risks

DEPLOYMENT

Client: All

Region: Global

Budget: Dependent on the project

KEY CONTACT

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Project Manager

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3.3 REPAIR SOLUTIONS

POST-CYCLONE REBUILDING AND ADAPTATION

SOLUTION

Resilient reconstruction of electrical grids: burying cables and bolstering networks, raising structures and installing new transformers

DEPLOYMENT

Client: EDF-SEI

Region: Saint Martin and Saint Barts (French-speaking Caribbean)

Budget: €12.8 M

Date: 2018-2021

DESCRIPTION

After the electrical grids on the North Islands were destroyed by Storm Irma in 2017, EDF and the local authorities decided to rebuild a resilient network to protect against the rising water levels caused by violent winds. The project was carried out with local teams as part of the emergency response.

ADDED VALUE

- Protect infrastructure and deal with the intensification of extreme weather events in the region, protect the grid against subsequent cyclones

KEY CONTACT

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Damage sustained by the grid in 2017

4. WATER INFRASTRUCTURE

4.1 DIAGNOSTIC SOLUTIONS

CALEDONIA

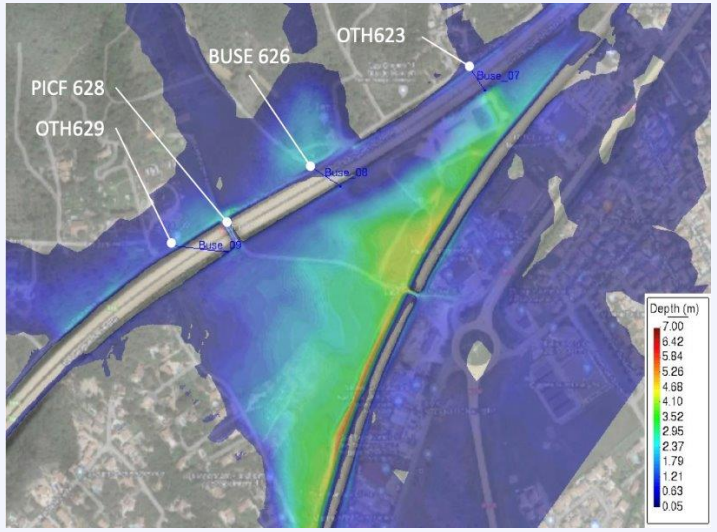
Impact analysis simulation for the A9

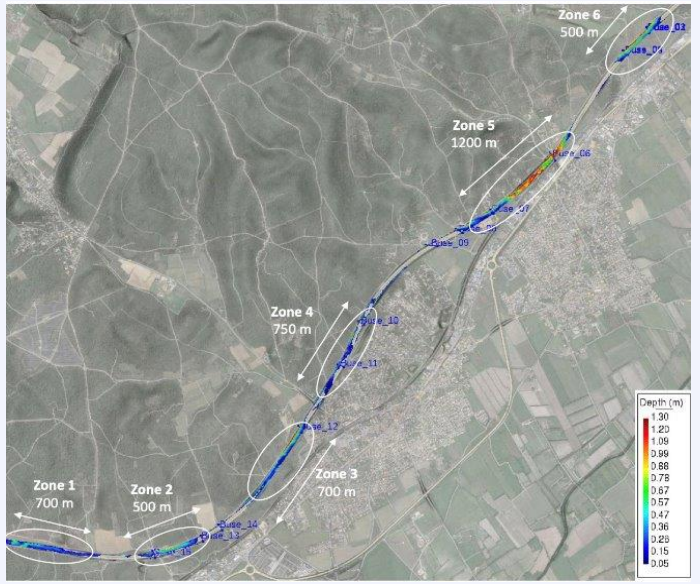
SOLUTION

CaledonIA is a piece of calculation software that uses artificial intelligence algorithms and integrates rainfall data from Météo-France to simulate urban flooding in real time

DESCRIPTION

There is currently no software able to rapidly predict (hour by hour) 3D water flows following flooding in urban areas. National meteorological bodies only forecast rainfall a few days ahead of time, leaving local authorities and water design offices unable to study future scenarios to tackle flood risks arising due to climate change.
The tool was used on the A9 to consider the vulnerability of the Gard area with respect to heavy rainfall as episodes in the Cevennes mountain region have already blocked the A9 network in the past. Climate change will only make such extreme weather events increasingly frequent. The study sought to assess the consequences of extreme precipitation along a stretch of the A9 motorway, including the road being submerged, and detect where water will pass and damage infrastructure.





DEPLOYMENT

Client: Local authorities, towns, departmental councils, insurers, design offices

Region: France

ADDED VALUE

- Identify risks
- Anticipate impact, in particular on users, surrounding areas and infrastructure
- Improve prevention and raise awareness among users
- Prepare crisis management in line with potential impacts
- Support informed decisions regarding the investments required as a priority in a given area

KEY CONTACT

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Scientific Director

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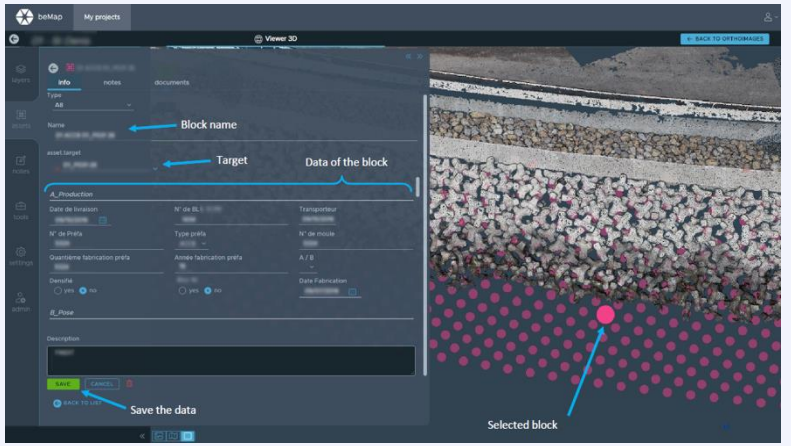
DIAGNOSTIC AND MONITORING EMBANKMENTS – CARAPACE

SOLUTION

3D modelling solution for embankments: building a digital twin to measure movement of blocks and check the state of the embankment with respect to degradation, land settling, strong swells, etc.

DESCRIPTION

- A patented 3D reconnaissance tool to analyse embankments and blocks (bathymetric and aerial readings)
- An asset management platform to monitor structures over the long term, centralising data and decisions in order to compare positions and movements of blocks in the embankments following hazards
- Two main use cases have been identified – supporting design offices in designing (simulations) and building embankments and improving reliability of checks; and monitoring the state of embankments given continuous and extreme degradations and reporting any non-compliance



Embankment monitoring platform

ADDED VALUE

- Effectively target maintenance
- Ensure the safety of the structure and therefore the regions they protect against the risk of coastal erosion, rising water levels and violent climate hazards such as cyclones

KEY CONTACT

Elisabeth Gardon

Department Lead

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DEPLOYMENT

Client: All

Region: Primarily France and the Middle East

Budget: All budgets

Date: Since 2019

Visualisation of movements within the embankment, block by block

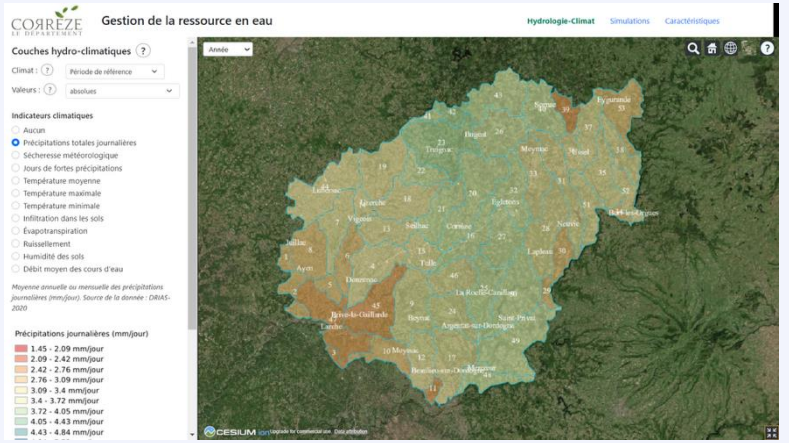
RESIL'ADAPT WATER

SOLUTION

A resilient concerted water management tool to adapt the way water is used in a given area according the future forecast scenarios

DESCRIPTION

This solution involves modelling areas with too much or too little water. The modelling is then combined with ideas to improve or change uses to adapt resource management to climate change. Different action levers, especially nature-based solutions, are trialled to offset the water deficit, such as adaptation solutions. The solution was applied to two areas with different terrain profiles – the Corrèze department (central southwest France) and the region of Borana in Ethiopia.



Example of the solution in use in Corrèze, France/RESALLIENCE

DEPLOYMENT

Client: All clients whose operations depend on the availability of water, especially regional authorities and property concession companies

Date: 2022-23

ADDED VALUE

- Identification of zones with the most severe deficits in available water reserves by use
- Visualisation of the geographic spread of trends from potential scenarios
- Decision aid

KEY CONTACT

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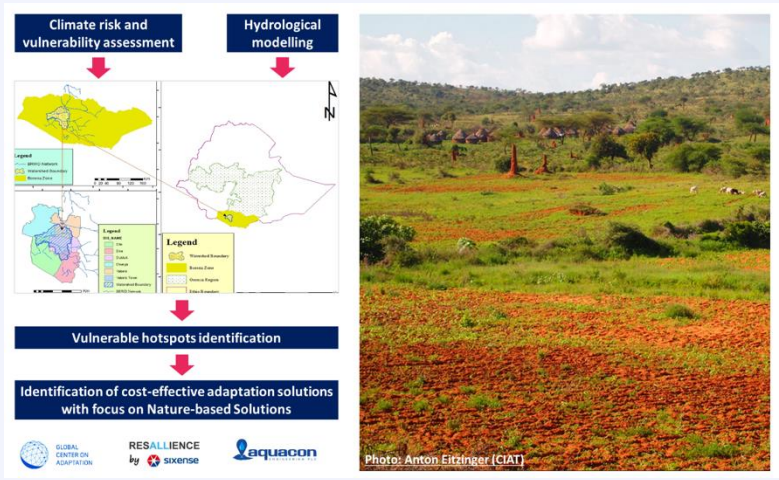


Example of the solution in use in Borana, Ethiopia/RESALLIENCE

RESIL HEAT ISLAND

Modelling heat islands/RESALLIENCE

SOLUTION

Comprehensive simulation and modelling of climate hazards (extreme heat, flooding, coastal erosion, etc.) using climate data, ground measurements and airborne measurements, as well as high-precision satellite monitoring

DEPLOYMENT

Client: All

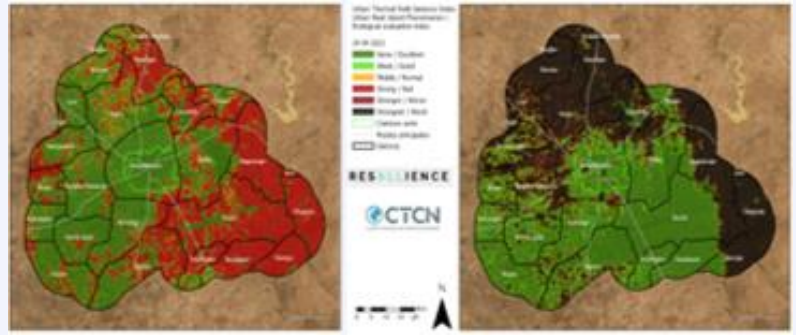
Region: Global

Budget: Dependent on the project

Date: 2021-22

DESCRIPTION

Climate data help simulate and model past and future climate hazards all throughout the world. Enriching these data with ground measurements or Earth observation techniques (satellite measurements) serves to calibrate and fine-tune modelling to better manage climate risks. This solution was successfully applied to rising sea levels and coastal flooding in Saint Louis in Senegal (OSS Saint Louis project with input from the Space Climate Observatory). It was also used to study erosion and sediment build-ups in Kazakhstan by putting in place nature-based adaptation solutions (planting saxauls) for an industrial client. This solution can be replicated and adapted to different geographic regions and hazards to help manage climate and environmental risks.



ADDED VALUE

- Precisely and comprehensively assess climate risks using a combination of multiple data sources
- Anticipate future changes with reliable predictive modelling
- More effectively manage climate risks by harnessing the decision aid

KEY CONTACT

Mario Al Sayah

Expert on climate indicators and Earth observation

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DIAGNOSIS OF RESILIENCE PERFORMANCE (DPR)

SOLUTION

Systematic modelling tool that studies all climate hazards affecting infrastructure, projects and the economy of a given region. It assess the losses and damage induced by climate hazards, as well as the investment required to reduce the losses and damage

DEPLOYMENT

Client: Regional authorities, property asset managers
Region: Global Date: 2021
Budget: Dependent on the project

DESCRIPTION

There are four versions of the DPR, depending on the area studied:

- The City, Area and Region DPR, which focuses on the critical infrastructure as well as the interconnections at play. The tool was applied to the city of Tetouan in Morocco.
- Island States DPR to systemically model climate risks across these states where critical zones (such as electricity grid, telecoms networks, water supply networks as well as airports) are studied in order to anticipate the social and economic impact. It was used in Dominica and Barbados.
- Building DPR, for asset and property managers interested in the interconnections within a building and its surrounding environment. This version was rolled out for CDC-Habitat (France) and AEW (France and Europe).

ADDED VALUE

- Understanding of interconnections in a given space
- Visibility of areas for improvement
- Decision aid

KEY CONTACT

Didier Soto

Team Leader and Expert in DPR

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Exposure of buildings in the capital of a Caribbean island state to flooding/RESALLIENCE

BIODI(V)STRICT

Biodi(V)strict
Urbalia & AgroParisTech

SOLUTION

Biodi(V)strict® is a diagnostic and decision-making tool that improves the biodiversity potential of urban and peri-urban development projects

DEPLOYMENT

Client: Property developers/urban planners/asset managers

Region: France

Budget: variable (type, surface)

DESCRIPTION

Biodi(V)strict® is a piece of computer software codeveloped by Urbalia and AgroParisTech, operating using Geographic Information System maps via QGIS. This tool helps assess the potential impact of a project on biodiversity, in comparison with the initial site and/or other development scenarios by calculating five indicators. By considering these indicators and comparing the before/after scenarios, it is possible to identify the main sources of pressure on the site in terms of biodiversity, as well as its strengths.

ADDED VALUE

- A quantified measurement of urban biodiversity – before/after
- Easy-to-understand indicators
- Quantitative and spatial data of natural habitats
- A dynamic tool that rapidly simulates various scenarios

KEY CONTACT

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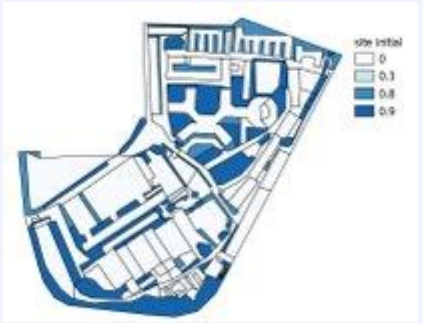

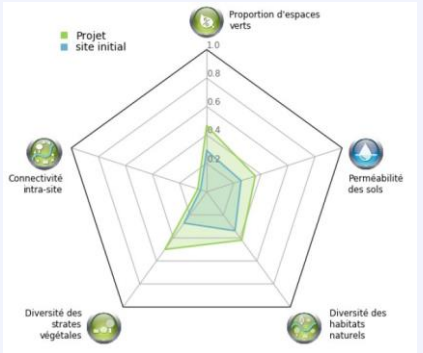

URBALIA – ECOLOGICAL ASSET DIAGNOSTIC

SOLUTION

Ecological diagnostic of built and landscaped assets, analysis of impact on biodiversity and implementation of an action plan to improve the ecological potential

DEPLOYMENT

Client: RIVP Date: 2021-2022
Region: Paris

Budget: variable according to the missions and surface concerned

DESCRIPTION

Urbalia drew up an inventory of the assets owned by RIVP, a social housing organisation in Paris (with more than 450 sites around the French capital), to identify the areas of improvement with the greatest potential. The aim was then to launch new development/maintenance contracts to put in place tangible actions on the sites identified.

ADDED VALUE

- Implement relevant and effective "biodiversity" indicators
- Produce a comprehensive and quantified inventory
- An overall approach – from diagnostics to launching new contracts
- Three new contracts put in place (differentiated management of outdoor spaces, creation of new semi-intensive green roofs, maintenance of existing green roofs)

KEY CONTACT

Arthur Tullou

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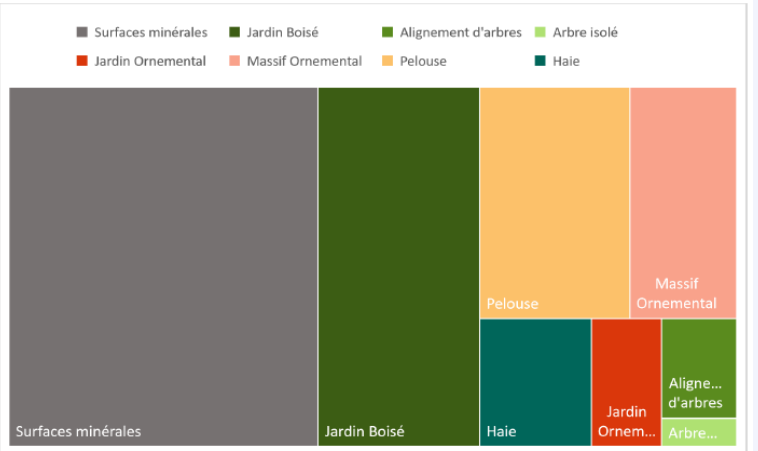

Surface proportions of landscaped developments

Green roof, RIVP asset

BI2O

SOLUTION

Bi2O is a tool that assesses and compares the environmental performance of development project

DEPLOYMENT

Client: All VINCI companies
Region: Primarily France
Budget: variable

DESCRIPTION

Bi2O assesses development projects by tracking and quantifying environmental improvements, particularly in terms of rainwater management, reduction in the urban heat island effect and biodiversity. The tool compares different versions of the same project with the existing situation. It can be used during the proposal stage as well as during the project design stage. Bi2O makes it possible to promote the Revilo service, as well as other products and processes, to clients.

ADDED VALUE

- Objective, intelligible indicators
- A distinguishing approach
- Rapid assessment

KEY CONTACT

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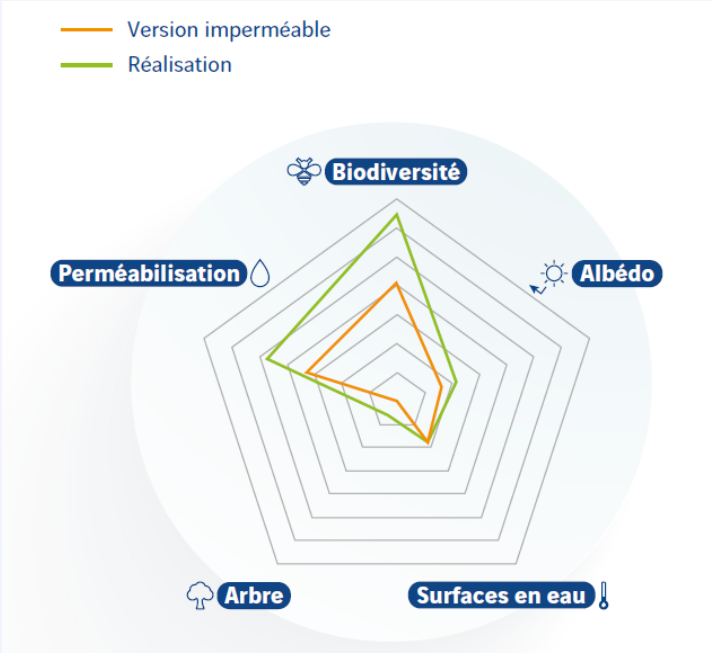

4.2 PREVENTION SOLUTIONS

OCEAN THERMAL ENERGY

SOLUTION

Exploiting heat energy from the sea to heat buildings

DESCRIPTION

Conventional air source and geothermal heat pumps used to power heating, air conditioning and hot water in buildings present certain limitations. These systems often face challenges such an unsuitable geology, limited space or regulatory restrictions, especially in densely populated urban areas and coastal regions. Ocean thermal energy recovers energy from the sea near ports using heat pumps to heat and cool neighbouring buildings.

ADDED VALUE

A submerged heat exchanger provides an effective, sustainable source of energy with minimal impact on the environment.

The aim is to decarbonise and eliminate visual and noise pollution from air and water source heat pumps.

KEY CONTACT

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Energy Project Manager

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DEPLOYMENT

Client: Public and private sector

Region: Global

ENVIRO MAT GEOTEXTILE – PROTECTION AGAINST EROSION ALONG COASTS AND RIVERS

SOLUTION

Geoquest provides a range of solutions to protect coastlines and waterway banks from erosion caused by rising water levels and increasingly frequent extreme weather events. It involves a geotextile formwork mattress filled on site with concrete and/or geotubes pumped full of sand

DEPLOYMENT

Client: Local authorities, transport and industrial infrastructure concession companies
Region: Global
20 or so projects

DESCRIPTION

The flexible formwork mattress is made of high tenacity polyester woven geotextile, which helps to shape and enhance the look of the slope. The geotubes are also made from woven geotextile to create embankments or rebuild coastlines or riverbanks. It offers an alternative, sustainable solution to protect against erosion that can be used in many situations, for example to protect areas against erosion including riverbanks, as well as embankments, coastal defence structures, as well as impervious surfacing work for reservoirs and canals.

The formwork mattress has for example been used to protect an industrial platform against erosion from waves off the coast of Moheshkhali, Bangladesh.

ADDED VALUE

- Reduce soil erosion and limit water speed
- Certain solutions help to promote biodiversity by creating an environment that supports vegetation and ecological diversity while also improving the aesthetic of the space
- This solution is less expensive, requires fewer resources to install and boasts a lower carbon footprint compared with conventional solutions (riprap or precast concrete blocks)

KEY CONTACT

Thomas Joussellin
Chief Technical Officer

Geoquest
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REVILO

SOLUTION

A solution to combat urban heat islands and bring more nature back into the city through a four-pronged approach: vegetation, water, soils and surfaces

DEPLOYMENT

Client: Primarily local authorities
Region: Primarily France
Date: 2022 Budget: Variable

DESCRIPTION

Climate change means all urban areas will need to tackle the urban heat island effect, where high temperatures can provoke risks for human health. Revilo represents one solution to cool built-up areas during the hot summer months, in particular during heat waves. Revilo combines and optimises four approaches in which Eurovia is proficient:

- Using vegetation to create shaded areas, facilitate evapotranspiration and enhance wellbeing for the community
- Channelling rainwater to water the vegetation
- Maximising soils and their ability to store and absorb water
- Modifying surfaces to make them more permeable and lighter coloured

ADDED VALUE

- A comprehensive solution
- An answer to political ambitions, public expectations as well as the priorities for cities and technical services
- The potential to redesign public spaces requiring investment and work
- Many successful applications

KEY CONTACT

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Jardin de l'Ars, Bordeaux (southwest France)

Parc de la Loubière, Toulon (southern France)

OASIS gardens, Paris

TRENCHMIX®

SOLUTION

Creation of a watertight screen using Trenchmix® for the embankments (9,000 m² of walls made using Soilmixing)

DEPLOYMENT

Client: The region

Region: Greater Paris region

Date: 2023

DESCRIPTION

The Seine Grands Lacs project involves developing embanked spaces upstream of the Greater Paris region that are able to retain a portion of water from the Seine in the event of a major flood. The pilot site in La Bassée is the first embanked space, stretching across 360 hectares capable or holding 10 million m^3. A pumping station and an 8-km embankment have been built across the towns of Châtenay-sur-Seine, Balloy, Egligny and Gravon.

ADDED VALUE

- Resist the risk of flooding in the event of rising water levels; Creation of a continuous screen; Work to make existing reservoirs more watertight; Fight against the erosion of embankments; Small footprint of the machine
- The environmental advantages of Trenchmix®:
  - Fewer natural resources consumed, such as water, cement and aggregate, replaced by the earth from the site
  - No or little excavated material
  - Contamination in the soil is neutralised, being treated on site with a binder
  - No movement of land

KEY CONTACT

Fabrice Matthieu

Expert methods engineer

Soletanche Bachy

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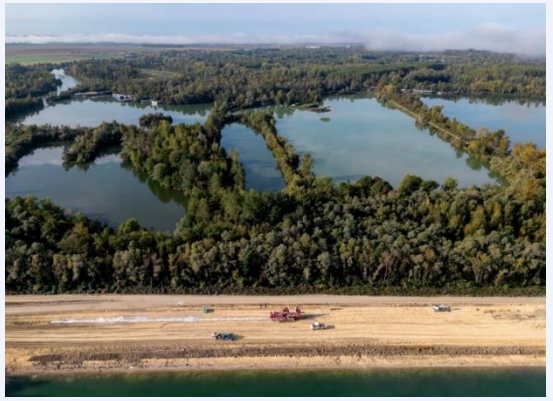
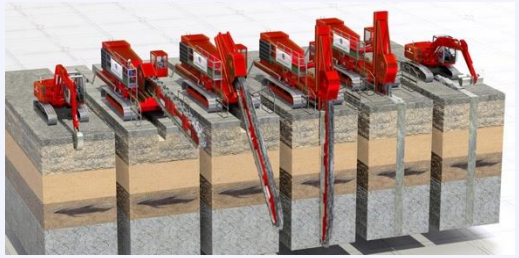


Pilot site at La Bassée

n°1 TM80 trencher



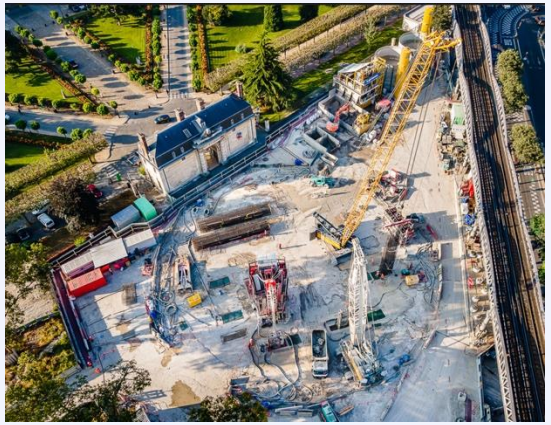
WASTEWATER RESERVOIR DURING PERIODS OF HEAVY RAIN

SOLUTION

Structure to avoiding discharging wastewater from a Paris sewer system into the Seine after heavy rainfall.

DESCRIPTION

Soletanche Bachy and Bessac were involved in the consortium that built the water storage tank (the Austerlitz reservoir) as well as two water recovery structures from storm drains either side of the river Seine. The reservoir was built with a 1.2-m thick moulded wall with plunge columns installed in barrettes 60 m deep. The shaft built to launch the micro TBM next to the reservoir made it possible to start work on the tunnel independently of the progress of work on the reservoir.



Aerial view of the Austerlitz reservoir worksite

ADDED VALUE

- Stop discharging wastewater from the Paris sewer system after heavy rainfall
- Improve water quality in the Seine ahead of the 2024 Games and create permanent zones where people can swim in the river
- Tightly control deep diversions for the moulded walls and bored piles made with high resistance low-carbon concrete

KEY CONTACT

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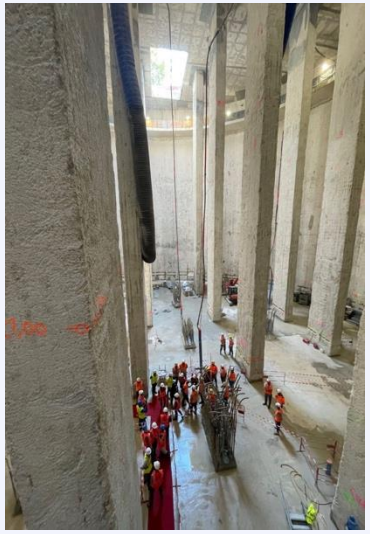

View inside

DEPLOYMENT

Client: Paris city council
Region: Paris
Date: 2021

HYDROVIA®

SOLUTION

HYDROVIA® is a range of pervious solutions to deal with rainwater run-off in urban areas. Depending on the intended use, the level of expected exposure and the desired aesthetic, a number of solutions exist: Hydrovia® Soft for environmentally friendly mobility, Hydrovia® Park for light vehicle parking and roads, as well as Hydrovia® Roc and Hydrovia® Print, two complementary alternatives.

DEPLOYMENT

Client: All
Region: France
Budget: All budgets
Date: Since 2022

DESCRIPTION

Integrated management of rainwater is a major concern for urban development and resilience projects. One solution is to use pervious surfaces able to absorb rainwater close to where it falls while also conserving the properties required for the intended purpose (safety, durability, integration into the landscape). The solutions in the HYDROVIA® range seek to limit rainwater run-off and facilitate rapid absorption.

ADDED VALUE

- Versatility of solutions across the range: resistance to rutting and cracking (degradation caused by light vehicle parking), integration of vegetation and into the surrounding landscape
- Possibility to take advantage of the colour of the aggregate, using translucent binder (Solis®), improving light reflection and helping to limit rising ground temperatures
- Simple to implement, these solutions are particularly well suited to environmentally friendly mobility lanes and light vehicle parking

KEY CONTACT

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Technical engineer

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Hydrovia® Soft – Nancy (eastern France)

Hydrovia® Park

Hydrovia® Print

Hydrovia® Roc

RESERVOIR PAVEMENTS

SOLUTION

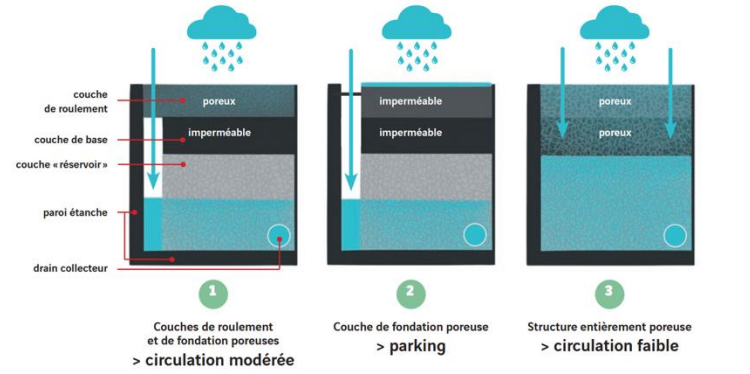
Reservoir pavements are road surfaces that boast significant water infiltration capacity. They are composed of layers of material that, given their high level of porosity, allow rainwater to infiltrate the pavement before it is returned to the environment, either via direct infiltration and/or the rainwater network

DEPLOYMENT

Client: All
Region: France and Global
Budget: All budgets
Date: Over 30 years' experience

DESCRIPTION

Integrated management of rainwater is a major concern for urban development and resilience projects. One way of addressing this matter is harnessing comprehensive structures such as reservoir pavements wherever project footprints make it possible to do so. By absorbing significant volumes of rain that falls during storms, the water can then be returned to the environment (depending on the absorption capacity of the road) or the water supply at a controlled pace, depending on the configuration.



The different types of structures

ADDED VALUE

- High capacity for infiltration/retention over a relatively small surface area
- Particularly adapted to car parks
- Adaptability of performance depending on project constraints

KEY CONTACT

Nicolas Hiroux
Technical engineer

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Building a reservoir pavement

EQUO VIVO – ECOLOGICAL ENGINEERING EXPERTISE

SOLUTION

Ecological engineering expertise to bolster ecosystem resilience. Controlling the full range of techniques to improve and restore biodiversity and ecological functions in natural and man-made habitats

DEPLOYMENT

Client: EPTB Seine Grands Lacs

Region: Seine-et-Marne

Budget: €5.05 M

Date: 2021-2024

DESCRIPTION

Equo Vivo benefited from offset measures for the La Bassée pilot site in Châtenay-sur-Seine (south east of Paris). The project is located in a regulated area (two type I ZNIEFF – natural areas of ecological, faunal and floristic interest – and one type II ZNIEFF) and a flood risk area due to the Seine. The ecological work was carried out around the lakes, which used to serve as material extraction sites, in coordination with the project infrastructure works. Overall, the project involved 200,000 m^3 of earthworks spread across 21 excavated material zones around various lakes, 2 hectares of wetland created and/or restored, and 25 hectares of meadows reconstituted.

ADDED VALUE

- Proficiency in and coordination of the various areas of expertise required for the project, including forest works, earthworks and soil bioengineering
- Adaptation of all projects in order to obtain the intended functions (project rescheduling to take account of the level of the water table, balancing earth movements, etc.)
- Adaptation of methods and in-house equipment for work in wetlands (caterpillar track dumpers, swamp excavators and amphibious excavators)
- Consideration of life cycles by species in work scheduling

KEY CONTACT

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Equo Vivo Brand Manager

VINCI Construction

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Worksite after earthworks

Overview

FLOOD PREVENTION SOLUTIONS ON THE A355 MOTORWAY

SOLUTION

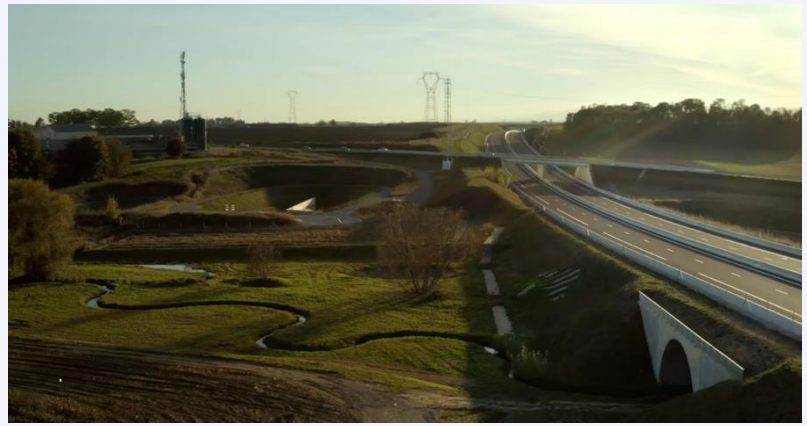
Implementation of special storage systems to collect water from natural drainage basins and thereby contain exceptional rainfall

DEPLOYMENT

Client: VINCI Autoroutes
Region: ARCOS network
Budget: Included in the construction of the A355
Date: 2021

DESCRIPTION

The A355 is a next-generation motorway that sets an example in terms of ecological transparency and environmental integration. Benefiting from innovative environmental measures, this new motorway was also the first road infrastructure project in France to have integrated offset measures, even before construction began. Overall, 1,315 hectares of environmental offset were deployed alongside the construction of this major bypass project. Equating to more than 4.5 times the project footprint! These measures primarily concerned forests and wetlands. Several waterways located along or near the motorway were thereby redirected with the addition of a water offset zone in order to restore their original character, regulate water flow and make them more favourable to the development of biodiversity. At the same time, the bridges were all designed to take account of swelling in the event of exceptional flooding.



ADDED VALUE

- Minimise impact on infrastructure operations
- Enhance security, sustainability, and long-term resilience of the infrastructure
- Eliminate the infrastructure barrier effect and protect villages downstream from flooding

KEY CONTACT

Arnaud Guillemin

Environment Manager

ARCOS network

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HS2 SUSTAINABLE FLOOD RISK MANAGEMENT

SOLUTION

Alternative approach for flood mitigation based on ecology and nature, using natural flood management techniques around the drainage basin, while also taking account of the ecological value at the design stage (nature-based solutions)

DEPLOYMENT

Client: HS2

Region: N1 N2 BBV JV

Date: 2022

DESCRIPTION

HS2 will pass through many waterways and the surrounding flood plains, meaning that if the project failed to include mitigation measures, it would potentially increase the risk of flooding in the neighbouring areas. Ordinarily, flood mitigation involves replacement floodplain storage. However, such conventional flood mitigation measures require changes to ground levels, leading to the loss of arable land and vegetation, making it difficult to uphold the pledges made to achieve No Net Loss in biodiversity.

ADDED VALUE

- Maximise the resilience of HS2 to climate change
- Minimise the impact on natural environments and improving biodiversity
- Reduce greenhouse gas emissions
- Reduce the cost of flood management

KEY CONTACT

Marvin Danvers

Environment Manager

VINCI Construction – Balfour Beatty

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Grazing in wetlands

Canley Brook: Design of replacement floodplain storage

River Cole: Design of replacement floodplain storage

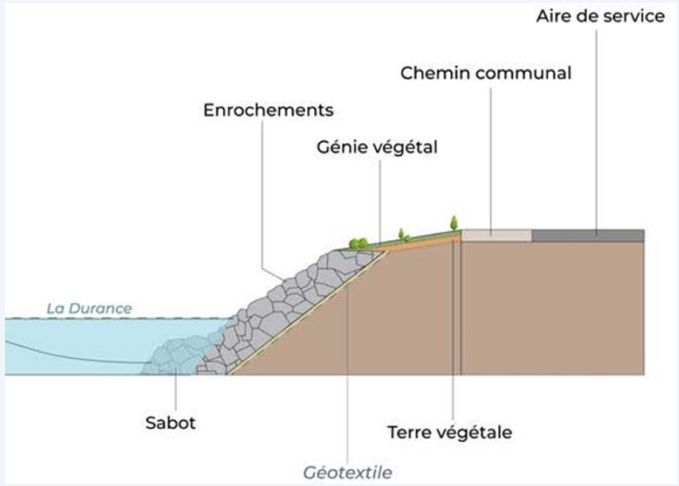
PREVENTIVE ACTIONS TO TACKLE CLIMATE CHANGE ON THE A51

SOLUTION

Bolstering riverbanks with riprap to protect the A51 from the Durance flooding and conducting vulnerability studies and risk assessments

DESCRIPTION

The flow of the Durance river, an affluent of the Rhône, is influenced by the rain of the Mediterranean climate and melting snow from the southern Alps. In the past, the Durance has been the location of many hydroelectric developments, as well as solutions exploiting the water and aggregate. For several years, the river management policy strives to achieve more natural characterisation, which changes the morphology of the riverbed. The effects of climate change and hydromorphological modifications to the riverbed cause ever-more severe and aggressive flooding to occur increasingly frequently, affecting in particular the A51 motorway, part of which runs alongside the Durance. Several localised areas of erosion were threatening the stability of the motorway and so required work to consolidate the riverbanks with riprap. Such work took place in particular in Manosque, consolidating 210 m of existing banks in 2023. Moreover, an overall vulnerability study and risk assessment of the A51 with respect to the Durance flooding, taking account of changes in the climate and the hydromorphology of the river, was carried out by the project manager Artelia.



ADDED VALUE

- Enhance security, sustainability, and long-term resilience of the infrastructure
- Anticipate risks for the infrastructure

KEY CONTACT

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Technical Director, VINCI Autoroutes

VINCI Autoroutes

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DEPLOYMENT

Client: VINCI-Autoroutes
Region: Escota network
Budget: €1.1 M pre-tax (val June 2010) (Manosque work)
Date: 2023

Consolidating the riverbanks alongside the A51 in Manosque - 2023

DRINKING WATER PRODUCED USING AIR AND SOLAR ENERGY

SOLUTION

Production of cool drinking water without any connection to the water supply or electricity grid

DEPLOYMENT

Client: Olympia Odos

Region: Greece

Budget: €10 K pre-tax/unit

Date: 2021

DESCRIPTION

System producing cool drinking water (between 10 and 15 l/day with two hydro-panels) using only condensation and solar energy

ADDED VALUE

Autonomous and sustainable system:

- Zero greenhouse gas emissions
- Zero underground water take
- >90% of materials used to produce the unit can be mass recycled

KEY CONTACT

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Olympia Odos

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THAMES TIDEWAY TUNNEL

SOLUTION

Design and construction of a tunnel to store sewage and diverting it from central London to a treatment centre. The project involves the main 5.5 km long tunnel (7.2 m diameter wide), as well as a 4.6 km long connection tunnel (5 m diameter wide), five shafts with internal structure and electromechanical work

DEPLOYMENT

Client: Bazalgette Tunnel Limited

Region: London, UK
Budget: €1.2 bn

Date: 2015-2024

DESCRIPTION

The Thames Tideway Tunnel is a vast project stretching 25 km in length, at depths of between 35 and 66 m. It can hold up to 1.6 million cubic metres of wastewater and was built to operate over a 120-year timescale, based on climate models published by the Met Office Hadley Centre (UKCP09). Modelling the future scenario based on a typical year, climate change and demographic growth will significantly aggravate the frequency of spillages from the Thames sewer system by 2080.

ADDED VALUE

- Explore uncertainties for 2050 and 2080 using climate forecasts and build for the future
- Make a key contribution to the essential verifications and improvements to the quality of the Thames in the near future with resilient infrastructure
- Combat the risk of rising water by building new anti-flood structures, especially at the King Edward Memorial Park along the Thames, which were studied with a view to rising their level in the future, in line with the forecast rise in water levels as published by the UK Environment Agency (TE2100)

KEY CONTACT

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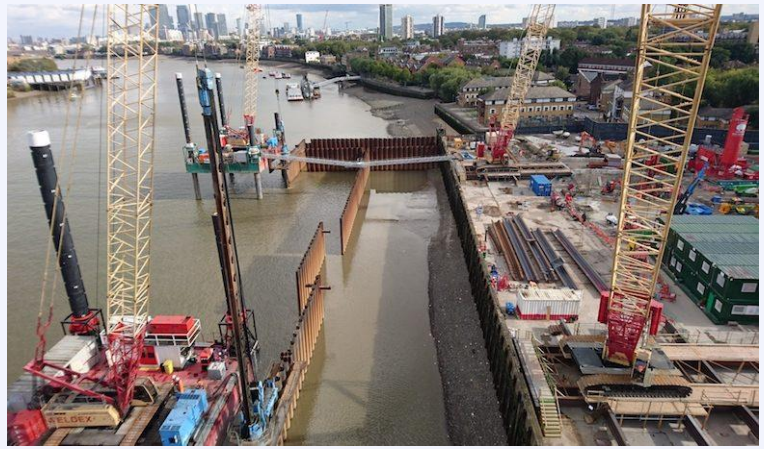
Tideway East view from inside



Tunnel worksite in London

DEVELOPMENT AT LA COTINIÈRE FISHING PORT

SOLUTION

Redevelopment of coastal areas: design and construction of embankments, resistant quays adapted to rising water levels

DESCRIPTION

On the existing port, construction of a third basin, two embankments, a 250 m quay, an earth platform and a new dock sales area, all scaled for both 100-year events and rising water levels forecast to 2100 (0.6 m increase). In addition, a former improvised car park was revegetated. This project falls within a wider drive by the towns and department to redevelop their coastal areas by working on biodiversity and ecosystems within dunes as well as bolstering the protections against flooding and other climate hazards.

La Cotinière port after completion of the work (2022)

ADDED VALUE

- Improve protection of land and communities against future risks due to rising sea levels
- Re-establish balance within the dunes, reduce land take due to building new embankments and earth platforms by revegetating the former improvised car park to:
  - Help combat erosion and maintain the dunes, which provide natural protection
  - Minimise the maintenance needs of embankments and dunes

KEY CONTACT

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DEPLOYMENT

Client: Charente-Maritime department

Region: Saint Pierre d'Oléron

Budget: €65 M

Date: 2016-2021

Renatured zone before the work (2019)

Renatured zone after the work (2022)

HYDROPLUS®

SOLUTION

Implementation of 14 3-m high Fusegates ® in labyrinth configuration to increase reservoir storage capacity by 31%

DEPLOYMENT

Client: Dam operators and owners

Region: Global

Budget: All budgets

Date: Since 1991

DESCRIPTION

The Sans Souci hydroelectric dam, operated by the Central Electrical Board (CEB), is located in Mauritius. The government wanted to reduce its dependency on fossil energies and so decided to increase the hydroelectric production capacity of the dam. The feasibility study found the best solution involved raising the level of the reservoir by 3 m using the Fusegate® system and thereby increasing storage capacity by 1.36 hm^3, equal to 31% of the initial volume. Consequently, annual energy production was increased by 3 GWh.

ADDED VALUE

Raising the Sans Souci dam is a good example of hydroelectric optimisation at an existing site. The use of Fusegate® makes it possible to raise the height of the dam without affecting its structural integrity.

By replacing a fossil energy source, the project has an extremely positive carbon footprint. In an average year, the additional 3 GWh production helps save 3,180 tCO_2eq. compared with the same energy produced by a coal-powered plant.

KEY CONTACT

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Director

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SIBELONZIP AND SIBELONMAT

SOLUTION

Geomembrane systems are installed underwater, while the canal continues to operate as normal
SIBELONZIP®: prefabricated watertight geomembrane panels with integrated zips to join them together underwater
SIBELONMAT®: watertight double-geomembrane mattress injected with cement grout

DEPLOYMENT

Client: **All**
Region: **Global**
Date: Since 2018

DESCRIPTION

Canal draining is costly and it is not always possible to suspend canal operations. Moreover, such processes have a considerable impact on the local environment and biodiversity.

SIBELONMAT® and SIBELONZIP® can be installed at any depth underwater, covering the entire surface or critical zones only.

ADDED VALUE

- Save water: prevent water loss and ensure it is captured, stored and distributed effectively all throughout the water cycle
- Avoid interrupting canal operations and the impact that has on operations, costs, the environment and the local community
- Rapid construction process: fewer personnel, less activity on site, lower installation requirements, less machinery used
- By maintaining water level and flow, they favour biodiversity, ecosystem health and sustainable water use in the surrounding area
- Prevent catastrophes caused by unstable embankments

KEY CONTACT

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SIBELONMAT®

SIBELONZIP®

FLOATING OFFSHORE WIND PROJECT STUDY

SOLUTION

Solutions to build floating wind turbines: 100/200 m tall, quadruped, each branch 90 m long, with the intention to do everything possible to minimise weight by limiting the use of excess material

DEPLOYMENT

Client: VCGP

Region: Le Havre, France

Date: 2022

DESCRIPTION

The sheer scale of offshore wind turbines means the infrastructure to support them are also gigantic. This needs to be taken into account when they are being built on land, along with the marine environment, while also reducing the size of production facilities. This study was carried out to address the relative lack of land available and to avoid affecting the seabed.

ADDED VALUE

Reduction in land use conflicts, improved energy performance (offshore winds are generally stronger and more consistent than on land, meaning more constant, higher levels of electricity generation), flexibility as more vast potential locations, and reduction on the impact on the seabed.

KEY CONTACT

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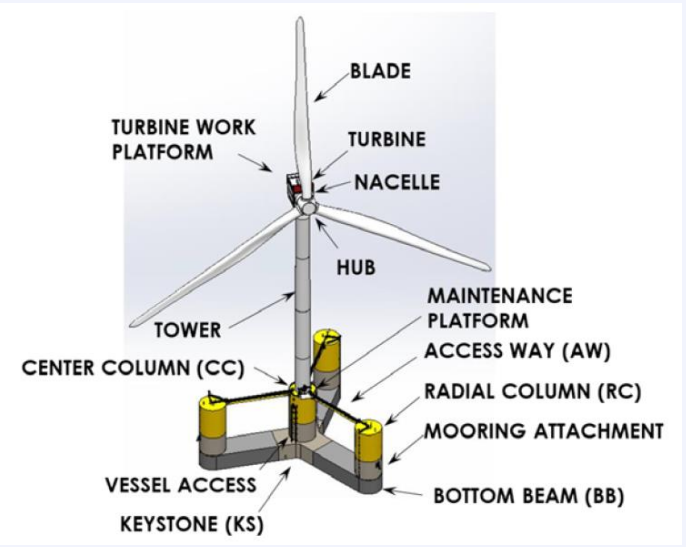
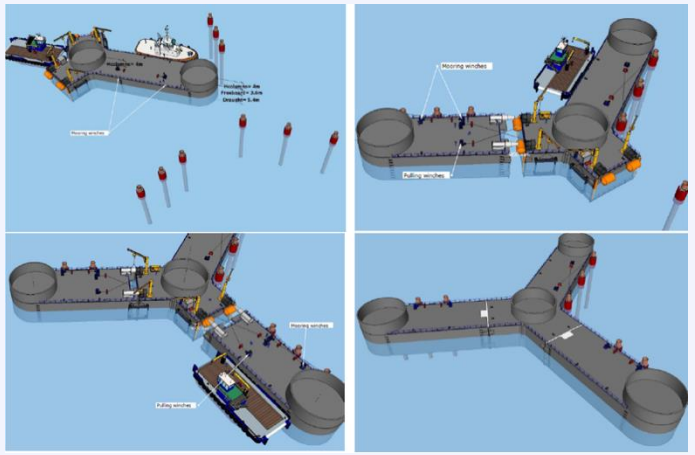


Overview



Assembling floatation devices

WATER MANAGEMENT AND MONITORING USING IOT

SOLUTION

Effective water management, essential for healthcare establishments

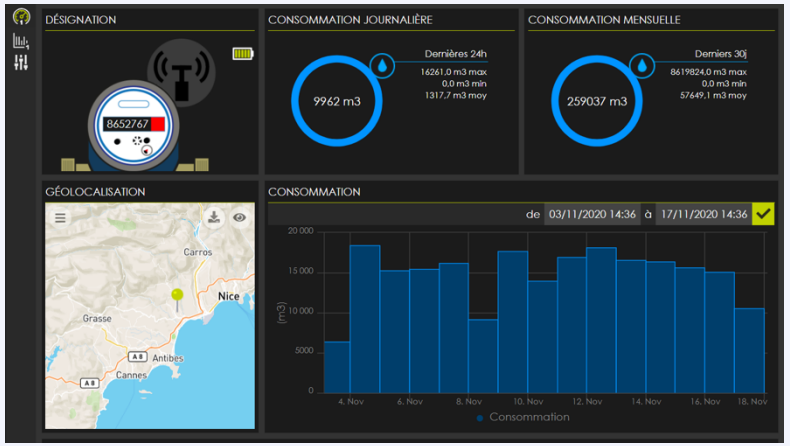
DEPLOYMENT

Client: Hospitals
Region: Marseille

DESCRIPTION

Effective water management is essential for healthcare establishments, enabling them to ensure good sanitation and save water.

The company was entrusted with the contract to manage the water resources for the Timone hospital and the APHM Nord hospital by providing a comprehensive water management solution that includes supplying, installing and configuring water meters, defining a water consumption target and an IoT surveillance system based on the IOThink solution, as well as installing sensors to monitor temperature and water consumption.



ADDED VALUE

- Two thirds of establishments say they pursue a policy to reduce the volume of water they consume. Of these establishments:
  - 85% use water saving equipment
  - 72% inform their staff about the issue

KEY CONTACT

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SMART USERS

Smart Users
Saving resources / by WMI

SOLUTION

Smart Users is an IoT solution to manage and optimise water and electricity consumption on worksites and in agencies

DESCRIPTION

In many cases, tracking water and electricity consumption involves taking manual readings from meters that are often hard to access. Readings are therefore rarely taken, as it takes time, costs money and is prone to errors. A lack of continuous surveillance can mean anomalies such as leaks or excessive consumption are not identified in a timely manner, even though they represent both a major risk for the environment and a significant financial cost for operators. To tackle this situation, **Smart Users** has developed an innovative solution – connected, automated and reliable monitoring to optimise consumption management and improve responsiveness.

DEPLOYMENT

Client: Worksite, agencies and concessions
Budget: Project of all sizes
Region: Global
Date: Since 2023

ADDED VALUE

- **Centralisation**: a single dashboard combining monitoring, alerts and reports
- **Responsiveness**: readings automatically transmitted every 15 minutes and automatic alerts in the event of an anomaly
- **Safety and forecasting**: data stored on VINCI servers, available for mutli-worksite/agency comparative and predictive analysis
- **Expertise and advisory**: support for optimised, long-term management
- **Integration and evolution**: connection with BeSafe and ability to collect all types of data on site, opening the door to a connected worksite

KEY CONTACT

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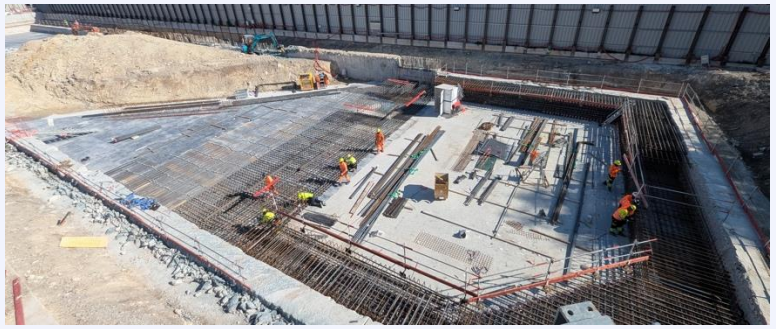
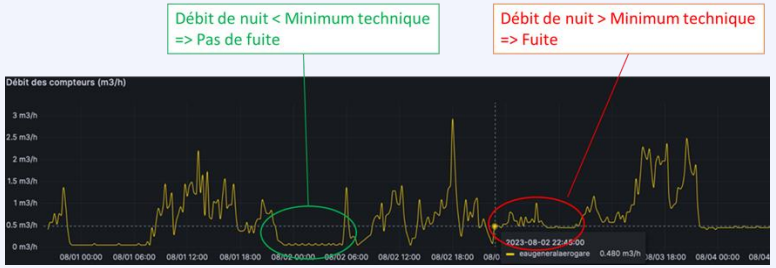


Rueil – Suresnes Mont-Valérien station worksite on the Line 15 West (Grand Paris)

Meters communicating water and electricity readings



Smart Users platform – example of water leak

LE GALION

SOLUTION

Combustion turbine plant in a flood zone with high liquefaction potential in the event of an earthquake

DEPLOYMENT

Client: Albioma

Region: Martinique, France

Budget: €20 M

Date: 2005-2007

DESCRIPTION

Installation of a combustion turbine plant in a flood zone with high liquefaction potential in the event of an earthquake, to safeguard electricity supply on the island. High voltage substation built on ballast columns on excavated material, above the level of a 100-year flood.

This reinforced design proved effective when just a few months after the plant was commissioned, it was hit by hurricane Dean.

ADDED VALUE

- Make the structure more climate resilient

KEY CONTACT

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ITAMI – PREVENTION MEASURES AGAINST FLOODS CAUSED BY HEAVY RAIN

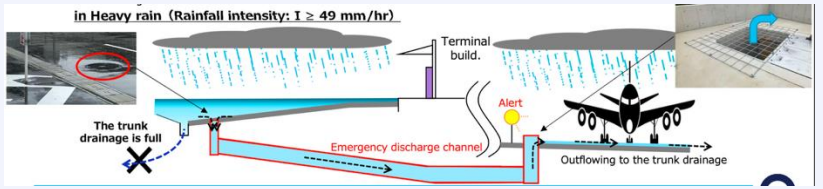
SOLUTION

ITAMI – Drainage and prevention plan to better deal with floods at Kansai airport Japan

DESCRIPTION

Located on an artificial island nearly 5 km from the coast, Kansai airport is situated 5 m above sea level. To protect against the risk of flooding, a range of measures has been adopted:

- Prevention measures: creation of storm water evacuation lines (drainage trenches deal with run-off water from the car park outside the airport in the event of heavy rainfall, the water is evacuated via the existing underground water collection tank, which avoids flooding the lower roads and car parks) and an underground evacuation canal.
- Flood handling measures: implementation of a removable water stop plate on automatic doors and watertight doors on generator rooms (installed in 2019).
- Flood recovery measures: acquisition of a large drainage pump vehicle.



DEPLOYMENT

Client: ITAMI

Region: Japan

ADDED VALUE

- Ensure the safety of passengers and personnel
- Maintain continuity of operations or quick recovery
- Adapt infrastructure to climate hazards

KEY CONTACT

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KIX – PREVENTION OF CATASTROPHES CAUSED BY TYPHOONS AND FLOODING AT AIRPORTS

SOLUTION

Prevention of catastrophes caused by typhoons and flooding at airports caused by climate change

DEPLOYMENT

Client: Kansai

Region: Japan

DESCRIPTION

Kansai Airports, in partnership with the Disaster Prevention Research Institute Kyoto University and the Department of Civil and Environmental Engineering and Architecture of Kumamoto University, have developed a model able to forecast weather conditions (typhoons and extreme meteorological phenomena) caused by climate change, and digitally analyse the impact natural phenomena such as heavy rainfall, high waves and storm surges could have on the airport. This model could facilitate more precise catastrophe planning, not only for Kansai airport, but also at other airports. The model was developed, put into use and approved by reproducing the damage caused by typhoon JEBI in 2018. The model could help develop and revise investment plans for embankment maintenance at Kansai International Airport and Kobe Airport, with the help of a typhoon model that takes account of climate change. The target zone covers the two airports in Osaka Bay.

ADDED VALUE

- Adapt infrastructure to climate hazards
- Anticipate extreme meteorological phenomena

KEY CONTACT

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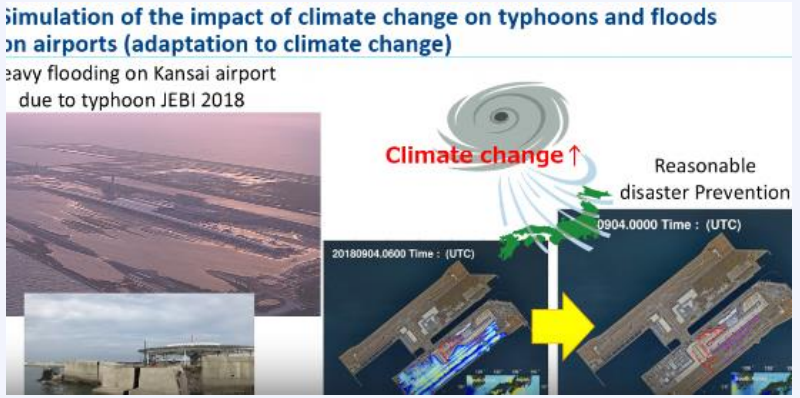

FOREVA ULTRA HIGH-PERFORMANCE FIBRE REINFORCED SHOTCRETE TO STRENGTHEN CULVERTS WHILE MAINTAINING TUNNEL GAUGING AND THE WATER CHANNEL

SOLUTION

Adaptation of existing Constructions to the Damaged Climate

DESCRIPTION

A large number of metal pipes were built around 50 years ago, which now need strengthening due to corrosion. This is especially the case for culverts, built so roads may cross over waterways. Standard reinforcement practices involve lining the structures, which significantly reduces their diameter, potentially meaning they are no longer able to handle the water flow in the event of flooding.

Climate change has made it necessary to upscale the potential capacity and scale of certain hydraulic structures. There are metal culverts that are not wide enough to sustain structural reinforcement by thick lining, without a second structure having to be built in parallel.

Lining by ultra high-performance fibre reinforced shotcrete involves lining the structure with a thin layer of concrete around 5 cm deep, an insignificant impact given the diameter of the structure generally lies between 2 and 6 m.

DEPLOYMENT

Client: **Public and private sector**

Region: **Global**

ADDED VALUE

Compared with conventional solutions using reinforced concrete or fibre-reinforced polymers (FRP), lining using ultra high-performance fibre reinforced shotcrete makes it possible to:

- Maintain the gauging of the structure and therefore its capacity
- Reduce the volume of materials required by 75%
- Complete the work over a shorter timescale
- Cut the total carbon footprint for the project by around 40%
- Improve the durability of the reinforcement compared with conventional reinforced concrete lining
- Avoid raising the waterbed, which would make it necessary to modify the structure both upstream and downstream

KEY CONTACT

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Ultra high-performance fibre reinforced shotcrete
Sales Manager

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FOREVA® CAC PROTECTS WATER INFRASTRUCTURE AGAINST CLIMATE CHANGE

SOLUTION

Foreva® CAC mortars offer lasting protection to adapt wastewater infrastructure to rising temperatures and less water

DEPLOYMENT

Client: **Local authorities and wastewater plant operators**

Region: **Global**

DESCRIPTION

Rising temperatures and the increased frequency of droughts due to climate change lead to higher concentrations of wastewater, favouring the development of sulphur-oxidising bacteria (Thiobacillus). These microorganisms accelerate the degradation of concrete inside the large section networks, wastewater treatment plants and municipal sump pumps.

The bacteria accumulate on wet surface walls and can destroy up to 20 mm of concrete per year by transforming Hydrogen sulphide (H_2S) from the wastewater into highly corrosive sulphuric acid.

Freyssinet has developed Foreva® CAC biogenic protection mortars using calcium aluminates, which it deploys on its worksites. The mortar inhibits the behaviour of the bacteria and considerably reduces the formation of acid on the concrete.

ADDED VALUE

To address the increasing incidence of damage to epoxy resin surfaces, calcium aluminate technology, which has proven effective for many years in France and the US, has emerged as the most reliable way of extending the useful life of structures exposed to the risk of microbiologically influenced corrosion.

As part of efforts to rehabilitate existing structures, deteriorated cladding is reconstituted using thickly sprayed Foreva® CAC 140 repair mortar.

To protect new-build structures, the exposed cladding is covered with a thinly sprayed layer of Foreva® CAC 100 mortar.

Thanks to their long useful life, these solutions represent a sustainable alternative to resin coverings while also boasting a considerably reduced environmental footprint over their entire life, as greenhouse gas emissions can be reduced by up to 70% on a sump pump.

KEY CONTACT

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CATHODIC PROTECTION TO OFFSET THE INCREASING PACE OF CORROSION

SOLUTION

Preventive and curative electrochemical treatment to control the corrosion rate of the rebars within reinforced concrete

DEPLOYMENT

Client: **Public and private sector**

Region: **Global**

DESCRIPTION

Climate change can cause average temperatures and water levels to rise, exposing reinforced concrete structures to more aggressive corrosive agents, such as chlorides, and the catalytic effect of temperature in corrosive reactions.

In these circumstances, cathodic protection of steel contained within concrete, whether it be above ground, underground or underwater, has proved effective over the past several decades. Applying a controlled electrical current to the metal significantly reduces the oxidisation of the steel reinforcements within the concrete, inexpensively safeguarding the durability of the structure over the long term.

ADDED VALUE

- Cathodic protection extends the durability of structures in a changing environment.
- It minimises the need to repoint and reconstitute concretes while also helping to reduce the carbon footprint compared with conventional repair work, over the entire life cycle of the structure.
- Cathodic protect can be applied to an extremely wide range of uses, as it can adapt just as well to new-build structures as repair projects.
- Depending on the technical constraints, the type of power available and the corrosivity of the site, bespoke solutions can be implemented.
- Freyssinet is proficient in this area of expertise, which is subject to strict regulatory standards, and guarantees reliable, durable systems.
- Once installed, these systems are regularly monitored to ensure performance remains optimal in light of changing environmental conditions.

KEY CONTACT

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TFC²: COMBINING COMPOSITE REINFORCEMENT AND CATHODIC PROTECTION

SOLUTION

2-in-1 solution

Structural reinforcement using composite carbon fibre reinforced polymers *AND* protection against corrosion of steel rebars within the reinforced concrete harness impressed current cathodic protection

DEPLOYMENT

Client: Public and private sector

Region: Global

DESCRIPTION

Harnessing its expertise in reinforcing and protecting reinforced concrete structures, Freyssinet has chosen to extend its core range of bonded composite reinforcement materials in order to expand the potential lasting solutions to respond to the major challenge presented by corrosion in steel reinforcements.

The Foreva®TFC² process combines bonding composite reinforcements to the surface of cladding with impressed current cathodic protection.

Its mechanical characteristics effectively bolster the load-bearing capacity of the components within the reinforced concrete, while the controlled electrical polarisation slows the corrosion rate of structural reinforcements.

This combined solution guarantees lasting structural support and extends the life of structures without the need for regular interventions on structures that withstand considerable attacks from their surrounding environment.

ADDED VALUE

The solution effectively strengthens and protects the structure against corrosion:

- It can be applied to all new-build and existing reinforced and prestressed concrete structures
- It fully aligns with the international normative framework for cathodic protection solutions
- It minimises the need for repointing and reconstituting concrete and does not increase the weight of the structure once reinforced
- It also helps to reduce the carbon footprint compared with conventional repair work, over the entire life cycle of the structure

KEY CONTACT

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REPLACING EXPANSION JOINTS WITH MORE ACCOMMODATING MODELS

SOLUTION

Adaptation of existing Constructions to the Damaged Climate

DEPLOYMENT

Client: **Public and private sector**

Region: **Global**

DESCRIPTION

Climate change is causing a considerable rise in temperatures, with more frequent spikes in temperatures and greater temperature variations. Such changes have a direct impact on infrastructure, especially bridges, which expand significantly with the heat, potentially causing mechanical constraints, deformations or premature degradation. Expansion joints are essential to absorb such movement and can be severely put to the test. As such, it is essential to adapt designs and upgrade equipment to ensure these structures remain safe, durable and in good working order.

ADDED VALUE

Freyssinet specialises in the design, production and implementation of solutions by a dedicated team of experts. They offer a wide range of expansion joints that can accommodate longitudinal movements of between 20 mm to over 1000 mm.

The diverse range of expansion joints make it possible to find a model that precisely adapts to the thermal constraints specific to each structure depending on its location, structure and scale of movement. Selecting expansion joints adapted to suit extreme temperature variations guarantees greater longevity for the structure.

With its very wide range of expansion joints and its many decades' experience, Freyssinet assists infrastructure designers and managers in safeguarding their structures while also optimising maintenance costs over the long term by choosing expansion joints to suit each situation.

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4.3 REPAIR SOLUTIONS

CARPI – RENOVATION AND REHABILITATION OF DAM WATERS

SOLUTION

Installation of an underwater watertight CARPI system using a SIBELON® geomembrane on the hydraulic structure

DEPLOYMENT

Client: All

Region: Global

Budget: All

Date: Since 1994

DESCRIPTION

It is not always possible to drain a reservoir due to the constraints inherent to a project, such as the role of the canal in supplying water, the risk of losing energy in hydroelectric systems, or because emptying and refilling a reservoir risks causing structural damage. In such situations, it is necessary to install underwater solutions. Working underwater requires a specialist team and certain components need to be modified compared with dry installation.

ADDED VALUE

- The geomembrane ensures watertightness
- Avoids impact on fish as well as other animal and plant life and economic activities
- Draining reservoirs interrupts or reduces hydroelectric energy production
- Draining reservoirs interrupts water supplies for human consumption and irrigation
- Draining reservoirs requires a permit, which is sometimes difficult/impossible to obtain

KEY CONTACT

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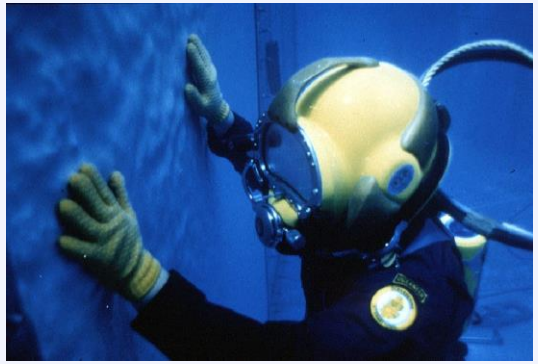

A SIBELON® geomembrane being rolled out, positioned and fixed in place underwater

MAINTAINING NOMINAL HYDRAULIC CONDITIONS ON A RIVER-SPANNING STRUCTURE

SOLUTION

Intervention in the event of intense rainfall forecast in order to remove logjams and debris that reduce the capacity of a culvert below its nominal capacity

DEPLOYMENT

Client: VINCI Autoroutes

Region: Escota network

Budget: €3 K (excl.tax)

Date: Recurrent

DESCRIPTION

In southeast France, the A8 motorway cross the Brague coastal river in a series of culverts. This structure was initially designed in the 1950s to be able to handle a 30-year flood. Beyond this level, the motorway finds itself inundated and can no longer be used. Insufficient maintenance of the riverbanks along the Brague upstream of the motorway can, in the event of flooding, lead to logjams at the entrance to the culverts. When the size of the debris exceeds the diameter of the culverts, they become blocked, reducing their capacity to below their nominal capacity and thereby increasing the probability and frequency with which the motorway is closed due to flooding. When heavy rain is forecast, a mobile crane is positioned over the culverts and removes the debris and logjams as they accumulate.

ADDED VALUE

- Keep a motorway open, particularly important during extreme weather events to enable emergency services to get around

KEY CONTACT

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Flooding of the A8 motorway when the Brague breaks its banks

Removal of logjams

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