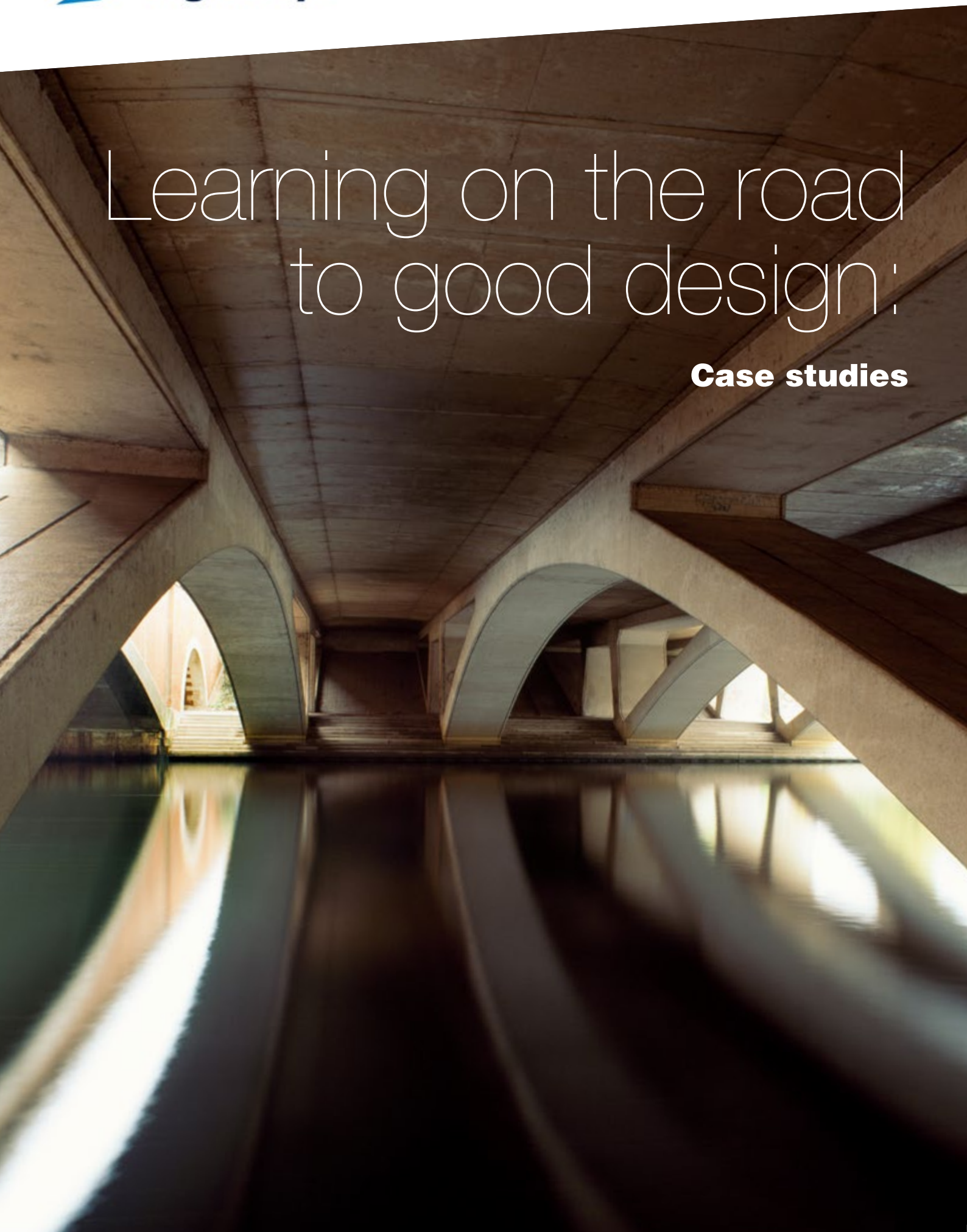
national highways

Learning on the road to good design:

Case studies



cover: M25 Runnymede Bridge, UK

Foreword

The road to good design (2018) set out our design vision and principles for the strategic road network. This first series of case studies help us better define our design principles and what 'good' looks like. They challenge us to improve our approach to design and the quality of the network and inspire by illustrating what creative design can achieve.

The examples are drawn from a wide range of projects from around the world. Not all are road projects, but there are connections and parallels to be reflected upon. I am proud a number of these are the work of the Highways Agency, the predecessor to National Highways. I encourage design teams to look closely at our existing network when designing, as there is much to learn from and build upon in terms of best practice.

One aspect of good design highlighted in the examples is the range of other benefits that can be generated from multidisciplinary and multifunctional design that makes the most of wider opportunities. Although important, road design that only solves a safety or traffic problem, is not necessarily 'good'. Many of the case studies illustrate that functional design can also be beautiful and generate other wider benefits.

I hope these case studies become a useful resource for all those involved in the planning, delivery and maintenance of our roads. They have been chosen to make us think about design quality, wider benefits and opportunities in all aspects of our work.

The development and publication of this first series of good design case studies was recommended by our Strategic Design Panel. I would like to thank members for their continued support and advice in helping us improve the design quality of our roads.

Mike Wilson
Chief Highways Engineer
and Chair of the Strategic Design Panel

Introduction

The road to good design (2018) set out ten principles of good road design to support National Highways' vision for a more inclusive, resilient and sustainable network. With the publication of the principles in the Design Manual for Roads and Bridges (2019), they became a requirement for design practice and scheme design.

Our ten principles are based on universal ideas of good design, but are not instructions for how to design a road. They are prompts for project teams to consider the whole, rather than individual elements only, to realise the wider benefits of good design. Close engagement with communities, careful assessment of context, design innovation, robust decision making, and collaborative working are all vital to good design.

The following 25 examples of good design illustrate the role of creative design in unlocking the wider benefits and opportunities associated with roads in the UK and beyond. Although none of the examples were designed with our principles in mind, they have been selected as they reflect one or more of our principles in practice and they represent a wide range of projects at various scales.

This is the first of a series of good road design case studies and is by no means a comprehensive piece of research. It only begins to illustrate what 'good' road design looks like to help embed good design into everyday practice. The examples have drawn upon publicly available information to provide a short description of each project and which key design principles it illustrates. Not all aspects of every example will be directly applicable to the strategic road network.

National Highways does not endorse the projects, responsible authorities, designers or contractors referenced in the case studies. Although care has been taken to ensure accuracy of the information provided, it should not be relied upon. Readers are encouraged to confirm and seek out further information as required when using the examples as precedents.

The examples have been selected to inspire and illustrate what may be possible through good design. Collectively they demonstrate the value of good design to people, the environment and economy on a number of levels. Design teams are encouraged to make use of these examples and to find others to support the planning and development of their own project.

Design principles reflected in each case study and type of project:

Case study	Design principle										Type				
	Safe and useful	Inclusive	Understandable	Fits in context	Restrained	Environmentally sustainable	Thorough	Innovative	Collaborative	Long-lasting	bypass / new road	public realm	public art	structure	sustainable development
A590 Newton bypass				■	■	■	■				■				
I-70 Glenwood		■		■	■			■			■			■	
A354 Weymouth		■		■		■	■				■				
Luminous Veil	■	■	■					■					■	■	
I-5 Freeway Park		■	■	■				■				■			
A3 Hindhead	■		■						■	■	■				
A82 Pulpit Rock	■				■		■	■						■	
A4 Delft				■		■	■	■			■				
A894 Kylesku Bridge	■			■				■		■				■	
A40 Northala Fields		■				■		■	■			■			■
A2 Chiasso		■		■			■	■						■	
Craigieburn bypass	■		■	■				■			■		■		
M5 Gloucester Services		■		■		■	■								■
Millau Viaduct	■		■		■			■			■			■	
Mersey Gateway	■		■		■					■	■			■	
Madrid Rio		■	■				■		■			■			
Lusail Expressway	■		■				■	■			■		■		
Oresund Link	■							■	■	■	■			■	
Cycle Limburg		■			■	■		■							■
M25 Runnymede			■		■		■			■				■	
A21 Lamberhurst				■	■	■			■		■				
Ely southern bypass	■	■		■			■				■				
Gates of Light			■		■	■		■					■		■
Hovenring	■	■	■					■						■	
A650 Bingley	■	■			■				■		■				

A590 High & Low Newton Bypass, UK

Facts

Location _____ Cumbria, UK
Length _____ 4km dual carriageway
Client _____ Highways Agency (now National Highways)
Designer _____ Pell Frischmann (designer), Laing O'Rourke (contractor)
Year completed _____ 2008

Description

A mix of single and dual carriageways, the A590 links the M6 motorway to Barrow-in-Furness in Cumbria and is a main route for tourists in South Lakeland. The scheme was designed to bypass the villages of High Newton, Low Newton and Ayside primarily to improve safety and environmental conditions, and is located entirely within the Lake District National Park.

The bypass comprises 4km of dual carriageway with five bridge structures and two grade-separated junctions. Four underbridges are clad in local stone where they are viewed up close, while a single simple overbridge retains its concrete finish and is viewed at speed from the bypass only. The absence of a central pier on the overbridge maintains views of the wider landscape for drivers, while the underbridges are narrow, reflecting the character of the adjacent country lanes.

Environmental works include the sympathetic grading of earthwork slopes, earthwork bunds to form false cuttings to visually screen the road, conversion of a former pig sty into a 'bat hotel' to replace roost sites lost with demolition of an adjacent property, a 'bat bridge' to guide bats across a cutting, and badger and otter tunnels.

Dry stone walls are a defining characteristic of the Lake District and some 8km of dry stone wall was built with the bypass. The design and construction of the walls using local stone was undertaken by a specialist contractor and help integrate the scheme into the Cumbrian landscape.

Waste was minimised throughout construction by reusing existing materials where possible, including road planeings, walling stones, gate posts, topsoil and subsoil. Imported materials were also sourced locally where possible, including from local demolition sites. The use of locally sourced materials benefited the local economy, minimised disruption and reduced miles travelled.

The bypass was awarded a CEEQUAL rating of 'excellent' for its approach to sustainability, resource efficiency and minimising environmental and social impacts.

Design principles

- Fits in context
- Restrained
- Environmentally sustainable
- Thorough

Images **1. A ribbon, not a scar:** Dry stone walls help integrate the scheme into the Cumbrian landscape. A soft central reserve with a wire rope safety barrier also helps reduce visual impact. **2. Stone age:** Underbridges are clad in local stone in keeping with the context. **3. A room for the day:** A former pigsty converted into a 'bat hotel' provides a new home for displaced bats. **4. Milestone:** A retained historic stone marker maintains a link to the past and conserves local character.

I-70 Glenwood Canyon, USA

Facts

Location _____ Interstate 70, Glenwood Canyon, Colorado, USA
Length _____ 20km motorway
Authority _____ Colorado Department of Transportation
Designer _____ Gruen Associates (landscape architects)
Year completed _____ 1992 (all sections)

Description

When the Colorado Department of Transportation began exploring the expansion of the I-70 Mountain Corridor to complete the national interstate system, the original proposals included blasting cliff faces, constructing extensive retaining walls and channelling the Colorado River in this highly sensitive location. However, they soon discovered a majority of stakeholders were firmly opposed to the plan.

Following direct public involvement through a citizen's advisory committee and a technical review group, a new proposal was brought forward in 1978 by Gruen Associates that preserved the natural topography of the extremely narrow canyon and maintained the integrity of the Colorado River and its tributaries.

Today eastbound and westbound carriageways often diverge, stepped on viaduct above the other or in tunnel, preserving the canyon floor, walls, vegetation and river where possible and affording dramatic views to drivers. Forty bridges and viaducts (totalling 10.5km), three tunnels and a 50mph speed limit minimise impact on the surrounding environment and allow fauna access to the river. The 1.2km tunnel at Hanging Lake protects this popular scenic area from noise and visual impact, as well as housing a control centre and maintenance area within the mountain. Other features of the project include four rest areas, a cycle and hiking path along the length of the canyon, and a boat launch and raft drop allowing for the continued recreational use of the canyon.

The project received more than thirty awards for innovative design and environmental sensitivity, including an Outstanding Civil Engineering Achievement Award (American Society of Civil Engineers 1993) and the Presidential Design Award (2000) as "a model for the design and construction of interstate highways in valued natural landscapes."

Design principles

- Inclusive
- Fits in context
- Restrained
- Innovative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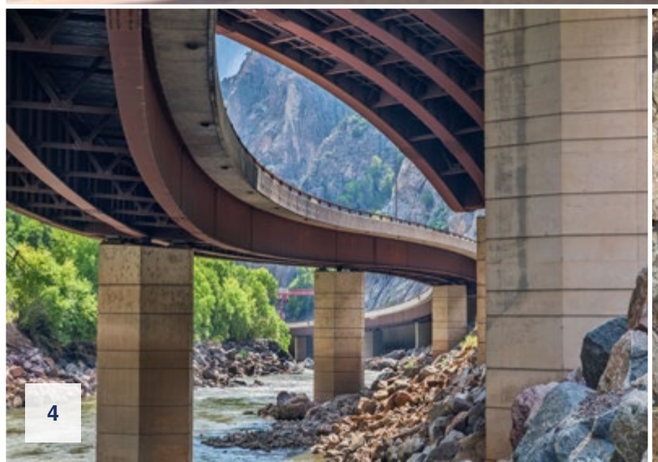
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Images **1. View from the saddle:** A cycling and hiking path runs the length of the canyon, accessible from rest areas. **2. A road runs through it:** The dramatic line of the I-70 follows the course of the river through the canyon. A ramp from a rest area beneath gives access for white water rafting. **3. View from the road:** The split carriageways of the I-70 step up the canyon walls. They are not hidden and consequently offer dramatic views for drivers. **4. Criss cross:** Where necessary viaducts step over the river while minimising their footprint. **5. Scenic bypass:** The 1.2km tunnel at Hanging Lake preserves this scenic area while providing access via an adjacent rest area. The tunnel portals are simple and unobtrusive and a maintenance area within the mountain eliminates the need for external buildings.

A354 Weymouth Relief Road, UK

Facts

Location Weymouth, UK
Length 10km single carriageway
Authority Dorset County Council
Designer Owen Williams (consultants), Skanska (contractor)
Year completed 2011

Description

Although proposals for a relief road date back decades, there was an impetus to complete the scheme in time for the 2012 Summer Olympics, with the nearby Isle of Portland hosting sailing events. The route between Weymouth and Dorchester is partly located in the Dorset Area of Outstanding Natural Beauty and was contentious when chosen. It bypasses the communities of Broadway, Littlemoor and Upwey, and a difficult hairpin bend on an existing road.

The scheme consists of a single carriageway with occasional passing lanes and 9 bridges, including 3 green bridges, plus complementary transport and environmental enhancements. Extensive new facilities for walking, cycling and horse-riding were built along the route, including connections to the South West Coast Path. A new park and ride facility and rugby pitches were also developed on an adjacent landfill site, along with the creation of some 200ha of green infrastructure in the Lorton Valley Nature Park. A landmark sculpture midway along the route, Jurassic Stones by artist Richard Harris, was funded by Arts Council England.

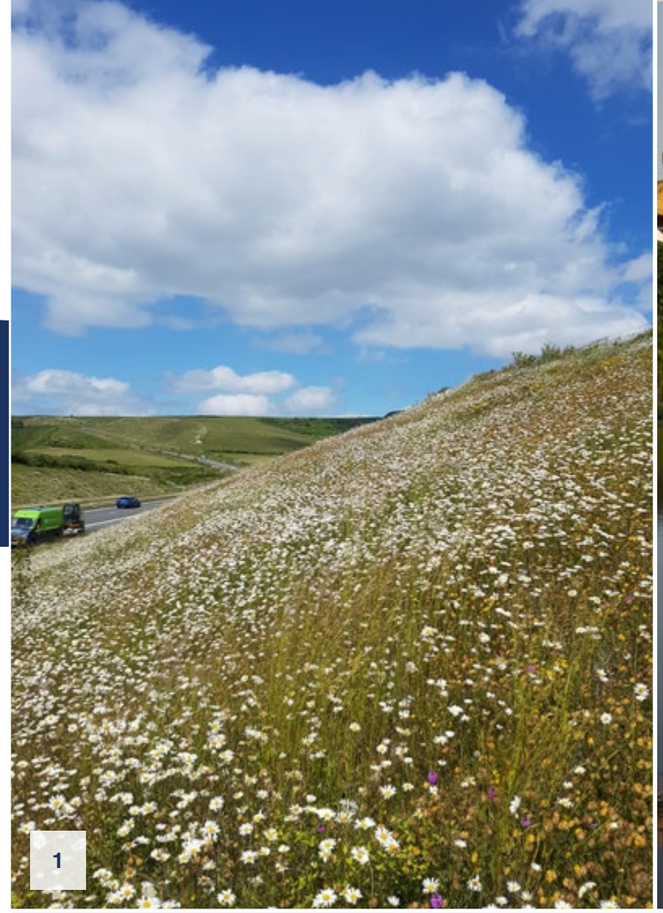
Several chalk cuttings through the Dorset Lowlands were made during the earthworks and the resultant slopes and verges were seeded with local grasses and wildflowers to ensure they blended with the surrounding landscape and supported biodiversity. Very little topsoil was used to create the necessary low-fertility growing conditions for the wildflowers.

Since opening, 30 species of butterfly have been recorded on these successfully developing chalk and limestone grasslands.

Dorset County Council has also taken an innovative approach to managing the scheme by maintaining low soil fertility through the collection of grass cuttings. Combined with the use of low nutrient soils in construction and wildflowers that restrict grass growth naturally, the road verges require less cutting, saving money while supporting biodiversity. This approach has now been adopted across Dorset, earning the Council a national Environmental Services Award.

Design principles

- Inclusive
- Fits in context
- Environmentally sustainable
- Thorough



Images **1. Flower power:** The use of low nutrient soils during construction and seeding of wildflowers attracts and sustains pollinating insects along the route. It also provides a pleasant outlook for motorists that changes with the seasons. Note use of visually unobtrusive galvanised post and wire fencing along the route. **2. Jurassic stones:** Fossil rich boulders revealed during earthworks were used to create an artwork within a balancing pond. **3. Pedal power:** Walking and cycling facilities run alongside much of the route.

The Luminous Veil, Canada

Facts

Location _____ Prince Edward Viaduct (Bloor Street Viaduct), Toronto, Ontario, Canada
Length _____ 0.5km
Authority _____ City of Toronto
Designer _____ Dereck Revington Studio (architects) and Yolles Partnership (engineers)
Year completed _____ barrier 2003, lighting 2015

Description

The Prince Edward Viaduct is a historic steel arch structure completed in 1918, some 40 metres above the Don Valley in Toronto. Over time the viaduct had become known locally as 'the bridge of death', unenviably rivalling the Golden Gate Bridge in San Francisco for the number of suicides recorded, with some 400 deaths by the time a national design competition for a barrier was announced in 1998.

The competition winning design known as the Luminous Veil, consists of over 9,000 stainless steel rods (or strings), 12cm apart and five metres high, stretched to cantilevered galvanised steel masts attached to the balustrades of the historic bridge. The new cantilevered structure, completed in 2003, carefully references the spacing and rhythm of the original historic streel structure below, but does not seek to imitate it. The barrier was originally intended to be lit, but this was not completed until 2015 in time for the Pan American Games in a second phase of the project. A third phase to light the whole historic structure below is planned, subject to future funding.

Lead designer Dereck Revington metaphorically refers to the barrier as a painting, a musical instrument, an orchestra, and sought to create a piece of functional public art that expressed healing and joy as well as mourning. Rising costs initially threatened to derail the project, but private match funding allowed the original vision to be realised and averted the erection of chain link fencing as a utilitarian alternative.

The outcome is a beautiful structure that is functional and robust, effectively deterring access, and also maintains views and complements the historic bridge. Most importantly however, the structure has changed perceptions of the bridge and the place, while acknowledging the shadow of those that have lost their lives here.

The project has won numerous architectural, engineering, lighting and mental health awards, recognising the successful bringing together of structural engineering, architecture and art to create a project that is more than a sum of its parts.

Design principles

- Safe and useful
- Inclusive
- Understandable
- Innovative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Images **1. A bridge with a view:** Views to the Don Valley are maintained but physical access effectively deterred by the stainless steel 'strings'. **2. Elegant:** The new structure is both refined and dynamic in appearance. Colour changing LEDs create a different atmosphere and meaning at night. **3. Integrated:** The design of the new structure is coordinated with that of the old in terms of symmetry and rhythm.

Freeway Park, USA

Facts

Location Interstate 5, Seattle, Washington, USA
Length 2.2ha urban park
Authority City of Seattle
Designer Lawrence Halprin Associates
Year completed 1976

Description

When Interstate 5 was cut through Seattle in the 1960s, it divided the city, separating the centre from neighbourhoods to the east and changing the character of adjacent areas. The new urban freeway was wide, loud and intrusive. Many in the community recognised the resulting aesthetic, environmental and urban planning problems before the I-5 was even completed.

In his 1966 book Freeways, landscape architect Lawrence Halprin proposed to integrate such new roads into the cityscape. He didn't seek to completely hide them, but to mitigate and complement them, and to knit neighbourhoods on either side back together. Soon after publication, Halprin was invited to develop his new ideas in Seattle with architect Angela Danadjieva. They proposed a new type of urban park, where community spaces would sit over a depressed section of the I-5 and restore pedestrian access to cut off neighbourhoods.

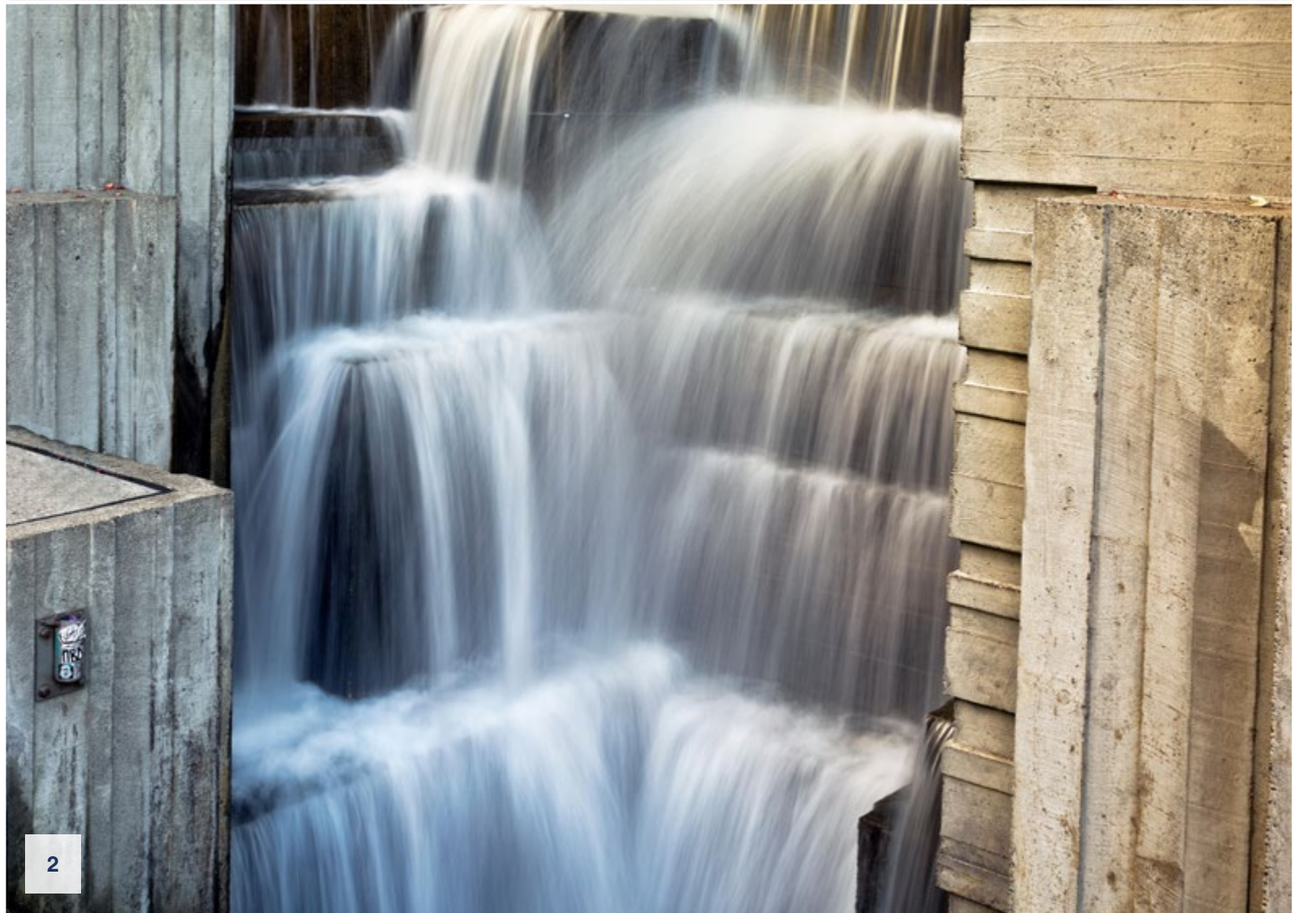
Completed in 1976, Freeway Park is defined by a series of irregular linked plazas enclosed by planting and walls. Distinctive architectural forms, zig-zagging pathways and fountains such as the 'canyon' and the 'cascades', where the sound of water masks the noise of traffic thundering past, echo both the western mountain ranges and the city's topography. The public spaces created are flexible in their use, offering the opportunity for large gatherings, as well as solitude in the heart of the city.

In keeping with the context, the Brutalist board-formed concrete walls, planters and seating, create a 'freeway vernacular' that reflects the surrounding road infrastructure. The water features and extensive planting, both of which cascade over walls at times, create a contrasting natural aesthetic. To overcome the many challenges of building a complex urban park over a road, a variety of innovative techniques were developed including the use of lightweight soils and shallow planting beds.

The park was extended in the 1980s and its tree canopy upgraded in 2005. Further improvement and restoration works are planned, but Freeway Park remains a pioneering work of modernist landscape architecture and a modern design icon.

Design principles

- Inclusive
- Understandable
- Fits in context
- Innovative



Images **1. Freeway vernacular:** The I-5 sits in an urban canyon below and the park echoes both the topography of the cityscape and that of the western mountain range. Clever architectural forms provide opportunities for informal seating and climbing, while traffic roars past on the I-5 unnoticed. **2. Cascades:** Brutalist concrete waterfalls define the character of the urban park and effectively mask noise from I-5.

A3 Hindhead, UK

Facts

Location _____ Surrey, UK
Length _____ 6.5km dual carriageway with 1.8km in tunnel
Client _____ Highways Agency (now National Highways)
Designer _____ Mott MacDonald (designer), Balfour Beatty (contractor)
Year completed _____ 2011

Description

The scheme completed the dualling of the A3 between London and Portsmouth, removing a bottleneck at the Devil's Punch Bowl and Hindhead. Environmental constraints included the Surrey Hills Area of Outstanding Natural Beauty and a Site of Special Scientific Interest (SSSI). Both on-line and off-line at-grade options were discounted due to their environmental impact. A tunnel beneath Hindhead Common was the most expensive option, but had wider and greater benefits for biodiversity, tranquillity, tourism and recreation.

The scheme consists of a twin bored tunnel in addition to at-grade sections of dual carriageway with 5 underpasses, an overbridge at a new grade separated junction, and a pedestrian overbridge. The tunnel service area to the north has a green roof to merge it into the adjacent landscape and parking hidden behind. To the south the tunnel service area similarly merges into an embankment. The tunnel portals are simple and elegant and allow the landscape to dominate. The concrete arch of the pedestrian bridge reflects the form and materiality of the tunnel portals.

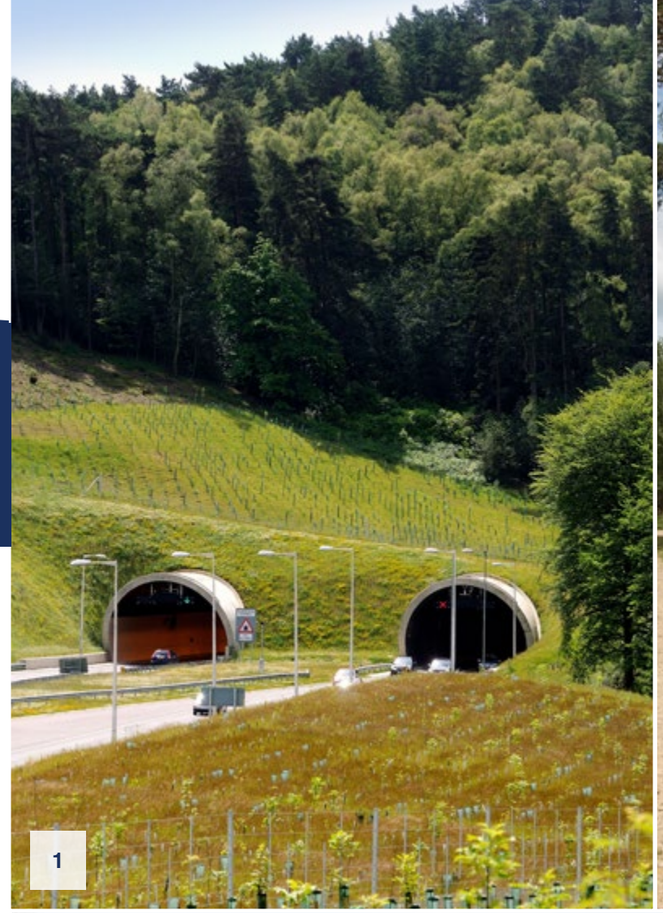
Trees were cleared from existing heathland to restore habitat and to open-up views. The old carriageway was buried in spoil from the tunnel and seeded with heather and grasses from Hindhead Common. Further work by the National Trust to restore a mix of upland and lowland heath and woodland habitats has improved the condition of the SSSI to 'favourable'.

An adjacent National Trust car park was extended, and the visitors centre and café refurbished to cater for a 20% increase in visitors after the opening of the tunnel. A Heritage Lottery funded sculpture co-created with local children sits on the line of the former A3 and celebrates the reunification of Hindhead Common and the Devil's Punch Bowl.

At the southern end of the scheme, the Canadian Memorial Underpass provides access to the two halves of Bramshott Common which was historically split by the A3. The war memorial consists of an avenue of maple trees and the underpass gives access to linear and circular walks from an adjacent car park.

Design principles

- Safe and useful
- Understandable
- Collaborative
- Long-lasting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Images **1. Light at the end of the tunnel:** The design of the tunnel portals and fencing is restrained, allowing the landscape of the hillside to take visual prominence. **2. Walk this way:** The number of visitors to the area increased by 20% after the opening of the tunnel and removal of the old A3. **3&4. Here today, gone tomorrow**: The covering of the old carriageway (3) in stone from tunnelling and the spreading of local seeds has allowed the heathland to begin to regenerate and a tranquil recreational area to be created (4).

A82 Pulpit Rock, UK

Facts

Location Loch Lomond, UK
Length 0.5km single carriageway
Authority Transport Scotland
Designer Tony Gee (consultants), McLaughlin & Harvey (contractor)
Year completed 2015

Description

The A82 is one of Scotland's most iconic scenic tourist routes and is the main road from Glasgow to the West of Scotland and the Highlands. At Pulpit Rock the A82 had been reduced to a single lane controlled with traffic signals due to continued rock falls onto an already narrow carriageway around the headland. The traffic signals caused significant delays, particularly during the summer.

Pulpit Rock itself is a Scheduled Monument comprised of a large rock outcrop into which a vestry was excavated in 1825 to accommodate the parish minister while he conducted open air services. With Loch Lomond to the east and a rail line to the west and with no route through, there were limited options to remove the bottleneck for traffic around the rock.

Following close consultation with the Loch Lomond & The Trossachs National Park, a relatively small but complex improvement scheme involving the stabilisation of the existing rock faces and widening of the existing carriageway onto a 180m long 5m wide viaduct cantilevered over the loch was developed. As required by the National Park, the scheme provides good views for motorists of the stunning and iconic landscape.

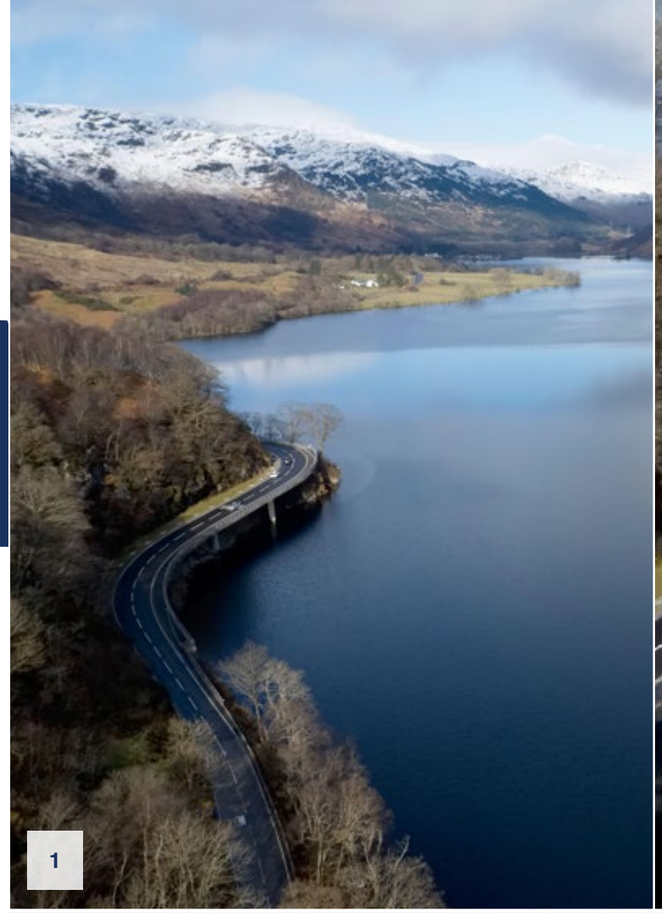
Although dry stone walling is common on the A82 in this section, the viaduct parapet is a bespoke steel design which fits with the cantilevered nature of the structure and allows for views over the loch. A retaining structure was discounted to preserve the integrity of the shoreline, and the viaduct abutments are clad in local stone at either end.

Despite the very constrained nature of the site, the A82 remained open to traffic during the day for the whole construction period, with only a limited number of night closures. These night closures allowed sections of the weathering steel structure to be delivered and lifted into place.

The scheme has won several awards including the Saltire Society's Award for Civil Engineering in recognition of its innovative approach on a difficult site.

Design principles

- Safe and useful
- Restrained
- Thorough
- Innovative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Images: **1. Take the high road:** The widened carriageway cantilevers over the shoreline, preserving Pulpit Rock and views of the loch and wider landscape. **2. Opportunities and constraints:** Night working on key elements allowed the A82 to remain open during the day despite the constrained nature of the site. **3. Take the low road:** The curve of the road still follows the shoreline. Weathering steel, stone abutments and elegant detailing help fit the viaduct to the dramatic context.

A4 Delft – Schiedam, Netherlands

Facts

Location Delft, Netherlands
Length 7km motorway
Authority Rijkswaterstaat
Designer Arcadis, ZJA Zwarts & Jansma Architects, Bosch Slabbers Landscape Architects (consultants) and Boskalis, Heijmans, VolkerWessels (A4ALL contractors)
Year completed 2015

Description

The A4 motorway between Delft and Schiedam significantly improves access between Rotterdam and The Hague. The motorway transects an area of outstanding natural beauty and a polder landscape with willow, godwit birds, sheep and ditches. Following many years of objections concerning the potential for visual and noise impacts on the sensitive rural and urban setting, a key design challenge was to conceal the motorway. This was a difficult challenge due to the volume of traffic, the scale of the new road and ground conditions.

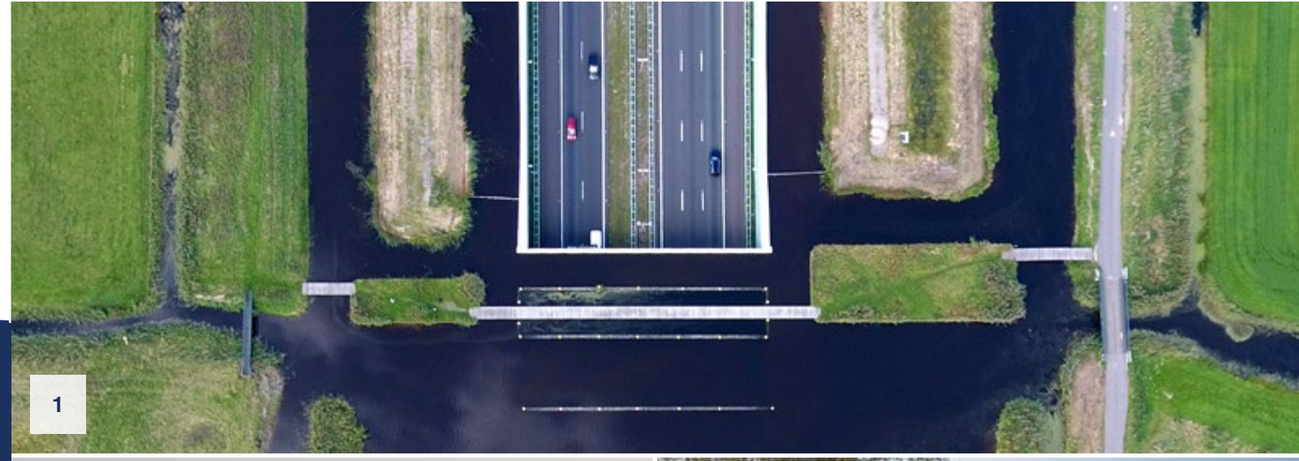
Environmental sustainability has been a primary focus of the project. The motorway is a 'honey highway', with habitat created for bees and other pollinating insects through the planting of 44 regional wildflower species. Another key feature of the project is the eco-aqueduct constructed across the motorway to connect natural systems. With a width of 100m, it supports biodiversity and recreation alongside each other.

The motorway has been successfully embedded into the context through careful design and is formed of three parts. The first part was built at grade through a recreational area outside Delft. The second part is recessed and transects the cultural-historic polder landscape. This landscape contains a bird nesting area, a green-blue bridge, extensive recreational facilities and a complex water management system.

For the third part of the route, the motorway is entirely enclosed in a 2km land tunnel through an urban area of Rotterdam. The tunnel was constructed from cement-bentonite walls with water resistant layers to form a container fitted with soundproofing at each end. Above the tunnel a new landscaped sports park has become a valuable community asset.

Design principles

- Fits in context
- Environmentally sustainable
- Thorough
- Innovative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Images **1. Green – blue bridge:** A combination of green and blue infrastructure crosses the A4 motorway. **2. Below the water line:** Much of the A4 is constructed below the waterline. **3. Level crossing:** Local walking and cycling routes cross the busy A4. **4. Gone fishing:** Water comes right up to the A4's retaining walls and is accessible to the public. **5. Urban parkland:** As the A4 nears the city, it is covered by parkland and sports pitches. **6. Polder landscape:** The A4 is another channel in the constructed landscape, where traffic flows instead of water.

A894 Kylesku Bridge, UK

Facts

Location Kylesku, UK
Length 275m (bridge) plus approach roads
Authority Highland Regional Council
Designer Ove Arup (consultants) and Morrisons (contractors)
Year completed 1984

Description

The iconic Kylesku Bridge, now officially named Drochaid a' Chaolais Chumhaing in Gaelic, was built to replace the short ferry crossing between Kylesku and Kylestrome. The ferry had multiple disadvantages for road users; it was a significant bottleneck and only operated during daylight hours. As the only other alternative to crossing the loch was a 175km detour via inland roads, a bridge provided a better long-term solution.

Curving across the deep-sea inlet of An Caolas Cumhang on Loch a' Chairn Bhain, the bridge successfully improved connections between the West Highlands and the rest of Scotland, significantly reducing travel times and stimulating economic growth and the provision of services for residents and tourists. The bridge was an economical solution that is also aesthetically pleasing. Due to its remote, sometimes harsh, location, it was designed and built to be durable and relatively low maintenance.

Immediately recognisable by its brutalist aesthetic, curved design, V-shaped piers and spectacular landscape setting, Kylesku Bridge is one of Scotland's most visually striking and technically innovative modern concrete structures. The prestressed concrete bridge deck is unusual, but selected to reflect the natural contours of the surrounding landscape and to tie into the existing approach roads. As such, it harmonises with the natural setting, responding to challenging topography while also giving its users panoramic views. The bridge deck is supported by two pairs of V-shaped piers located on the shores in order to reduce the length of the main span. There is no joint between the piers and the deck, with expansion joints and bearings located at the abutments to ease maintenance.

In 2019, the bridge was classified by Historic Environment Scotland as a Category A structure, regarded as "visually striking and technically innovative". The significance of the bridge is further reflected in its growing status as a tourist attraction along the North Coast 500 route due to its breath-taking views and use in numerous advertising campaigns.

Design principles

- Safe and useful
- Fits in context
- Innovative
- Long lasting


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Images **1. Rugged:** The brutalist concrete aesthetic contrasts yet complements the highland landscape. **2. Minimalism:** The angled piers reduce spans and minimise the depth of the deck. The small abutments also help minimise the visual impact. **3. Look at that:** The curved deck offers a panoramic view for motorists during the crossing. **4. Location, location:** Spanning the shortest distance and improving the existing roads resulted in the curved alignment.

A40 Northala Fields Park, UK

Facts

Location A40 London, UK
Length 18.5ha parkland
Authority Ealing Borough Council
Designer FoRM Associates, LDA Design
Year completed 2008

Description

Northala Fields Park lies to the east of Northholt and directly south of the A40 Western Avenue, a main artery through west London into central London. The open space is one of the most significant park developments in London in recent decades.

Northala Fields provided a highly innovative, economic and sustainable solution to the use of materials generated by the demolition of the original Wembley Stadium in 2003 and spoil from the construction of the new stadium and White City shopping centre. This waste and spoil was used to create the new park through waste disposal charges, turning the materials into new habitats for wildlife and a range of recreational facilities. The facilities include two playgrounds, walking trails and viewing points, a model boating lake, six fishing lakes and three wildlife ponds. Along with a visitors' centre, these attract both local people and visitors from further afield to the unique development.

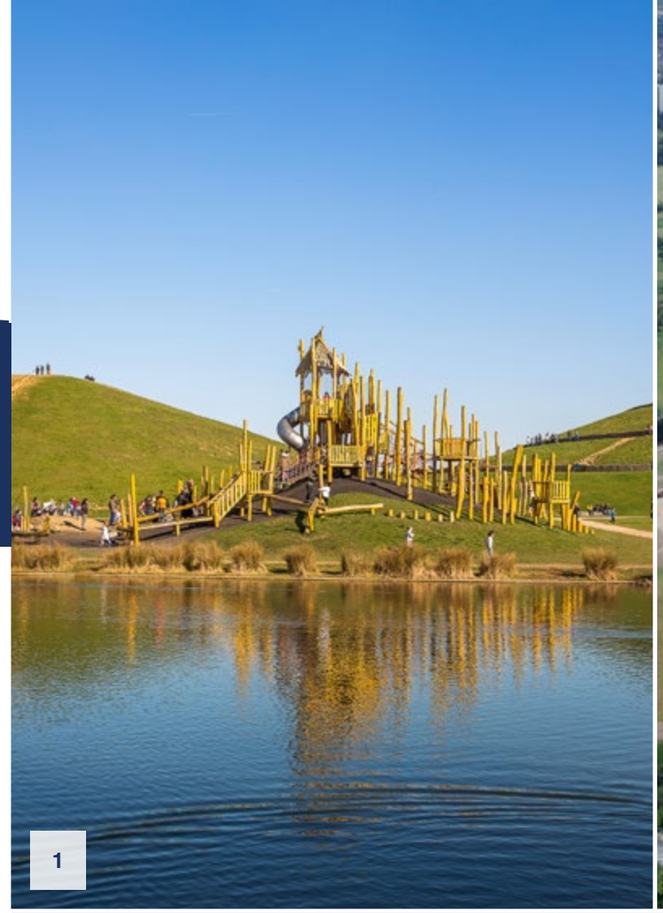
Four conical earth mounds help to reduce visual and noise intrusion from the adjacent A40 and provide a view to a unique sculptural landmark from the road. The tallest mound at 22m high provides a 360-degree panoramic view of the surrounding area and as far as the City and Canary Wharf. Gabions filled with rubble are used across the site to define boundaries and paths.

The wildlife value of Northala Fields has been improved with the re-modelling of the site from derelict land to a public park. The project created new areas of habitat using native species. Each mound was designed with varying soil conditions to support different planting mixes to create four distinct habitats – grassland, wildflower meadows, streams and woodland.

The design approach considered a careful balance of enhancing biodiversity in the area, while meeting requirements to minimise any potential bird strike hazard to aircraft from the nearby Northolt Aerodrome. Another significant feature of the design was the extensive community involvement in all stages to meet local needs.

Design principles

- Inclusive
- Environmentally sustainable
- Innovative
- Collaborative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Images **1. Waste not, want not:** Waste from the demolition of the old Wembley stadium was used to create a much-needed new public park. **2. View from above:** A new landscape with its distinctive forms was created adjacent to the A40 in London, funded solely through landfill tax. **3. View from the park:** A path leads up one of the mounds with views over London and the park with its areas of wetlands. **4. View from the road:** The land art is appropriately scaled to be viewed at speed from the A40.

A2 Chiasso, Switzerland

Facts

Location _____ A2 Chiasso, Switzerland
Length _____ 1.8KM
Authority _____ State of Canton Ticino
Designer _____ Mario Botta (architects) and Grignoli Muttoni Partners (engineers)
Year completed _____ 2004

Description

The A2 through Chiasso previously created a significant noise issue for residents due to the large number of vehicles, and in particular HGV's, crossing into and from Italy. Noise barriers were needed to provide relief for residents, but the urban location required a suitable architectural response. The conceptual response was a 'tree lined' street, with a row of steel 'trees' to support transparent panels.

Chiasso itself is divided by the national border with Italy, a rail line and the A2 motorway. By providing noise barriers, it was vital to avoid further division. The design of the barriers responds to the urban character, while at the same time creates through their transparency, a continuity between the built area and the surrounding landscape.

The noise barriers consist of a number of different modules depending on the location. In order to contain the noise, the barriers extend over the carriageway in places and horizontal elements on the walls avoid excessive noise reflection. The structure on the north to south side is formed by a roof of laminated glass panels which rest on a steel lattice supported by a main tubular steel 'trunk' and 'branches'. With a maximum height of 8.5m and regularly spaced at 10.5m, the visual effect is of a tree lined street, albeit at a motorway scale and viewed at speed. The south to north side structure, while much simpler, consists of similar modular elements giving the whole design an overall unity.

The design solution did not try to hide the motorway, but accepted its presence and sought to reduce the potential visual severance of the barriers. In addition, the modular system developed meant production and construction was efficient.

The project has resulted in a significant improvement to the quality of life of residents with a reduction in noise through a design that is both functional and visually striking.

Design principles

- Inclusive
- Fits in context
- Thorough
- Innovative

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Images **1. Extended protection:** Local residents living at height are also insulated from noise generated by adjacent access roads with a similar family of structures. **2. Reaching for the sky:** The trunk like bases of the structure have been carefully integrated into the vehicle barrier. **3. Tree line:** To reduce the noise generated by the motorway, modular steel 'trees' support a transparent canopy.

Craigieburn Bypass, Australia

Facts

Location _____ Melbourne, Australia
Length _____ 4.8 KM
Authority _____ Victoria
Designer _____ Tonkin Zulaikha Greer, Taylor Cullity Lethlean and Robert Owen
Year completed _____ 2005

Description

The Craigieburn Bypass, linking the Hume Freeway to the Metropolitan Ring Road, showcases Melbourne's vibrant design culture, while saving some 30 minutes on peak hour journey times. The bypass integrates art, landscape and road infrastructure to create a dynamic driving experience while reducing impacts on adjacent communities.

The design includes two main sets of walls to provide noise attenuation and a pedestrian bridge on the southern section of the route, as well as establishing design parameters for other bridges, barriers and retaining structures.

The 'curtain wall', appears as long sinuous earth toned ribbon, fluid in its form, dynamic and experiential. Made from facetted steel sheets modelled in simple concave and convex undulating folds, it sits atop of a recessed dark concrete base.

At the climax of the curtain wall, the ribbon rises over the road as a pedestrian bridge to create a city gateway. Carefully sited at the point where motorists first see Melbourne's skyline, it frames the view in a welcoming gesture. Similarly, when exiting the city, it frames a view of the wider landscape ahead. The curved bridge is complex in plan and elevation, and its truss structure is clad with the same weathering steel as the wall from which it springs.

By contrast, the 'scrim wall' is located alongside a residential area and comprises patterned acrylic panels and repeated bright blue sculptural monoliths. The patterned acrylic provides translucency and the contrasting monoliths are rotated slightly to create a constantly changing driving experience. At night part of the scrim wall is illuminated with 11,000 LEDs to generate patterns in response to traffic levels.

Gabions and concrete panels are also used for sound attenuation, responding to the local context and adding to the sequential and dynamic driving experience. The bypass won multiple awards for its creative response to movement, arrival and context. It creates a suitable northern gateway to the city while resolving the need to reroute the Hume Highway through expanding urban fringes.

Design principles

- Safe and useful
- Understandable
- Fits in context
- Innovative

Images **1. Heavy metal:** The earthy colours of the weathering steel footbridge across the bypass creates a local landmark and visual gateway to Melbourne. **2. Functional art:** Sculptural barriers along the route insulate residents from noise while also providing visual interest to road users. **3. Night light:** Some barriers are transformed in the evening with lighting. The function and importance of the barriers is highlighted, not hidden. **4. Framed:** The weathering steel noise barrier continues over the footbridge to frame a view of downtown Melbourne for road users.

M5 Gloucester Services, UK

Facts

Location _____ Gloucestershire, UK
Length _____ 25 ha
Authority _____ Stroud District Council
Designer _____ Glen Howells Architects and BWB Consulting
Year completed _____ 2014

Description

Gloucester Services are situated on each side of the M5 between Junction 11A and Junction 12 in Gloucestershire. The site is on the boundary of the Cotswold Area of Outstanding National Beauty (AONB). The services provide rest and refreshment, fuel and electric vehicle charging and extensive landscaping, including green roofs on buildings. Farm shops and kitchens offering local produce and food, replace fast-food outlets normally associated with such services. However, the planning of the services did not come without opposition due to the potential for damage to the AONB setting.

To lessen the potential impact on the AONB, arched and sloping green roofs reflect the form of the surrounding hills and help the buildings blend into the wider landscape. The green roofs also help insulate, slow storm water runoff and support biodiversity. Attenuation ponds are provided as part of a sustainable drainage system and also provide a pleasant outlook for diners. Tree planting is used throughout the sites to help screen the services, and local seed mixes were used. Species such as yellow rattle and birdsfoot trefoil were included in grassland and on the roofs to attract and support pollinator species.

The award winning main buildings, designed to achieve a BREEAM Excellent rating, are constructed from timber and clad in local Cotswold stone. Both materials have a low environmental impact and create a warm and inviting environment. Skylights reduce the demand for lighting during the day and with their green roofs, the services are an exemplar for the development of sustainable service areas.

As an opportunity to create a special experience, the services celebrate the people and produce of Gloucestershire. With thousands of people stopping each day, local producers have been given wider exposure for their businesses. In addition, through a unique partnership with the Gloucestershire Gateway Trust, the services help invest in organisations that bring sustainable positive change to more deprived areas of Gloucestershire, providing jobs and supporting local regeneration schemes.

Design principles

- Inclusive
- Fits in context
- Environmentally sustainable
- Thorough

Images **1. Reflections:** Attenuation ponds manage storm runoff from the building and car parks and provide a pleasant and relaxing outlook for diners. **2. Sustainable development:** The use of timber, natural light and green roofs minimises the environmental footprint of the buildings. **3. Merging:** The sloping form, green roof and local stone, helps the service area building blend into its context. The entrance is also obvious from the car park, eliminating the need for signage.

A75 Millau Viaduct, France

Facts

Location _____ Millau, France
Length _____ 2.5km bridge
Authority _____ French Ministry of Public Works
Designer _____ Michel Virlogeux, Foster&Partners, Eiffage (contractor)
Year completed _____ 2004

Description

For many years local authorities had tried to solve congestion in the town of Millau, southern France, which is on the main north-south route between Paris and the Mediterranean. In the end, the dramatic Millau Viaduct provided the solution, carrying the A75 safely across the 250m deep and 2.5km wide Tarn Valley and completing a missing link in the national motorway network.

Crossing one of the deepest valleys in France, the viaduct pushed the boundaries of structural engineering and construction. Engineer Michel Virlogeux first conceived the original concept in the 1980s, however it was initially considered unfeasible until other options, including a tunnel, were dismissed. In the end following a competition, the viaduct was constructed under budget and months ahead of schedule.

Utilising concrete for the 7 piers and steel for the deck and pylons, Millau Viaduct is one of the world's longest cable-stayed bridges at almost 2.5km and the highest at 343m. The six central spans are 342m each and outer two spans are 204m each. The viaduct has a 3% slope and gently curves on a 20km radius. Temporary pylons were used to support the prefabricated deck sections high above the valley floor during construction before the cables were installed.

To accommodate the expansion and contraction of the deck, each pier and pylon splits into two thinner sections at deck level. This adds to the viaduct's dramatic silhouette. There is no hiding a structure on this scale and height, but its subtle and elegant appearance helps it to fit into the wider landscape.

4.8 million vehicles pass over the viaduct annually and 1 million visitors stop each year. As planned through the commitment of 1% of the budget to regional economic development, the viaduct has brought new opportunities to Millau by improving access and is now a popular stop off point for tourists traveling to southern France and Spain. A visitor centre with a viewing area enables tourists to learn about the local area and the story of the viaduct.

Design principles

- Safe and useful
- Understandable
- Restrained
- Innovative


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Images **1. Framed:** The visitor centre tells the story of the viaduct and the local area and provides a view of the structure which has become an attraction itself. **2. Windbreaker:** 3m tall transparent screens along the length of the viaduct shield it from high winds, but also allow for spectacular views out. **3. View from below:** Taller than the Eiffel Tower, the viaduct's piers soar above the valley. **4. Anticipation:** The cable stayed structure on the A75 motorway marches over the valley creating a dramatic landmark.

Mersey Gateway, UK

Facts

Location Widnes/Runcorn, Cheshire, UK
Length 2.4KM
Authority Halton Borough Council
Designer Knight Architects, Ramboll, CH2M, Mersey Link Consortium (contractor)
Year completed 2017

Description

Mersey Gateway is a significant highway improvement project providing a major river crossing of the Mersey between Runcorn and Widnes in the Liverpool City Region. The six-lane crossing is the longest in England and provides an elegantly integrated solution, acting as a catalyst for growth in the local borough and wider region. The bridge is part of a new and improved 9km link road project providing access to the motorway network; a significant undertaking for a small local authority.

Mersey Gateway Bridge is the first long span cable supported concrete bridge constructed in the UK. It is located 1.5km upstream from the older and previously heavily congested Silver Jubilee bridge which will provide for local access only in the future. The new bridge provides a vital new link for the region by providing better and more reliable access from Liverpool to the M56 motorway over the River Mersey, St Helens Canal and Manchester Ship Canal, but will also drive local regeneration and development.

The distinctive three tower design is a unique composition for a large cable-stayed bridge, with the two outer towers markedly taller than the central one. The position of all three towers provides an optimum span combination, minimising the footprint within the environmentally sensitive estuary and while observing a maximum height set by the nearby Liverpool Airport. The curved approaches to the bridge enhance the driver experience by providing varying views of the structure. Feature lighting adds to this experience at night.

The design was selected from a range of options to maximise benefits for users and the local community, minimise impact on the surrounding environment and also to reduce future maintenance requirements. Collaboration between designer and constructor was exemplified in the construction of the approach viaducts, which adopted a moveable scaffold system and the use of sliding framework travellers for the balanced cantilevers of the cable-stayed bridges deck. The award-winning bridge was completed on time and under budget and provides an iconic new landmark for the region.

Design principles

- Inclusive
- Understandable
- Restrained
- Long lasting


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Images **1. Over the salt marsh:** The decks of the approach viaducts and the bridge used a similar traveling form system to cast the concrete insitu. **2. All lit up:** The lower central tower creates a distinctive silhouette. The colour and brightness of the LED bridge lighting changes. **3. Cable tidy:** The cable stay bridge was designed for rapid construction and minimal maintenance. Transparent wind shielding allows views out. **4. Cross the Mersey:** The new crossing with its long approach viaducts in the foreground and the iconic arch of the Silver Jubilee Bridge in the background during low tide.

Madrid Rio, Spain

Facts

Location Madrid, Spain
Length 6km linear park
Authority Ayuntamiento de Madrid (city council)
Designer Burgos & Garrido Arquitectos Asociados, Porras La Casta Arquitectos and Rubio & Álvarez-Sala (MRIO arquitectos)
Year completed 2015

Description

Madrid Rio is an urban park along a stretch of the Manzanares River in central Madrid, Spain. It is a new iconic feature of the city enabled by the tunnelling of the western stretch of the M30 ring road that previously had a poor safety record, severed the city from its river and created a barrier between two sides of the city. The project involved multiple tunnels with a total length of over 40km to bury the M30 motorway alongside the river. The construction of the tunnels was highly complex work modifying multiple layers of the city's infrastructure, while providing great relief to residents who had lived with the urban motorway for many years.

The previous at-grade stretch of motorway had removed Madrid's connection to its river, making it both inaccessible and invisible. Once the motorway had been tunnelled, large open spaces became vacant in the heart of the city providing an opportunity to reconnect neighbourhoods and create a renewed sense of place alongside a rediscovered river with its ecological, cultural and historic connections.

The award-winning project has successfully reconnected the historic city centre with its more modern periphery. It has provided new open spaces and opportunities for recreation in the heart of a dense city. Over 33,000 trees, 40km of footways and 30km of cycle tracks have transformed the area from one of traffic choked carriageways, to valued contemporary open spaces.

Some 120ha of new parkland has been created through the project. This includes new soft landscape, squares, paths and promenades, new play areas, sports facilities and an urban beach, all supported by the restoration of the river. It included the provision of 12 new pedestrian bridges and the redesign of 6 others to make them more pedestrian accessible. Alongside smaller gardens within Madrid Rio, larger parks include La Arganzuela, Salón de Pinos and Huerta de la Partida. These all have helped reconnect the city's social fabric.

Design principles

- Inclusive
- Understandable
- Thorough
- Collaborative


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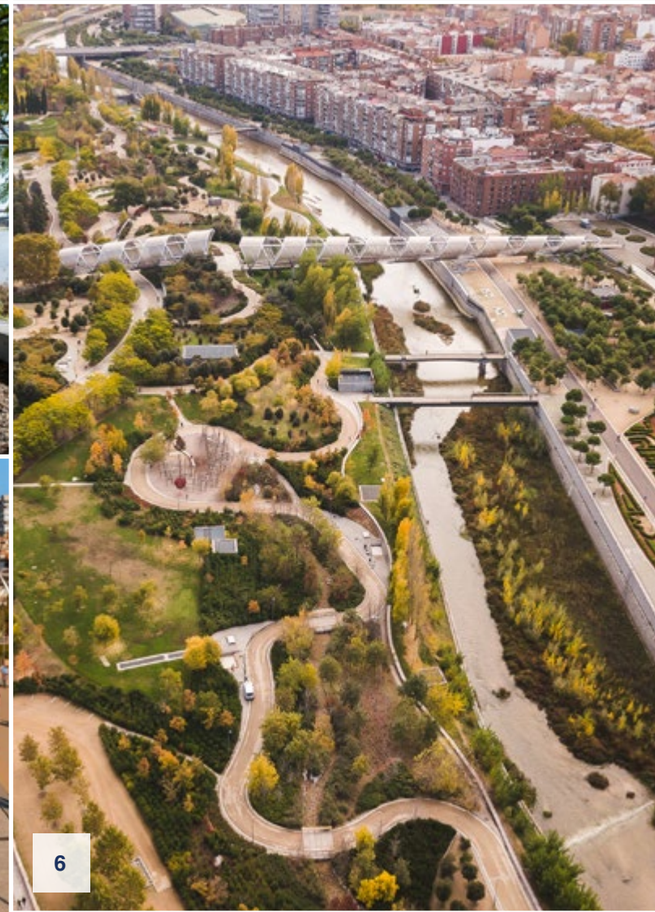
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Images **1. People over traffic:** The M30 on both sides of the river is now accommodated in tunnels below new urban spaces. **2. Crossing the Manzanares:** Numerous bridges allow for easy access over the river. **3. Out of sight, out of mind:** Traffic now flows more safely on the M30 under the city. **4. A waterfront rediscovered:** Where there were once carriageways choked with traffic, there are now landscaped promenades. **5. Healing the city:** The city has reclaimed its waterfront from highways infrastructure and traffic. **6. Child's play:** Play areas and urban recreational trails sit above the M30 below, protected from associated noise and air pollution.

Lusail Expressway, Qatar

Facts

Location _____ Doha, Qatar
Length _____ 5km
Authority _____ Ashghal (public works authority)
Designer _____ AECOM (designer), Hyundai (contractor)
Year completed _____ 2017

Description

The Lusail Expressway links Doha's central business district, West Bay and two of its most significant residential and commercial districts – The Pearl and Lusail. It provides four lanes in each direction and includes three complex multi-level interchanges containing multiple flyovers and tunnels alongside two additional bridges, which cross over the West Bay Lagoon canals.

Responding to the Qatar National Vision 2030 and the needs of the 2022 FIFA World Cup, the Qatar Expressway Programme is designed to improve highway capacity, connectivity and safety to meet the demands of regional population and economic growth.

The Expressway's iconic appearance is inspired by the Qatari marine heritage, forming a combination of Qatar's past and future. The blue wall graphics that line the retaining walls and tunnels are inspired by the waves of fishermen's nets under water and are designed to be viewed at speed.

The design of the project also focused on enhancing facilities for walking and cycling. The provision of 6.5km of pedestrian and cycle paths lining the Expressway provides social, health and environmental benefits. As well as the road, path and landscape works, the project upgraded the city's storm water drainage network and additionally the local electricity and telecommunications networks.

A key feature, the Al Wahda Arches, serves as the gateway to Doha's West Bay. At 89.7m, they are the tallest and most prominent architectural sculpture in Qatar. The unique tilted and intertwined arches, connected by a fishnet-like design referencing Qatar's maritime roots, demonstrate an innovative combination of the past and future. Lit at night, the arches are a landmark on the Doha skyline

Design principles

- Safe and useful
- Understandable
- Thorough
- Innovative


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Images **1. Looking forward:** Doha today is a place of growth and change, redefining itself from a sleepy port to a global city in only a matter of years. **2. Persian Gulf:** Super graphics reminiscent of the area's maritime and pearl diving past line the walls of underpasses and tunnels. **3. Looking cool:** White and blue tones provide relief from the harsh sun. **4. Time machine:** As the expressway connects the older part of the city to new neighbourhoods on the coast, it literally connects the past to the future through this gateway structure.

Øresund Link, Denmark/Sweden

Facts

Location Øresund Strait, Denmark/Sweden
Length 16km total link, 8km crossing
Authority Vejdirektoratet (Denmark)/Vägverket (Sweden)
Designer Arup (engineering), Hochtief, Skanska (lead contractors)
Year completed 1999

Description

The Oresund Link which connects Sweden (Malmo), and Denmark (Copenhagen) is comprised of a 4km tunnel, a 4km artificial island and an 8km cable-stayed bridge. The Link has decreased journey time between Sweden and Denmark to a ten-minute drive or train journey, promoting cross border communication and economic growth across the region.

For centuries, the Oresund Straight presented an obstacle to the transport of passengers and freight between Sweden and Denmark. It had also been a psychological barrier and the difficult journey hindered closer relations between the two cities, regions and countries.

The 1991 agreement between the Danish and Swedish governments stated the bridge would need to be constructed with due consideration for “what is ecologically motivated, technically possible and financially reasonable to prevent any detrimental effects on the environment”. The cable-stayed bridge is the longest road and railway bridge in Europe and its 490m central span is the longest in the world to carry both road and rail traffic. The bridge is a composite structure with a steel truss supporting a concrete deck carrying four lanes of traffic above two railway tracks inside the truss on a steel deck. The steel trusses were prefabricated onshore in large sections.

Partly due to the proximity of Copenhagen Airport and to allow for an unobstructed passage within the Straight, an uninhabited artificial island called Peberholm connects the bridge and tunnel. The island now hosts an abundance of flora and fauna having been allowed to develop freely. As well as over 500 different plant species, Peberholm has become a new breeding ground for birds in the Oresund Straight.

The Link has created a wider cross border region with a combined population of nearly 4 million people. Due to the presence of the fixed link, it has become easier to live on either side of the Straight and to work on the other. The short commute has supported sustainable development on both sides and cooperation on a cultural, political and economic level continues to develop.

Design principles

- Safe and useful
- Innovative
- Collaborative
- Long lasting


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Images **1. Over and under:** The transition between bridge and tunnel takes place on an artificial island in the Øresund Straight. **2. Regional development:** Linking Copenhagen in Denmark and Malmo in Sweden, the new link has transformed the local and regional economies. **3. Dual use:** A railway runs below the road deck. One piece of infrastructure, but two modes of transport efficiently accommodated. **4. A tale of two towers:** Part cable stay bridge, part viaduct and part tunnel via an artificial island, the link required collaboration not only between two nations and cities, but also two road and rail authorities.

Limburg, Belgium

Facts

Location _____ Flanders, Belgium
Length _____ 212m (Cycling Through Water), 700m (Cycling Through Trees)
Authority _____ Visit Limburg (project sponsor)
Designer _____ buro landschap (landscape architects)
Year completed _____ 2016 (cycling through water) 2019 (cycling through trees)

Description

Limburg is known for cycling infrastructure, with over 2,000km of cycle paths throughout the province, including three unique ones: Cycling Through Water, Trees and Heathland. These iconic developments provide a distinct view of nature in places that people might otherwise cycle past without noticing. The innovative design of these paths allows users to enjoy the landscape in a completely original way.

Cycling Through Water is a 212m concrete path in the De Wijers Nature Reserve allowing cyclists to pedal straight through a lake, with water at eye level on both sides. From a distance, the position of the path creates the illusion of people gliding through the water. The path establishes a fine balance between ecology and tourism. As part of the scheme, a nature conservation project has improved conditions for local flora and fauna, overlooked by an adjacent open-air museum.

Cycling Through Trees takes cyclists up 10m through the treetops of the Pijnven Nature Reserve. A gradually inclined path allows users to ride along a 100m diameter double circle that offers 360-degree views of the surrounding landscape. The path is elevated on a network of weathering steel columns, reflecting the form and colour of the trunks of the pine trees that encompass it, thus enabling the entire structure to fit into its context.

Cycling Through Heathland in Hoge Kempen National Park is the latest development that takes cyclists over a 300m wooden structure as part of a 4km path through pine forests and heathland. The structure provides a panoramic view for cyclists across the landscape at its highest point.

All three projects have become highly popular amongst tourists and locals alike, sustainably boosting the local economy and encouraging active travel and recreation. A fourth attraction, Cycling Underground, is planned to take cyclists into the marl caves in the south of Limburg. All of these special experiences are part of a wider cycling network which creative design is making more attractive.

Design principles

- Inclusive
- Restrained
- Environmentally sustainable
- Innovative


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Images **1. Forest of columns:** A weathering steel structure takes cyclist up into the tree tops. The earthy tones help it blend into the forest. **2. Cycling through the trees:** The structure gives cyclists a different, lighter, perspective of the forest. **3. Cycling through the water:** The route goes through the lake, rather than over or around. **4. Water attraction:** Touring by cycle has boosted the local economy. **5. Eye level:** The unique cycling experience provides a different perspective.

M25 Runnymede Bridge, UK

Facts

Location _____ Surrey, UK
Length _____ 126m
Authority _____ Department of Transport (now National Highways)
Designer _____ Ove Arup (designer), Fairclough Civil Engineering (contractor)
Year completed _____ 1983

Description

A particular design challenge in constructing the M25 motorway was crossing the River Thames at Runnymede. A new bridge was needed alongside the existing bridge designed by architect Sir Edwin Lutyens. Designed in 1939, but not constructed until 1961 as part of the A30 Staines Bypass, the existing bridge presented both aesthetic and engineering challenges.

It was decided early on that a replica bridge to carry both the M25 and A30 would be visually inappropriate and difficult to construct in this sensitive location close to a weir and the historic meadows of Runnymede. The original bridge is a single low and wide arch over the river with shorter span arches onshore. High quality external finishes had been specified by Lutyens, including Portland stone, handmade facing bricks and white concrete. Although the original bridge has the appearance of a solid masonry structure, steel trusses concealed behind brick panels transfer loads from the deck to the arch.

The solution for the new bridge was an open spandrel arch of the same low and wide form as the original, but made up of four parallel white concrete frames. Each frame is made up of two balanced half-frames which are connected over the river. Trapezoidal portal rings in the middle of the half frames onshore transfer loads vertically to avoid disturbing the foundations of the original bridge in the London clay.

The open spandrels allow light to penetrate and avoid extending the tunnel effect of the original bridge for pedestrians and cyclists. A series of steps allow access to the river and introduce a degree of human scale to an otherwise monumental structure. Construction did not require traditional formwork in the river to support the arches as the frames were cast onshore, slid into position over the river and connected in the centre.

The new bridge is a thoroughly modern expression of a traditional bridge form which preserves and enhances the integrity of the original. It is a creative and technically innovative solution that generates a strong visual relationship with the original, but is not a copy.

Design principles

- Understandable
- Restrained
- Thorough
- Long-lasting


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Images **1. Reflections on modernism:** The aesthetic forms are a visual expression of the flow of structural forces in concrete. **2. No imitation here:** In harmony yet contrasting with the visually heavy brick infill structure adjacent, the new bridge allows access to the water from adjacent riverside paths. **3. Wide load:** The solution for the M25 was an efficient yet elegant structure that mirrors the adjacent bridge in form. **4. Inspiration:** The form of the original bridge provided the starting point for the design.

A21 Lamberhurst, UK

Facts

Location _____ Kent, UK
Length _____ 3.2km Bypass, 40m Green Bridge
Authority _____ Highways Agency (now National Highways)
Designer _____ Fira Landscape Architecture, May Gurney (now Kier Group)
Year completed _____ 2005

Description

The A21 Lamberhurst Bypass is a dual carriageway designed to remove through traffic on the London to Hastings route from the village of Lamberhurst. Alongside traffic calming measures in the village, the bypass relieved the village of heavy traffic and reduced the severance effect of the old A21. The scheme includes one of the UK's first land or green bridges, an innovative feature to support landscape and habitat connectivity. The award-winning green bridge maintains a historic driveway from the gatehouse to the National Trust's Scotney Castle, located in the High Weald Area of Outstanding National Beauty (AONB).

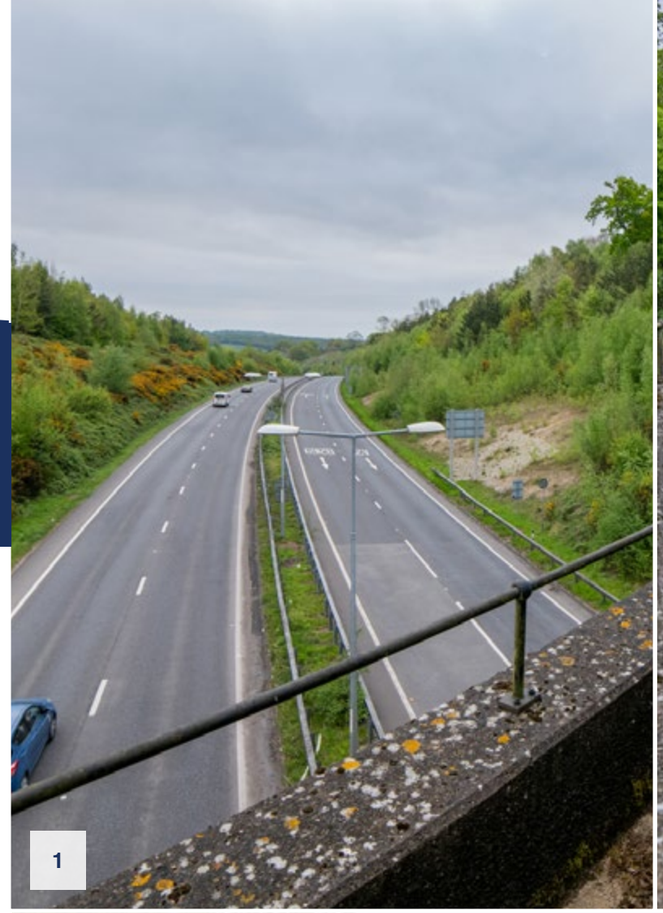
The densely planted green bridge spans 40m and was designed to ensure existing woodland along the ridge stretching east to west across the AONB was not interrupted by the construction of the road. It fits the natural and historic context and ensures the quality of visitors' experience and the picturesque landscape on the approach to the house is maintained. The bridge also serves as a connection between two woodland habitats and was designed to continue the roll of the hill that would have been interrupted by the bypass. The single span low concrete arch provides sufficient width and depth for trees and shrubs on each side of the access lane, giving wildlife sufficient space and successfully screening the road below.

Planting on the bridge and the approaches was designed to address the fragmented habitat areas of the local dormice population. The National Trust manages the landscape using traditional management techniques such as hedge laying, to create a safe and connected habitat over the bridge. A wealth of wildlife has been recorded using the bridge including deer, foxes and badgers.

Located entirely within the AONB, the bypass itself crosses the River Teise and the landscape was designed to fit with existing features. On the northern section, open views are created to the east from the road, whereas these views are closed on the southern section in proximity to the green bridge. A soft central reserve with wire rope vehicle restraint helps reduce the visual impact of the carriageways. The setting back of abutments on an access overbridge midway along the bypass allows for clearer forward views ahead.

Design principles

- Fits in context
- Restrained
- Environmentally sustainable
- Collaborative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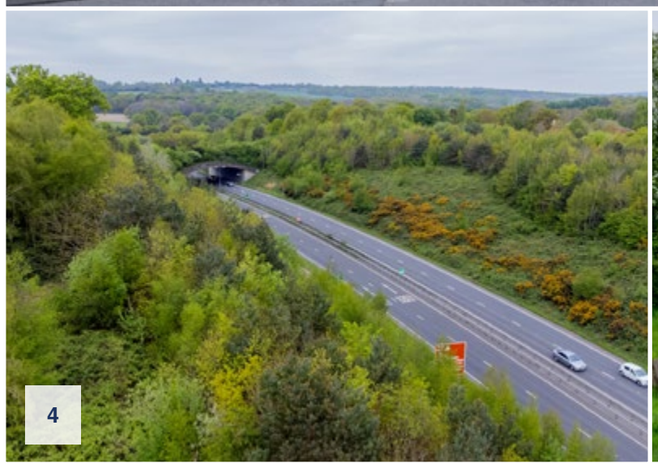
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Images **1. A view from the bridge:** The A21 is integrated into the wider landscape. **2. Life support:** The concrete arch bridge supports a variety of planting and wildlife. **3. Green infrastructure:** The green bridge crosses the A21 to provide access to the National Trust's Scotney Castle for people, flora and fauna. **4. Up and over:** The A21 links London to the south coast and here passes through an Area of Outstanding Natural Beauty. **5. Out of sight, out of mind:** Visitors are unaware of the A21 below.

A142 Ely Southern Bypass, UK

Facts

Location _____ Cambridgeshire, UK
Length _____ 1.7km
Authority _____ Cambridgeshire County Council
Designer _____ Knight Architects (bridge designer), VolkerFitzpatrick (contractor)
Year completed _____ 2018

Description

The Ely southern bypass completes the A142 to the south of the city, easing congestion by providing a new east-west link and connection to the A10. The single carriageway road includes a 300m long viaduct crossing the River Great Ouse, and a 100m long two span rail bridge. The new route removes the need for heavy goods vehicles to use a level railway crossing adjacent to a low railway underpass in the city. The bypass has successfully reduced congestion and a barrier to future growth of the city.

First proposed in 2003, the setting within the Fen Landscape and protected views towards Ely Cathedral posed a challenge for the bypass. Workshops with local stakeholders were subsequently held to help understand and resolve the complex issues raised and establish a positive approach to the design. As part of the project, improvements are also being undertaken in the station area to remove the level crossing and improve pedestrian and cycle access to the railway underpass.

In addition, a new walkway links the Fen Rivers Way and Ouse Valley Way footpaths together, providing a circular walking route in the area. This also improves access to the River Great Ouse Country Wildlife Site and provides users with improved views of Ely and its surrounding landscape from a look-out platform provided on the viaduct. As such, the bypass has been designed to resolve a long-standing traffic issue, and to provide residents and visitors an enhanced experience of the city and the Grade 1 listed Ely Cathedral.

The low-profile design of the railway bridge and viaduct enables them to sit comfortably within the fenland landscape while respecting the floodplain. Weathering steel was used for both structures to minimise future maintenance and fit into the landscape context. Features such as the viaduct's V shaped concrete piers and its cantilevered walkway separating pedestrians from traffic, demonstrate innovative thinking and sensitivity to the context. As a result, there was good support from the community and stakeholders for the project.

Design principles

- Safe and useful
- Inclusive
- Fits in context
- Thorough

Images **1. Protected:** The walkway adjacent to the carriageway is set down lower, reducing noise for users. The human scaled timber cladding softens the hard concrete structure for pedestrians who are in close proximity. **2. Viewing platform:** The footway/cycleway is positioned on the north side of the bridge to provide views of the wetlands and to Ely Cathedral. **3. Floodplain:** The bridge crosses the River Great Ouse on large V shaped piers. Its low height protects long distance views to medieval Ely Cathedral.

A7 Gates of Light, Netherlands

Facts

Location _____ Afsluitdijk, Netherlands
Length _____ 700m Floodgates
Authority _____ Rijkswaterstaat
Designer _____ Studio Roosegaarde
Year completed _____ 2017

Description

The Afsluitdijk is a 32km long and 90m wide dam and causeway, part of the larger Zuiderzee Works that provide flood protection and additional land for agriculture in the Netherlands. The Afsluitdijk dammed off the Zuiderzee, a salt water sea inlet, to create the Ijsselmeer, a new fresh water lake. In addition to providing a vital flood defence, the Afsluitdijk was designed to accommodate both a rail line and roadway. The rail line was never built, and the unused reservation eventually became the second carriageway of the A7 motorway.

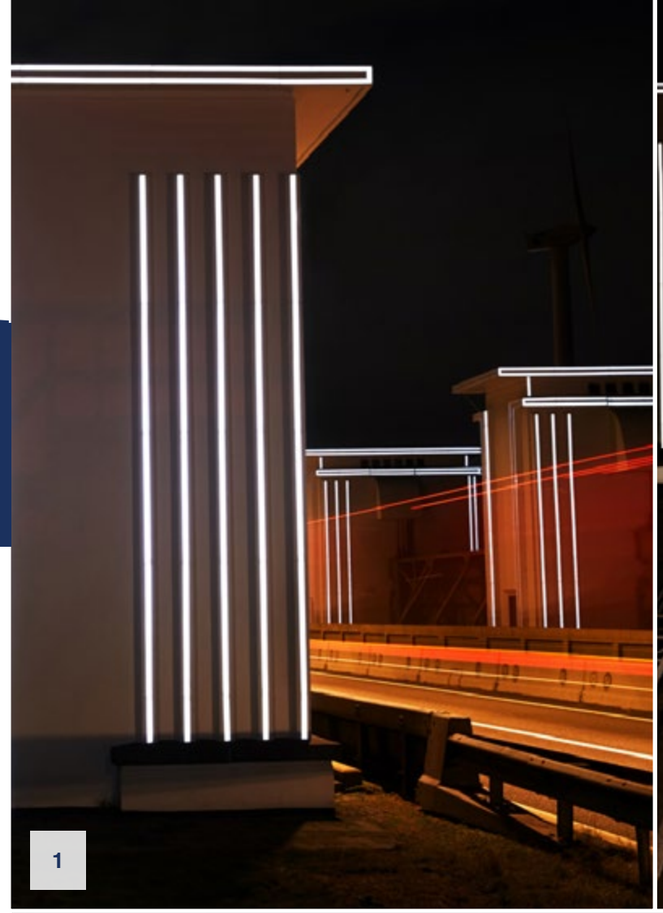
After 85 years a major renovation of the Afsluitdijk began to secure its future role for both flood protection and mobility. As part of the renovation programme, Studio Roosegaarde was commissioned to create Icoon Afsluitdijk, a three piece art and design work based around light. The pieces include Gates of Light, Windvogel and Glowing Nature. Windvogel used smart kites with light emitting cables to generate power when flown from the Afsluitdijk. Glowing Nature was an interactive exhibition with bioluminescent algae held on the Afsluitdijk. Both of these pieces were temporary.

The Gates of Light focuses on the 60 monumental floodgates built as part of the original Afsluitdijk; 36 at the western end (Stevinsluizen at 450m long) and 24 at the eastern end (Lorentzsluizen at 250m long). These floodgates control water levels in the lake and the A7 motorway passes between and alongside them. They are the historic features of the crossing. As part of the planned renovation of these structures, they are now illuminated after dark through retroreflection using the headlights of passing vehicles.

The permanent Gates of Light allows users to light up the floodgates themselves to create a futuristic landscape without using additional energy or causing permanent light pollution that could disturb local birdlife. Inspired by the retroreflective wings of butterflies, durable micro prisms were developed and applied to key architectural features of the floodgates with their renovation. The design reflects a deep understanding of context and enhances what was already present, celebrating this key piece of infrastructure and the experience of using it.

Design principles

- Understandable
- Restrained
- Environmentally sustainable
- Innovative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Images **1. Retro:** 60 monumental floodgates were restored with a retroreflective layer which is illuminated by the lights of passing vehicles only. **2. Dutch master:** Artist Daan Roosegaarde was commissioned to create a number of public art projects with the renovation of the Afsluitdijk. **3. Night watch:** The art deco lines of the flood gate structures are highlighted against the night sky to enhance the road user experience. **4. Dual use:** The Afsluitdijk is a 32 km long dike which protects the Netherlands against flooding and also supports the A7 motorway.

Hovenring, Netherlands

Facts

Location Eindhoven, Netherlands
Diameter 72m
Authority Eindhoven City Council
Designer ipv Delft
Year completed 2012

Description

When new development began adding pressure to an already busy junction near the A2 motorway outside Eindhoven, a solution was sought to increase capacity while ensuring cyclists and pedestrians could still negotiate the junction safely and conveniently. Although cyclists and pedestrians could cross at grade at an existing signalised roundabout, it was not ideal considering the volume of traffic. An underpass for cyclists and pedestrians was discounted as they were generally discouraged by the local authority for personal safety reasons.

The solution was a standard signalised crossroad junction to accommodate vehicles, while creating a unique structure for cyclists and pedestrians above. The bridge comprises a single 70m high pylon rising from the centre of the junction, 24 steel cables and a circular steel deck. The cables are attached to the inner side of the deck where it connects to an inner circular counterweight. This keeps the cables away from the cyclists while avoiding torsion within the structure. Slender 'M' shaped supports near the approach spans also help ensure stability.

Lighting was fully integrated into the design of the structure, appropriate considering Eindhoven's historic association with lighting and the Philips company. Lighting within the inner counterweight helps illuminate the junction, while lighting is also fully integrated into the handrails on the paths above. This provides a high level of illumination to great visual effect, while reducing clutter.

To reduce the slope on approach for cyclists and pedestrians, the junction itself was lowered by one and a half metres. In addition to prioritising the needs of these pedestrians and cyclists, the low retaining walls required with the level change provide vehicle restraint without the need for additional barriers around the junction. The concrete foundation of the pylon in the centre of junction (with 'HOVENRING' inset into it) also provides sufficient protection, again without the need for additional barriers.

The new bridge is not an isolated piece of iconic infrastructure. It is part of an extensive local network of segregated paths common across the Netherlands.

Design principles

- Safe and useful
- Inclusive
- Understandable
- Innovative


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Images **1. Suspended:** The pylon which supports the bridge deck was expressly designed to be a landmark structure.**2. Ease of use:** The bridge allows cyclists to negotiate the busy junction without stopping. **3. City of Light:** Lighting was a key part of the overall design, reinforcing the sense of place as well as enhancing personal security. **4. Up and over:** The bridge accommodates the movement of cyclists from four directions without complication.

A650 Bingley Relief Road, UK

Facts

Location West Yorkshire, UK
Length 4.8km
Authority Highways Agency (now National Highways)
Designer Arup (designer), Amec (contractor)
Year completed 2004

Description

The A650 Bingley Relief Road substantially reduced through traffic and significantly improved the environment of the town centre. Before it was completed, 36,000 vehicles a day often brought the town centre to a near standstill, negatively impacting on safety, air quality, public transport and the economy.

Options for a bypass or relief road were limited due to the geographical location of Bingley in a valley. In the end the road was threaded through a narrow, mostly urban, corridor between a river, railway, canal and built development. The road also had to cross two peat bogs, one of which was designated as a Site of Special Scientific Interest (SSSI). The dual carriageway required 26 structures in total, including two viaducts, two footbridges, four overbridges, one rail bridge and numerous soil-nailed retaining walls. The Leeds and Liverpool Canal also had to be realigned by some 150m, an unusual undertaking for a road scheme.

The scheme faced numerous technical challenges which required innovative technical solutions. To cross the 10m deep northern peat bog, a 200m reinforced embankment with driven concrete piles was required. The southern bog which is a SSSI, required strict environmental controls and a 200m long viaduct formed by a series of low pre-cast concrete arches was used to minimise any impact. A sustainable drainage system successfully maintains the ecological-hydrological balance of each peat bog.

The scheme had broad support from stakeholders and the community. Two footbridges across the relief road have improved access to both the town centre and the canal, including the Bingley Three Rise Locks. The Three Rise Bridge is a simple steel truss arch, while the Britannia Bridge to the south is a cable stay structure that acts as a gateway to Bingley. Local stone cladding was used on many of the retaining and other structures, including the walls of the realigned canal, in response to the context and reinforcing a sense of place. The scheme became the first civil engineering project to win the Prime Minister's Better Public Building Award in 2004.

Design principles

- Safe and useful
- Inclusive
- Restrained
- Collaborative


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Images: **1. Mind the gap:** Maintaining local connectivity while relieving the town centre of heavy through traffic was a design objective. **2. Compression and tension:** The cable stay footbridge ensured the bypass did not become a barrier to local connectivity and reflects the industrial heritage of the town. **3. Material world:** Retaining walls clad in local stone reflect the local built context. **4. In-between:** This section of the bypass is squeezed between the Leeds and Liverpool Canal, railway lines and Bingley town centre.

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Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ

National Highways Limited registered in England and Wales number 09346363