

People, places and processes:

**A guide to good design
at National Highways**



Foreword



Successful roads are the result of good design, not chance. Good design benefits road users, the places through which our roads pass and local communities. Good road design can also have wider positive environmental, social and economic impacts for regions and the country.

We set out our design vision for the strategic road network in *The road to good design*. Ten principles of good road design support our vision for a more inclusive, resilient and sustainable network. Since publication in the Design Manual for Roads and Bridges, these became a requirement for design practice and scheme design.

In the second road period we committed to further embed and promote our principles of good design into our work. The publication of this guide reflects our continued commitment to good design in our first year as National Highways. It should also help us respond to the increasing challenges of climate change and biodiversity in the years ahead.

In the pages that follow we elaborate on our ten principles to help better define good road design and provide additional guidance on achieving our design vision. The guide however is not exhaustive or prescriptive. Good road design still needs the creative input of multi-disciplinary design teams and an understanding of people and places for success.

I hope the guide becomes a useful reference for all of those involved in the planning, delivery and maintenance of our roads. It should challenge us to think about design quality in all aspects of our work.

The publication of this guide 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.

A handwritten signature in black ink that reads "Mike Wilson".

Mike Wilson

Chief Highways Engineer and Chair of the Strategic Design Panel

Connecting people, places and processes:

M60 Greater Manchester.
One of a pair of elegant
landmark footbridges
connecting communities over
the orbital motorway which in
turn connects the region.

The 10 principles of good road design

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Introduction

Every day countless decisions are made regarding the strategic road network. Many have the potential to enhance or erode the distinctive character of a location, and the experience of driving through it. They could relate to the direction of a major road project, or a smaller, minor improvement or routine maintenance; all can change a place, and our experience of it, for better or worse.

Although many of these decisions may seem purely technical in nature, they can still affect the quality and appearance of the network. They should therefore be considered 'design' in its broadest sense. By focussing on good design, we can make a difference to the experience of road users and the communities through which our roads pass. Good design is a powerful tool for achieving a higher quality of life, as well as greater economic vitality and a more efficient use of resources. Good design is also sustainable design, that should address the challenges of both climate change and loss of biodiversity.

We need to design in a way that is sensitive to the context of a road's surroundings and responsive to the needs of those who use it and the communities through which it passes. Good design creates infrastructure that is not only functional, but also makes a long-lasting positive contribution to the country and the environment.



Good road design puts people and their safety at the heart of the design process and considers the quality of places for future generations.

Therefore, at National Highways through our design vision:

We aim to put people at the heart of our work by designing an inclusive, resilient and sustainable road network; appreciated for its usefulness but also its elegance, reflecting in its design the beauty of the natural, built and historic environment through which it passes, and enhancing it where possible.

(The road to good design, 2018)

To support our vision for the network, we established a set of 10 principles that follow the themes of people, places and processes to connect the country. They are based on universal ideas of good design which we must have due regard to in accordance with our Licence. They encourage better design, provide a basis for objective design review and should result in a better-quality network and user experience.

The 10 principles of good design are not instructions for how to design a road. They are prompts to challenge us to consider the whole rather than individual elements, and to realise the wider benefits of good design. Continued close engagement with communities, careful assessment of context, innovative design, robust decision making and collaborative working, are all vital for road investment to truly enhance our urban and rural environments.

The purpose of this guide is to further the thinking about the design and quality of our roads. It supports both *The road to good design* (2018) and the Design Manual for Roads and Bridges standard *GG103 Introduction and General Requirements for Sustainable Development and Design* (2019). It gives supplementary guidance and advice to these documents, but does not constitute an instruction or requirement itself. It is a best practice guide to help designers, such as engineers, landscape architects and environmental specialists, and others such as project managers involved in the improvement and maintenance of the network, achieve our vision and better outcomes.

View from the road:

The copse at Cookworthy Nnapp seen from the A30 in Devon is a local landmark often referred to as the 'coming home trees'.

The guide has four parts:

Connecting people

People are at the heart of our design work, making roads safe and useful, inclusive and understandable. These three principles ensure design reflects users' needs, engages with communities and works intuitively for all.

Connecting places

Good road design demands a deep understanding and response to place, to create a quality experience for the user and wider community. These three principles ensure design is restrained, environmentally sustainable and fits the context.

Connecting processes

A successful outcome focussed on people and places requires good design processes. These four principles ensure design is collaborative, thorough and innovative, generating long-lasting outcomes that are of benefit to users and the wider community.

Supporting good design

To support the application of the 10 principles of good design, further guidance is provided in terms of context, appearance and user experience. The geographic, environmental and socio-economic context should inform all design decisions, as should minimising greenhouse gas emissions and adapting to climate change. This is supported by a series of architectural and visual design considerations to help relate the principles to the form and appearance of the road. These in turn can be used to consider user experience and ask: 'What will drivers and passengers see and feel using the road?'

Connecting people



Murdoch's Connection:

Named after Dr Mary Murdoch, the footbridge links Humber Dock and Princes Dock over the busy Castle Street (A63) in Hull city centre and is integrated with wider public realm works.

Good road design makes roads safe and useful

Safety is fundamental to good road design; it is integral to both the usefulness, of its function and the confidence of road users and their well-being. Good design creates safer roads which support and link to other wider imperatives, both nationally and locally, and that are fundamentally useful, meeting users' need for mobility effectively.

Safety, usefulness and design are closely associated; the core purpose of a road is to connect places both efficiently and safely. Good road design ensures safety and usefulness applies equally to all road users, both motorised and non-motorised, and is attractive to each. If a road is perceived as less safe or less accessible, it will not be used to its full potential by users, nor fully benefit local communities.

This is particularly applicable to pedestrians who may be reluctant to cross a road if it is perceived to be unsafe or difficult, thereby creating a barrier within or between communities. Such barriers act to reduce the potential of the road to support wider imperatives such as housing or economic growth.

Safety

The consideration of safety applies to all activities and is therefore integral to good road design. Designs need to comply with engineering requirements for safer roads for all users and be able to be built and maintained safely.

Good road design can contribute to safer driver behaviour by avoiding confusion and conflict, reducing monotony and providing visual clues to aid understanding of the road and appropriate speed. Roads therefore need to be designed for a safe speed.

Thorough network and corridor planning should help avoid future conflicts between busy roads and nearby communities. The overlooking of associated pedestrian and cyclist routes is encouraged where appropriate to aid personal safety. The safety of vulnerable road users should be a focus for designers at all stages.

Usefulness and function

Unlike a street, a road is primarily built for mobility and has to be functional to be useful. Roads connect people and places at various scales and distances and where possible, should be free-flowing and multi-functional. This may include roads also functioning as ecological, active travel



Supporting access to growth and housing:

M4 Bristol. A £100m growth and housing fund in the first road period supported new infrastructure to enable development.

(walking and cycling), public transport or utility corridors, connecting open spaces and landscapes and defining boundaries to towns and cities.

Mobility needs will include long or short journeys connecting regions or adjacent communities and careful consideration should be made of these needs in the design process. Will a single route be able to cater for these needs safely or would separation of long and short journeys be more appropriate? Will the road meet local, regional or national needs, or all three?

Structuring towns, cities and regions

Transport corridors, such as canals, rail lines and roads, overlaid on a natural landscape and along with built form, act together to create a sense of place through pattern, shape and scale. Road design can therefore be used to structure and order the landscape and place, from the local to a regional scale.

Roads help define connections and routes between places, focal points and local and regional boundaries that shape towns, cities and regions and make them distinctive. Buildings and land uses may change over time, but the pattern established by roads is long-lasting and this aspect of road design should be a key consideration in their planning.

Consider future land uses

Opportunities for land adjacent to and beyond a road corridor may emerge during planning and after construction. Understanding and influencing the potential future use of this land can greatly enhance design outcomes. It can help reinforce green infrastructure and a sense of place and should be considered early in the process.

Opportunities to make better use of residual and other land along a corridor should be considered. For example, for wildlife, public open space, other public facilities or complementary development or redevelopment. Designing and developing such land simultaneously with the road in partnership with others should be considered for an integrated approach. Such an approach should avoid the creation of awkwardly shaped and difficult to access or maintain parcels of land.

The core purpose of a road is to connect places, both efficiently and safely, for the benefit of people.

Transforming and regenerating areas

The building of major infrastructure such as motorways, bridges, railways and stations with a recognisable design quality can give towns, cities and regions a strong image and sense of place. Such infrastructure can both stimulate and support housing, economic, environmental, cultural and tourist development for example.

Road design should recognise the potential of deprived and underutilised areas to benefit from the development of well-designed and well-connected infrastructure. New infrastructure can also be used as a distinctive symbol of a town, city or region and be a powerful sign of regeneration and development. Road design should therefore consider how it can best serve new activity and ideas for the use of land both functionally and visually.

As well as considering wider objectives such as housing and growth strategies, designers should also be conscious of the potential for unintended consequences. Will new infrastructure encourage future development in locations that should otherwise be protected such as areas of outstanding natural beauty? Will appropriate controls be put in place by others to give such protection?



Bridging a gap: The Eureka Skyway bridge over the M20 serves as a gateway to the growth area of Ashford, Kent.

2

Good road design is inclusive

Inclusive environments facilitate dignified and equal use by all. An inter-disciplinary design process involves and places people's needs and views at its heart, nurturing well-being and creating a shared sense of ownership of the road. All users and communities are considered carefully in order to reduce barriers to access and participation, particularly mindful of the most vulnerable.

Open to all, inclusive roads and facilities are accessible and available equally. If alternative access or routes are necessary for reasons of safety for example, they should be as convenient and equally available to these users.

An inter-disciplinary approach to inclusion involves more than just assembling a range of disciplines to have input into the design. Design teams should work interactively with users and communities to formulate and achieve a design vision.

Designers such as landscape architects should be incorporated into the team as equal members alongside engineers, traffic planners and others. All team members should play a meaningful role in discussions throughout the design process. They should remain open to listening to different opinions, particularly those expressed by users and local communities

Consider equality and diversity

Users and communities are diverse and the design process and completed road should reflect this diversity. Different opinions should be sought and respected throughout the process to ensure the road design seeks to meet the needs and aspirations of the whole community, and in doing so should also seek to foster good relations between people.

Road schemes should not disadvantage specific users or communities and should be accessible, particularly crossings for vulnerable pedestrians. Roadside facilities should also be fully accessible to all users and advance equality of opportunity.

Involve communities

To be fully inclusive, make efforts to involve all sections of the community in the design process, including those perceived as being 'hard to reach'. Although consensus will unlikely be reached on every issue by everyone, involving a range of people from different communities will allow for different views to be raised and



Placing people at the heart of design:

The Itford Farm bridleway bridge on the South Downs Way National Trail replaced a difficult and dangerous at-grade crossing of the A26 and was designed in harmony with its rural setting, a designated Area of Outstanding Natural Beauty.

considered. This will range from a local landowner directly affected, local children attending a nearby school, freight and professional drivers or other motorists who may only use the road occasionally.

Adopting a robust approach to design and involving communities in the process can also add value beyond the road corridor. It can protect locally valued areas, stimulate economic growth as appropriate and promote healthier lifestyles.

Collaborative and inclusive design produces roads that are more acceptable to users and communities, and that are safer, more accessible and useful to them. Roads that are imposed with poor consideration of people and communities will be resented, lack a sense of ownership and act as barriers.

Support accessibility and connectivity

New or improved roads and bridges should give good connections and movement options for people. Often their quality of life is affected by their proximity to local amenities and the time and effort involved in travel. The frequency and ease with which they can cross major roads will affect their connectedness with other people, communities and parts of the urban or rural environment. The ease of access to other modes of transport such as rail and bus and how the local area helps walking and cycling all contribute to this connectedness. Design considerations should therefore extend beyond the road corridor itself. Good road design is as much concerned with functionality as it is with aesthetics.

Accessibility and connectivity, a choice of travel options and convenience are key attributes of a community's quality of life. They should be fundamental to good road design. An interconnected and multi-modal local transport network can contribute to connecting communities, reducing inequalities and give structure to the built environment.

The strategic road network should be made as easy, comfortable and safe as possible for pedestrians and cyclists to cross and access bus stops, local facilities and neighbourhoods. Not only should pedestrian and cycle routes permeate and connect neighbourhoods, they should be integrated with a wider movement network as part of an overall design framework.

Inclusive design produces roads with wider benefits that are more acceptable to users and communities.

Consider all users

The walker, cyclist and horse rider's experience of the road environment is different from the motorist's. It is more intense because of the closer contact with their surroundings, slower speed and greater physical activity and movement. Long monotonous paths directly adjacent to roads and barriers can quickly become tiring, while small detours to more varied landscapes with less noise can make their experience more pleasant and attractive. Such users can also stop or pause at will and can be offered a greater choice of route than the motorist.

The increased vulnerability of walkers, cyclists and horse riders should be recognised, and their differing needs, including purpose of journey, responded to through design. In doing so however, they should not be overly inconvenienced or have the quality of their experience degraded. For example, bridges needing steps or long ramps can significantly increase journey time and underpasses can be unwelcoming, even perceived as threatening, if not designed and maintained well. Reducing opportunities for suicide should also be an early design consideration with accessible structures.



Pedal power: Cycle infrastructure needs to be convenient and safe to use if it is to provide an attractive alternative.

3

Good road design makes roads understandable

Easy to read, a good road is intuitive to use so as to be safe and efficient for all. 'Self-explaining roads' focus on the essentials and eliminate unnecessary and confusing clutter to make them legible, while responding to place and enhancing both environmental and economic outcomes.

Self-explaining roads that naturally encourage drivers to adapt their behaviour in a way that is compatible with the context is an important concept for achieving safe roads. The road environment should make drivers feel uncomfortable exceeding the speed limit and should make them aware of conditions ahead without relying on signage alone. A self-explaining road can also reduce the need for additional engineering or enforcement measures to modify driver behaviour. Achieving a safe outcome for all road users and the community is fundamental to good road design.

The idea of self-explaining environments is not new. Buildings such as churches, homes and workplaces, and spaces such as streets, squares and parks, have all traditionally been recognisable. Their function and the behaviour expected in and around them understood. Where such buildings and spaces are not understandable, there will be unease or confusion. When applied to roads, good design should strive to avoid situations where drivers are unaware, or un-warned, of changing conditions ahead. Examples include the transition between rural and urban areas or single and dual carriageways, areas with high pedestrian activity and pedestrian and cycle crossings, and at road junctions.

Design has a key role to play in bringing legibility or readability to the road corridor. Thoroughness and multi-disciplinary collaboration in design is central to making roads understandable.

Hierarchy through appearance

Good road design should differentiate between categories of road, making each distinctive so that users are able to understand their function and appropriate speed intuitively.

A road hierarchy should be developed that differentiates roads through corridor width, landscape approach, adjacent land use and environment. Engineering and traffic features of each road type such as carriageway width, road markings, signage and street lighting

Providing clarity for drivers:

Simple and easy to understand signage for emergency areas was developed to replace text based signs following customer research.



should be mostly consistent. The motorway is a good example of this as it leaves the driver with no doubt through its appearance - several wide lanes, no opposing traffic, no cross-roads and no pedestrians, cyclists or horses. However, inconsistencies on other types of road can cause doubt and unsafe driving behaviour. This is often an issue at the interface between rural and urban areas.

The effective differentiation of roads needs the multi-disciplinary consideration of the whole road corridor which sometimes may be beyond the highway boundary.

Improve legibility

Legible roads provide drivers with clues as to how to drive and what to expect ahead. Hard (built) and soft (planted) elements can be used as indicators to improve legibility and behaviour.

Varying the alignment, planting or view can alert drivers of changes such as bends or built up areas and assist with recognition of the type of road they are on. The type, position and height of planting can also be used to differentiate the widths and enclosure of the road and therefore design speeds.

The overall appearance of the road and the design approach taken can also aid legibility. On higher speed roads, elements should generally have unity and consistency along the corridor. There should be a greater recognition of the adjacent context and local landform, with opportunities for greater contrast, variety and design detail, at lower speeds.

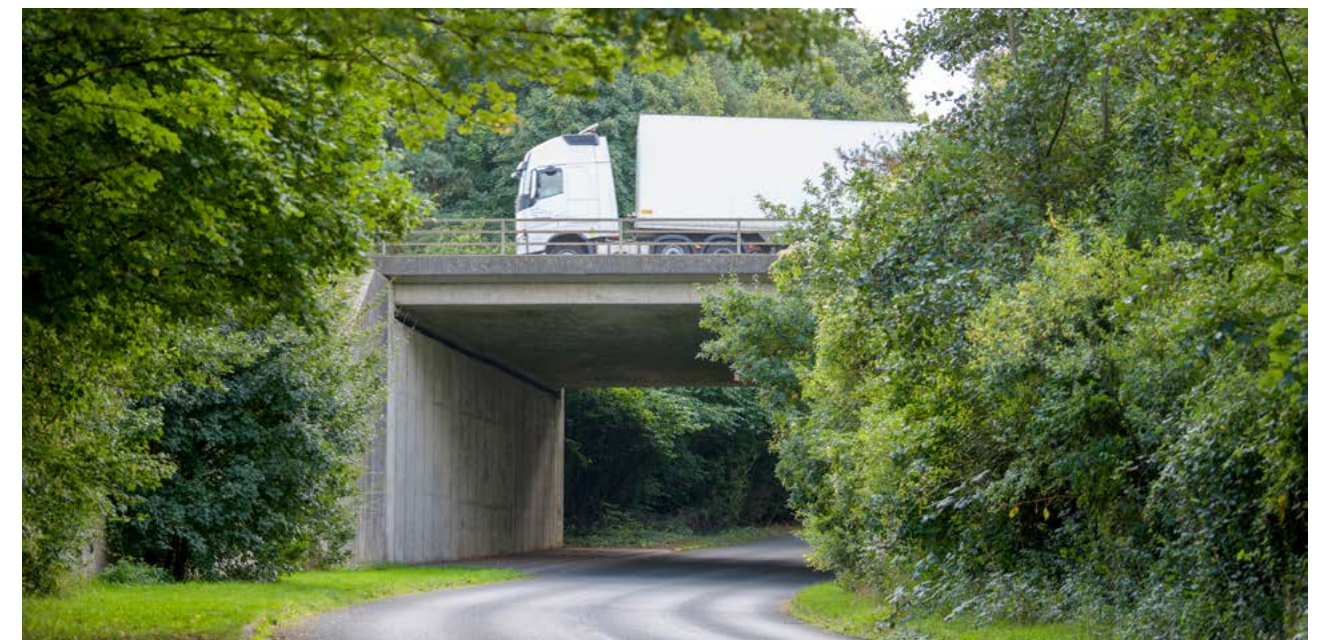
Legible roads can also help road users understand where they are and with wayfinding (literally finding your way). Views to built-up areas, landmark buildings and structures and distinctive natural features can help drivers locate themselves, reducing reliance on directional signs. Such features can also contribute to a richer user experience and response to place. This may become even more relevant in the future with the development of autonomous or connected vehicles. Such future technology may safely allow for more focus by the road user on the wider landscape over the immediate road environment.

Self-explaining roads naturally encourage drivers to adapt their behaviour in a way that is compatible with the context.

Reduce clutter

Road side clutter can be detrimental to both the character of the environment and the safety of users. For example, signs, signals and road markings are important and need to be simple and concise to be easily understood. However, the over-provision of signage can dilute important messages if it results in information overload. Such clutter, including unnecessary fencing and barriers, should be designed out to minimise the impact on the local environment and improve efficiency and effectiveness.

Signs and road markings should only be provided where there is a clear need and should be minimal and sympathetic to the context. Clutter can often accumulate over-time as signage is added without consideration of its impact. Good design can prevent this by considering requirements at an early stage. Careful design of the signs themselves can also help avoid clutter by ensuring they are the appropriate size and by combining signs onto fewer structures. Mounting, placement and lighting of signs are also important design considerations to reduce clutter. Yellow backing boards can be particularly visually intrusive and should only be used where there are no other alternatives to address an identified safety issue.



Reading the road: Local roads and lanes should through their appearance indicate that lower speeds are appropriate and that they are shared with other users.

Connecting places



A line in the landscape:

The M5 connects the country through the landscape of Somerset, crossing waterways, field boundaries and other infrastructure while creating a new pattern.

4

Good road design fits in context

The aesthetic quality of a road and its design in relation to the places through which it passes, is integral to its function and the experience of those that use it. Good road design demonstrates sensitivity to the landscape, heritage and local community, seeking to enhance the place while being true to structural necessities. It builds a legacy for the future.

Context is the three-dimensional composition of natural and historic features, buildings, infrastructure and open space. The composition and relationship between these built and natural elements helps create a sense of place or space with meaning. This context is where communities live, work and play and influences and reflects them; the built, natural and historic context provides a sense of place and identity for communities.

The life and character of communities, and therefore context, differs across England. From quiet rural areas, to traditional villages and small towns, to bustling modern metropolitan areas. For example, the sense of place in Cornwall is different to that in Manchester.

The character and function of the built and natural environment should be a key consideration throughout the design process. Road design works best when it leaves the positive features and character of the place as intact as possible and is in scale to achieve a sensitive fit between the road and the place.

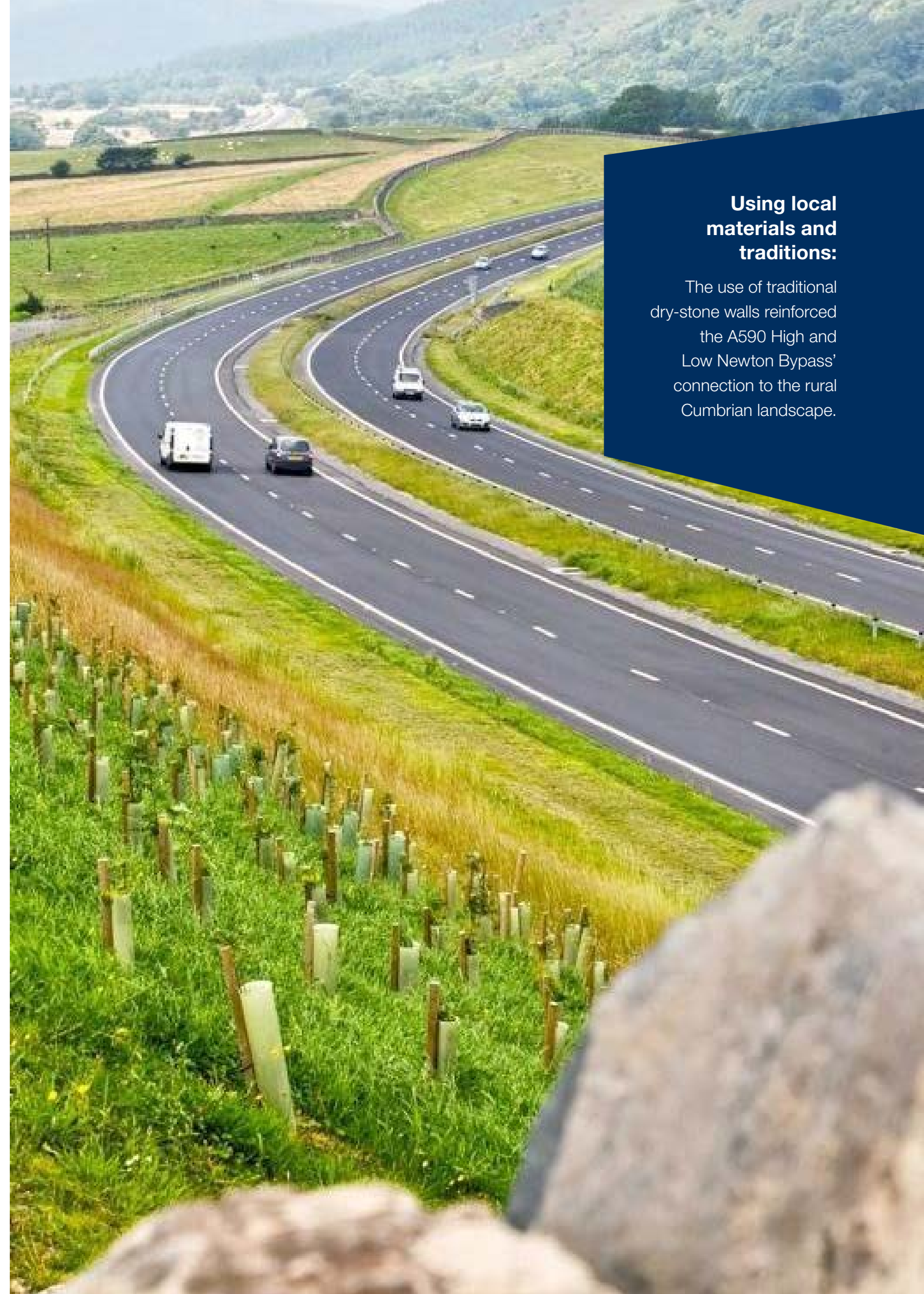
Place making

An understanding of place should be the starting point for every designer. We develop a sense of place through experience and knowledge. It emerges through knowledge of the history and geography of an area, its flora and fauna and an understanding of the land itself. Local people and communities will have a strong sense of place from living there and much can be learned from them.

Good road design recognises that travelling is not simply a matter of getting from A to B as quickly and safely as possible. It is a journey through different places at different scales and speeds. This experience should be visually and physically stimulating for the traveller, making them aware of their context and allowing them to recognise and appreciate their whereabouts. Reinforcing a sense of place should be the primary means of achieving this.

Using local materials and traditions:

The use of traditional dry-stone walls reinforced the A590 High and Low Newton Bypass' connection to the rural Cumbrian landscape.



Minimise negative visual impact

Designing the road to fit the context will help minimise negative visual impacts and reinforce the existing sense of place. Mounding and false cuttings can help screen the road behind natural looking landforms. Allow space for screen planting where necessary and where appropriate to the landscape and built character of an area. Such screen planting should not be introduced where it would inappropriately reinforce the linear nature of a road corridor in a landscape or inadvertently draw attention to it. Planting outside the highway boundary can be considered where appropriate to reduce negative visual impact subject to consent and maintenance arrangements.

Boundaries to respond to local character

Boundaries are the visible interface between land ownership and functions and should be designed to provide a context sensitive response. Many areas of the country have traditional ways to define boundaries, such as hedges or stone walls. These should be recognised by designers, and opportunities taken to reinforce a sense of place where appropriate in consultation with landowners. Boundaries should also be simple in form and layout and their three-dimensional effect always considered.

Opportunities should be taken to explore the space between the carriageway and boundaries to incorporate walking and cycling paths and to plant local native vegetation. Such consideration of boundaries, and the spaces between, helps create human scale and frontage that fits the context. There is also a need for designers to look beyond boundaries to ensure integration with the wider context.

Integrate natural systems

All places have their own unique natural character based upon the interplay of natural systems such as geology, topography, vegetation, water courses and climate. Contrasting examples of this include the Cheshire plain or the Cumbrian fells.

The integration of natural systems and patterns into road design supports local biodiversity and natural resilience to climate change for example. This requires an understanding of natural characteristics to inform landform, planting and seeding decisions. This will help ensure that the road fits local patterns and ecology, making it part of the landscape.

Roads that respond to their context will be well-grounded, be more accepted by communities and have less environmental impact.

Consider the view from the road

The principal features and symbols of the landscape, including activities which take place in it, should relate to the design and be visible from the road. Vertical and horizontal alignment will help expose this character to enhance and heighten the experience of the journey through the landscape. This will enliven the journey and make it more pleasant, memorable and safer.

Consider variations in curvature, alignment and elevation for views. Splitting carriageways also allows views to be opened up and varies the effect of a constant width on long sections. As well as enhancing the view from the road, design can shape movement in a way that enhances the physical sensation of travel.

Expose interesting and valued views not only through road alignment, but through the design of the landscape. Avoid obscuring important views with planting, and consider framing views subject to safety and maintenance considerations. Monotonous tunnel-like corridors with no varied views or interest should be avoided as they may increase driver fatigue.



Place making: Although the adjacent cooling towers are now demolished, the M1 Tinsley Viaduct (suitably constructed from steel) remains a landmark in Sheffield.

Good road design is restrained

Functional, but responding positively and elegantly to the context, good road design allows for the expression of the character and identity of the places and communities through which a road passes. Good road design can enhance a sense of place and add to what we have inherited, particularly through the use of appropriate materials and traditions, but does not make unnecessary superficial or superfluous visual statements.

The widening of roads and their junctions and the building of new roads can be conspicuous, potentially eroding existing character and negatively affecting the context and sense of place. A thorough understanding of place is required to generate a sensitive and restrained response. The scale, footprint and alignment of the road should generally be restrained in a manner which protects character as far as possible, while also protecting communities from visual and noise impacts.

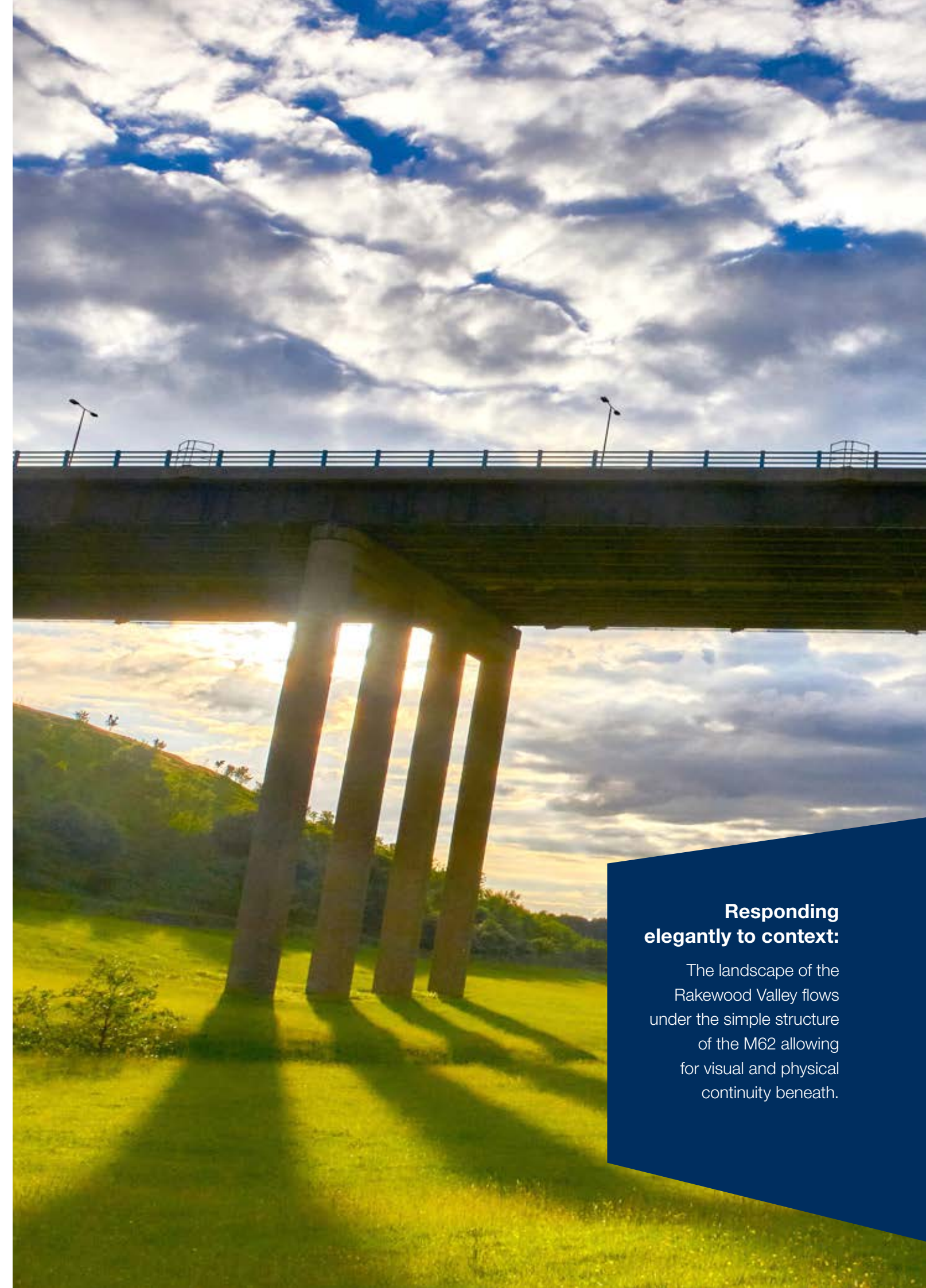
Minimise impact

The siting and design of roads should avoid overpowering the scale of the context and affecting its uniqueness. Road footprints, or the mark made on the land, are becoming larger because of increased engineering and safety standards and multifunctional requirements, over and above increases in traffic volumes.

Road improvements can involve widening of carriageways, disturbing adjacent properties and vegetation, altering the scale and quality of the existing corridor. Motorways have the largest footprint and are usually out of scale with many environments, particularly historic. Reducing the impact of the footprint and integrating motorways into an urban environment is particularly challenging.

Simply reducing a road's footprint however may not minimise impact. Increased land take can allow for split carriageways, more landscape and embankments instead of retaining walls, all potentially reducing visual impact for example. Account should also be taken of potential future widening and maintenance.

Varying horizontal and vertical alignment can also reduce footprint and should lessen the need for high, long and obtrusive cuttings. Vegetation can also help integrate the road, instead of simply using as screening to reduce visual impact. The geometry of road corners should also be reduced to minimums, particularly in urban areas.



Responding elegantly to context:

The landscape of the Rakewood Valley flows under the simple structure of the M62 allowing for visual and physical continuity beneath.

Integrate noise measures

Noise barriers are important, but have the potential for creating visual intrusion, reduction of sunlight, loss of character and social exclusion. They can also create a ‘tunnel’ effect within the road corridor. Good road design should seek to reduce potential noise to avoid or minimise the need for barriers. This approach should apply right at the route options stage and opportunities should be explored with stakeholders to consider adjacent land uses and standards. Less noise sensitive land uses and restricted development near major roads should be encouraged and architectural design to reduce noise within developments considered.

The design of the road to reduce noise generation through changes in horizontal and vertical alignment and the choice of pavement should be considered. Earth mounds to reduce noise, if feasible within the constraints of the corridor width, or a combination of mound and low noise barriers can also be considered. If it is not possible to control noise levels within the road corridor and barriers are required, they need to be designed so that they are consistent with the overall design approach and integrate a suitable landscape buffer if possible. Noise barriers should be considered as an architectural element in their own right.

Respond to topography and landform

After route selection, the vertical and horizontal alignment of the road is the most fundamental design decision. As well as influencing impact on the context, alignment significantly affects earthworks and bridging. Consequently, a road should be formed three-dimensionally in relation to the topography and landscape as a whole.

Roads need to be designed in three-dimensions and should work with existing contours to mould the road into the landscape, minimise disturbance of natural landform and fit the road more comfortably into the overall topography. Where possible, gently curving alignments in undulating natural landscapes should be created and carriageways independently graded on hillsides to minimise earthworks to reduce deep cuttings. Cuttings in ridgelines should be avoided, and the road alignment curved to avoid creating a notch on the skyline.

‘Good design is as little design as possible – less, but better.’

(Deiter Rams)

Natural characteristics

Much can be learned from the local natural characteristics of an area for restrained design, particularly regarding landform and landscape. Local watercourses and wetlands demonstrate how water is naturally channelled and cleansed. Local woodland indicates how trees propagate themselves in terms of spacing and reveal which species work well together and suit the area. Ground conditions show us what the local fauna have adapted to and depend upon.

Landscape design should create conditions to support biodiversity and help establish and continue natural processes. Design should consider creating diverse ground conditions with variable gradients, depths of materials, and the seeding and planting of native species. This should improve plant survival and resilience, reduce water consumption and support local fauna. Natural plant spacing which reflects the need to out-compete weeds, and provides space for the plants at maturity, should be considered alongside plant groupings that are mutually supportive and thrive in an area. A ‘water-sensitive design’ approach using open drainage channels with native plants, rocks and gravels will help cleanse storm-water runoff.



A colourful barrier to noise: The maritime themed barrier on the M27 in Portsmouth protects residents of Port Solent from noise.

6

Good road design is environmentally sustainable

Making an important contribution to the conservation and enhancement of the natural, built and historic environment, good road design seeks to achieve net environmental gain. It is multi-functional, resilient and sustainable, allowing for future adaptation and technical requirements, while minimising waste and the need for new materials.

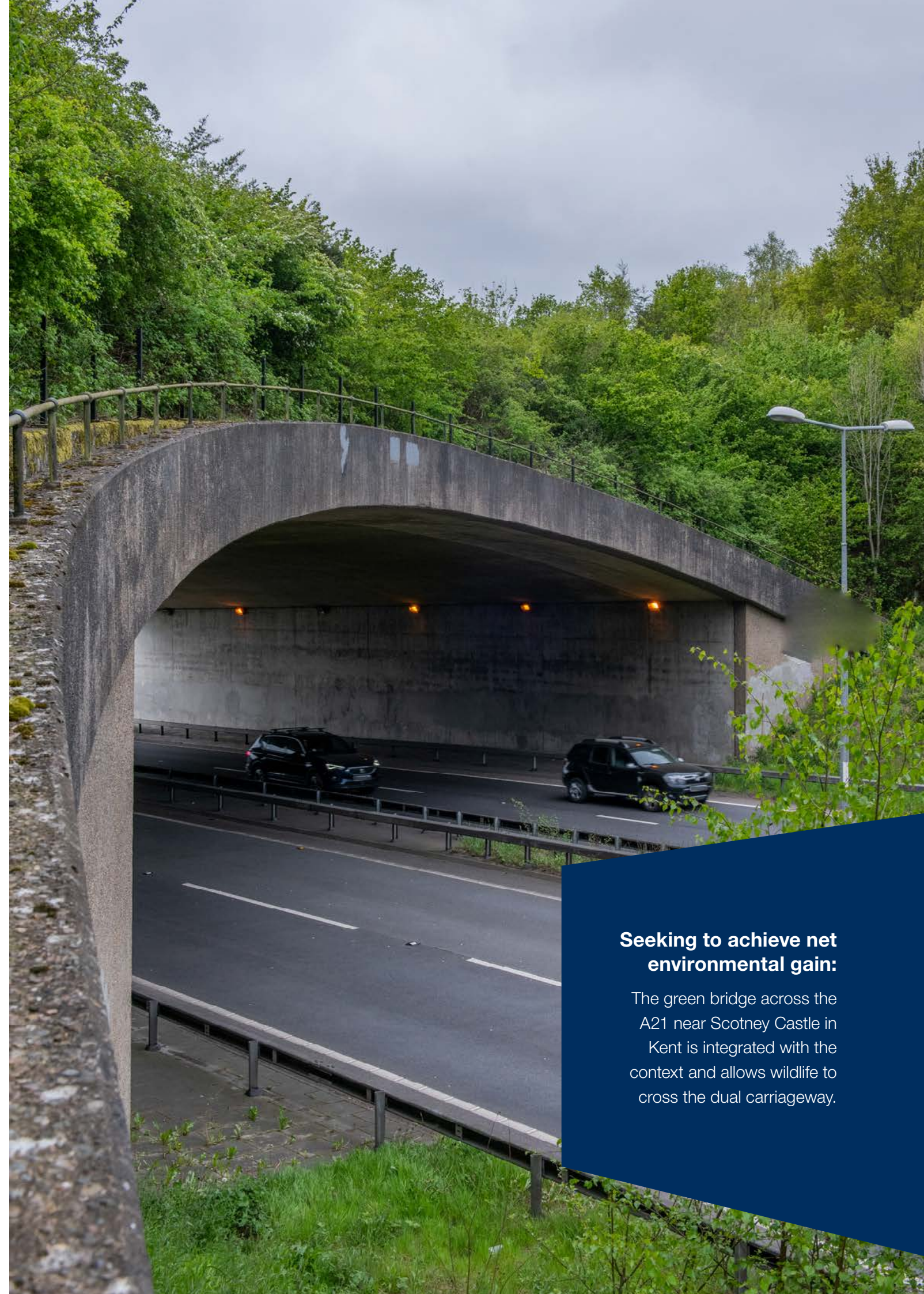
Roads are inherently linear and will most often pass through different environments. It is therefore essential to consider the patterns and characteristics of local buildings, history and natural systems, urban or rural. Ecosystems in particular have developed in response to terrain, soil and hydrology and since these often extend well beyond a corridor, roads can have environmental impacts that are regional in scale.

As well as being important for biodiversity, built, historic and natural systems are an attribute of the landscape. They contribute to structure, character and sense of place. Natural systems can have recreational value and context sensitive roads need to respond to, rather than diminish such systems. Roads should not be designed simply in terms of traffic movement, but also seek to maximise these 'co-benefits' in the context of ecological and cultural values that sustain life and enhance human settlement.

Continue natural systems and create green corridors

Route selection and design should seek to restore or replace natural system linkages to achieve environmental net gain or measurable improvements to the wider natural environment, including biodiversity and other natural capital. A continuous tree canopy, for example, can provide for wildlife movement as well as habitat, and also provide a windbreak for agriculture, visual screening and recreational benefit.

Roads can act as barriers to wildlife and sever habitats. The severance of natural systems should be avoided, especially when crossing waterways. Severance can be minimised with the use of crossing points that fit with natural patterns and local native planting. Planting should be selected and designed to help reconnect natural systems and habitat and, where possible, to enhance existing biodiversity and to mitigate historic severance. Roads should also be seen as an opportunity to provide for habitat connectivity.



Seeking to achieve net environmental gain:

The green bridge across the A21 near Scotney Castle in Kent is integrated with the context and allows wildlife to cross the dual carriageway.

Integrate historic buildings and landscapes

The value of the historic or cultural context in which a feature sits is at least as important as the feature itself. Historic features, such as a house and its grounds, are both part of the cultural and physical context and visual quality of a place and their integrity should therefore be protected. Roads should avoid cutting through sites and damaging items of historical or archaeological importance. They should avoid disrupting buildings, groupings or landscapes defining the character of a place.

The incorporation of historic buildings and landscape as landmarks along a route should also be considered if they are visible. Access to sites should be sensitive and consideration given to the use of service roads which can keep a new road away from a site while keeping it visible. Road elements such as boundaries which are sympathetic to a historic context should be complementary in character and use traditional local construction techniques and materials where appropriate. Signage should be located to minimise visual impact.

Be resilient

Roads are long-lasting, and designers should anticipate long-term environmental needs and constraints under which they will function and plan for roads to be resilient to change. Although our ability to predict the future is limited, we know environmental conditions will alter in coming decades with climate change.

Our climate is changing because of increases in greenhouse gases caused by human activity, including road building and operation. National Highways' response involves both mitigation and adaptation. Good road design seeks to reduce the greenhouse gas emissions associated with projects via the hierarchy of good carbon management – 'build nothing', 'build less', 'build clever', 'build efficiently'. In addition to greenhouse gas reduction, roads should be designed to be resilient to expected changes to the climate as they can be directly affected by it. For example, these changes may include increased heat, drought or rainfall events, impacting on pavements, structures, landscape and drainage.

Be multifunctional

Green infrastructure is the network of multi-functional green spaces and links which support natural and ecological processes capable of delivering a wide range of environmental and quality of life benefits for local communities.

Good road design should contribute to wider green infrastructure networks by working with others to support recreation and health, sustain biodiversity and protect soil, water and other resources. This will also help buffer extreme weather events, reinforce a sense of place, improve water quality, sustain cultural and historical places, support walking, cycling and horse riding, stimulate economic activity and maintain productive rural landscapes.

Considering good design from the start will help maximise benefits, achieve better outcomes, avoid negative impacts and reduce the need for mitigation.

The circular economy

The circular economy is an alternative to the traditional linear economy (make, use, dispose) in which resources are kept in use for as long as possible, maximum value is extracted in use and recovered at end of life to retain as much value as possible.

Minimising the use of material resources is the important starting point. Where materials are required then a focus on reusing and recycling existing materials and maximising the use of those already on site rather than importing from elsewhere should be the priority. Opportunities to prolong the life of assets, through consideration of durability, maintenance upgrades and the retention of high value materials, should also be sought.

Designing out and reducing waste through off-site manufacture should also be considered and information accurately recorded to support asset management.



Busy as a bee: Supporting biodiversity on the A38 in Devon with wildflower verges.

Connecting processes



A team effort:

Significant landmark structures such as the Orwell Bridge require a coordinated multi-disciplinary approach to design.

7

Good road design is thorough

The result of robust processes that create a continual cycle of improvement, good road design starts with an in-depth understanding of people, place and context; learning from best practice worldwide. The design of all elements of the road environment are considered together and integrated into a responsive design.

Good design should be considered from the earliest planning stages of an improvement or new road. A common misconception is that good design is an 'add-on', enhancement or mitigation measure, only to be considered at the latter stages and only if the budget allows. On the contrary, good design should contribute to all stages, including at the early stages in the setting of aims and objectives.

Considering good design from the start will help deliver successful projects, maximise their potential, achieve better outcomes, avoid negative impacts and reduce the need for mitigation.

The right team

Project teams should be multidisciplinary and include engineers, traffic planners, landscape architects, environmental specialists and others. Depending on the project, additional specialist designers could include architects, masterplanners, urban designers and others. The whole team is collectively responsible for the outcome and should work together to develop and deliver a design vision. Teams should be inspired to co-produce well-designed projects that are safe, sustainable, maintainable and cost-effective.

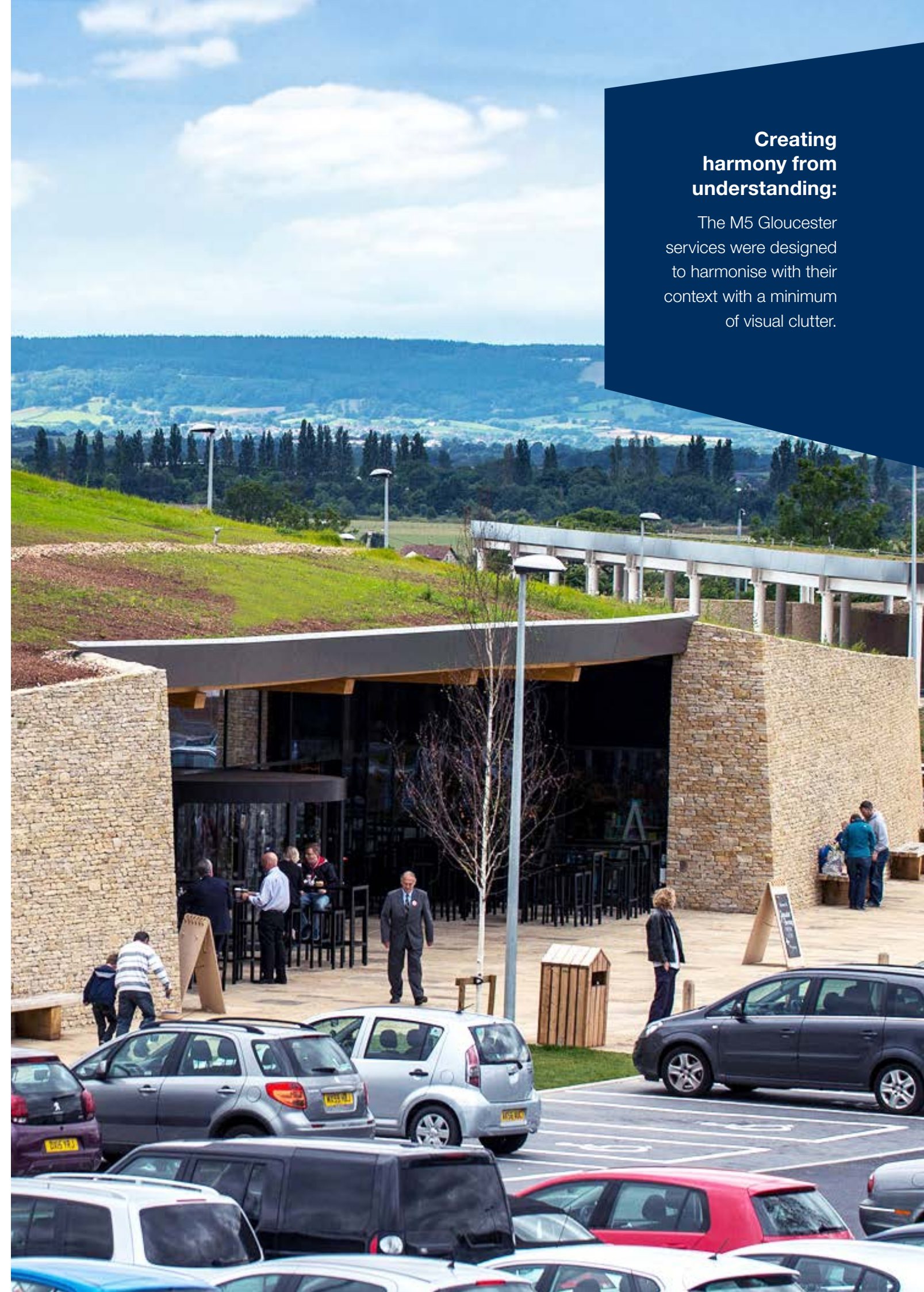
As projects can take years to design and construct, they may invariably involve different teams. It is therefore important to ensure design continuity so that design quality is not diluted, and time and resources are not wasted on re-design. Such design continuity can be achieved by providing clear and consistent briefs to teams from the start. A design vision and objectives should also be developed and managed via a design narrative through all the project stages. This design narrative can also be used to document design decisions throughout and be shared with each subsequent design team.

Learning

Project teams should learn from past successes and failures if they are to improve and produce better outcomes. Continuous learning is encouraged, particularly through the use of case studies and precedents. Understanding what works, where and why, should be a key component

Creating harmony from understanding:

The M5 Gloucester services were designed to harmonise with their context with a minimum of visual clutter.



of the design process and could involve the use of site visits, case studies and precedent images. Such case studies and images can also be a valuable resource for community engagement to supplement illustrations and visualisations to help make the design 'real' for people.

In addition, National Highways undertakes a post-completion evaluation of schemes and this should be an additional learning resource for teams. These evaluations provide insight into planning, designing, constructing and maintaining schemes.

Place analysis

A thorough analysis of context is the foundation of a good design outcome and should occur at each stage of a project. The purpose of such an analysis is to develop a full understanding of the character and working of the places through which the road passes or will pass. All projects should start with an analysis of the geographic, environmental and socio-economic context as the basis for the design vision or concept.

Place analysis should include the characteristics of the landform and quality of the natural, built and historic environments of the road corridor and how these environments work for local communities. Stakeholders and communities should be involved in the analysis and be consulted on the findings to ensure the thoroughness of the analysis; the people who live in an area will often know it best.

Integrate elements

The design of all elements - including retaining walls, noise barriers, bridges, guard rails, fences, central reserve barriers, shared paths, gantries, signs and lighting – needs to be integrated into the overall design of the road, with elements fitting together and put sensitively into the place through which the road passes.

Simplicity is often the best approach to the design of individual road elements. Designs that are more complex than necessary are more expensive, consume more resources, are harder to build and maintain and will lack elegance.

The number and placement of all the various road elements relative to one another and in relation to the road design should be considered as a whole. The over-use of disparate road elements should be avoided, and all should contribute to the unity of the road corridor.

The number of design solutions to a given problem should generally be minimised. For example, a range of noise barrier designs rather than one type may raise difficulties for future maintenance. Similar issues arise for

colours, fencing, railings, lighting, etc. There should still be the potential for contrast and variety, but this should generally only be considered for selected locations and reflect an overall design vision.

Elements, where appropriate, that humanise the built environment such as modular paving, ornamental planting, seating, lighting or fencing, should be durable, simple and refined and fit with the character of the place with regard to materials, colour and landscape design.

All elements in the road corridor should look as though they have been considered as part of an overall design concept. A random distribution of disparate elements with incompatible designs can be untidy, visually confusing and difficult to maintain.



Understanding and responding to the context: Bridges on the A590 in the Lake District National Park are clad in local stone, reinforcing characteristics that make it a special place.

Considering good design from the start will help maximise benefits, achieve better outcomes, avoid negative impacts and reduce the need for mitigation.

Good road design is innovative

Responding positively to change, good road design captures opportunities for betterment and develops in tandem with emerging new technologies. Designing to a standard is not the same as achieving good design; an innovative and resourceful approach that is mindful of context is necessary to achieve better outcomes.

National Highways (formerly Highways England and Highways Agency) has a successful track record of innovation, from pioneering the use of more efficient and effective pavement materials to developing and building smart motorways. The long-term challenge is to be a wider enabler of positive change, supporting breakthrough vehicle technologies and maximising capacity, while leaving a positive environmental legacy and addressing climate change. Innovative design can help meet these economic, environmental and efficiency challenges in a rapidly changing world.

Design innovation should be structured around making the network safer, improving user satisfaction, encouraging economic growth and delivering better environmental outcomes. Keeping the network in good condition, supporting the smooth flow of traffic, achieving efficiency and supporting walking, cycling and horse riding should also be a focus for design innovation. These innovation activities are supported through the road investment strategy.

New ways of working

Innovation and freedom in the development of design solutions is encouraged. Change should be embraced as an opportunity, but it is important that projects are guided by a rigorous and transparent design methodology that recognises the importance of context. If such a design methodology is lacking, innovation and associated decision making can become subjective and confused. A strong design methodology in no way prevents innovation and creativity, but provides a means for new ideas to be tested and standards challenged with place making in mind.

Much innovation in design may focus on materials, efficiency and rapid delivery in construction and the reduction of future maintenance. Involving contractors experienced in construction and maintenance in the design process will assist in the development of innovative solutions. The resulting road should be simpler, safer and greener.



Responding positively to change and opportunity:

The wind shielding on the Second Severn Crossing has resulted in fewer closures due to high winds and reduced impact on the local and regional economy.

Technology

Ever increasing rapid advances in technology are impacting on design, construction and maintenance and user experience. Sophisticated computer modelling allows for ever greater testing and simulation of design ideas, for example through the use of 'digital twins'. Emerging connected and autonomous vehicle technologies may also unlock significant safety, traffic flow and environmental benefits and fundamentally change the experience of using the network in the future.

Although it is impossible to predict the future, designers should be conscious of this potential for significant change. Designs therefore should be adaptable to future needs. Designers should be open to new ideas to future proof the network as far as possible. However, the unpredictability of technological change does mean measures to accommodate future technology should remain flexible themselves to ensure best value is achieved.

Standardisation, modularisation and prefabrication

Most design and construction today has some element of standardisation, modularisation and prefabrication. These techniques and methods are encouraged when context and appropriateness is considered. The challenge to the designer is to use innovative standardised or modular elements in a creative way and use bespoke elements sparingly and effectively only to reinforce a sense of place if necessary.

The innovative standardised signage system developed by Jock Kinneir and Margaret Calvert in the 1960s to replace previously unclear and inconsistent signs became a worldwide exemplar. This system still in use today makes roads safe and easily understandable through the uniformity it brings to the road environment.

Modularisation and prefabrication can be innovative and provide many benefits – quality, safety, efficiency, speed of construction, reduced waste value, ease of maintenance, etc. Like standardisation, how these elements are used and arranged is the creative challenge for the designer to ensure a sense of place is not eroded.

A robust design methodology provides a means for new ideas to be tested and conventions challenged.

Creativity

Creative designers will find opportunity in constraints and problems. The problem of excess spoil could be an opportunity for land art to create a local landmark, space for recreation and a sense of place for example. Constraints should be viewed as a useful framework which provide a focus for a design and should not inhibit creativity, but instead fuel innovation. In this context, mitigation should be viewed as a last resort, the result of not effectively or sufficiently resolving a constraint or problem.

Design is essentially a problem-solving activity and a creative approach is required to develop innovative solutions, balancing functional, technological and aesthetic aspects. Simply designing to a standard will not necessarily produce good design and will only ever ensure minimum functional and safety requirements are met. Good design provides the opportunity to ask how it should be done and done better.

To bring further creative insight and innovation to the design process, enlisting the help of a creative designer with a different perspective could be considered. They can help to bring new understanding of the wider landscape and sense of place and ideas for how this could be translated into the user experience, and the design of the road and its elements. Designers should also consider how opportunities from other industries could be utilised in the design of roads.



Innovation in construction: Prefabricating bridges and moving them into position over the A14 reduced the length and number of road closures required.

Good road design is collaborative

Collaboration ensures roads are useful to and accepted by the communities they serve. Collaborative working requires a rigorous process that identifies dependencies and wider opportunities, and facilitates effective communication and engagement from the start. Community engagement will be led by a local sense of culture, place and value.

Community and stakeholder involvement is integral to good design. It is one of the most important elements in delivering roads that are context sensitive. Adopting a collaborative approach can make a project more acceptable, if not more welcome, to communities and stakeholders. This two-way dialogue requires that design intentions are illustrated comprehensively and realistically to be effective. Well considered illustrations can help integrate different design elements, aid clear communication and promote the project through the approval and consent systems.

Plans and aerial views can be helpful to explain the overall layout, but can be difficult to understand as they are either abstractions (maps) or present views (from the air) that will never realistically be seen. Eye level views either computer generated or sketched will provide a more realistic view of a proposal. These can be taken from a user's perspective (walker, driver, etc.) and agreed viewpoints.

Collaboration, consultation and communication

A fully collaborative approach often involves a small number of stakeholders who may be given some decision-making powers and shared accountability and is best used for more complex problems that have a major impact on the stakeholders.

Consultation will give communities and stakeholders the opportunity to provide input at or near the start of the process to inform the decision-maker(s) – solely accountable for success - of relevant issues or facts. The difference with a fully collaborative approach is that the decision-maker(s) may choose to use or ignore the input (noting that people expect to be included in decisions that affect them).

A balanced consultation approach will engage communities and stakeholders, and see the decision-maker presenting key information and

Generating opportunities for others:

Close working with National Trust and Natural England allowed for the restoration of heathland at the Devil's Punchbowl with the rerouting of the A3 via the Hindhead Tunnel. The National Trust refurbished their visitors centre and café at the site after it opened.



giving people the chance to ask questions and make comments. The decision-maker mainly listens and asks questions and does not simply present decisions and answer questions.

If a new road is to be accepted by a community, trust is key. If designers and decision-makers make pre-determined decisions or do not make use of what they have been told in consultation and do not say why, communities will be less likely to participate and are more likely to object. By communicating early and openly, designers and decision makers can build trust and ownership. When communities feel their concerns and ideas have been taken seriously, they are more prepared for change.

Values and vision

Consultation with communities and stakeholders should help identify a range of issues to be addressed and the values of an area - what is it about the context that is appreciated by the community and what in the area is important to people? Context analysis should ideally be discussed with communities and stakeholders early on. This can add useful local knowledge and insight and can confirm that it accurately reflects existing conditions. It should also confirm values placed on key attributes such as views, landscape quality and special places are in accordance with community opinions and understand how proposals may change the character.

Once the context is understood and agreed, the design vision and objectives should be developed and design principles for realisation agreed. These design principles can then generate a design concept and narrative for the project.

A design vision is a statement of the desired future character based on both the sense of place and transport requirements - how we (National Highways, stakeholders and communities) want the road to function, to look and to fit into its natural, built and historic environment and contribute to the future of the area. Design objectives articulate what it is that needs to be done to achieve a vision. They respond to the constraints and opportunities drawn from the analysis of context, transport requirements and stakeholder and community expectations, and should govern overall quality. Objectives should be broad and few in number – five or six from which a wider range of design principles can be developed.

Design principles in general link a project's design vision and objectives to the concept. The principles support the objectives through approach, ideas, composition themes and guidelines which will define both the concept and further design development. The principles should be described with concise text and images. The design concept translates

the project's principles into a site-specific and integrated design and engineering solution. There may well be different design options that meet the stated principles, but will lead to a preferred solution.

A collaborative design approach can make a project more acceptable, if not more welcome, to communities and stakeholders.

Opportunities and constraints

Designers should see change as opportunity. They need to identify and assess not only contextual constraints, but also opportunities. For example, be aware of future land use and movement patterns, as well as current and future opportunities for a corridor's landscape and integration of different transport modes. This understanding of opportunities beyond the road corridor requires collaborative working.

Appreciating the iterative link between design development and environmental assessment is also critical to collaborative working. Environmental assessment is not a separate process occurring after design and key constraints and opportunities should therefore be considered from the start. The design and environmental assessment process should seek to 'design out' the potential negative impacts of a project early on, leaving only minor remaining impacts to be dealt with through mitigation. There should be clear design proposals for any such mitigation, and this should be integrated within the overall design concept.



Working with others: When transport corridors intersect as here on the M25, successful outcomes require collaborative working between different authorities.

Good road design is long-lasting

With quality materials and careful detailing, good road design brings lasting value. The design process requires sufficient time for challenges to be resolved before delivery and is adaptable to future needs and technologies as part of the commitment to whole-life operation, management and maintenance.

The consideration of maintenance and longevity is essential to good design and sustainable development. The network is extensive and growing and maintenance is therefore a large and costly component of annual expenditure. Design today should support future positive outcomes, including resilience to climate change.

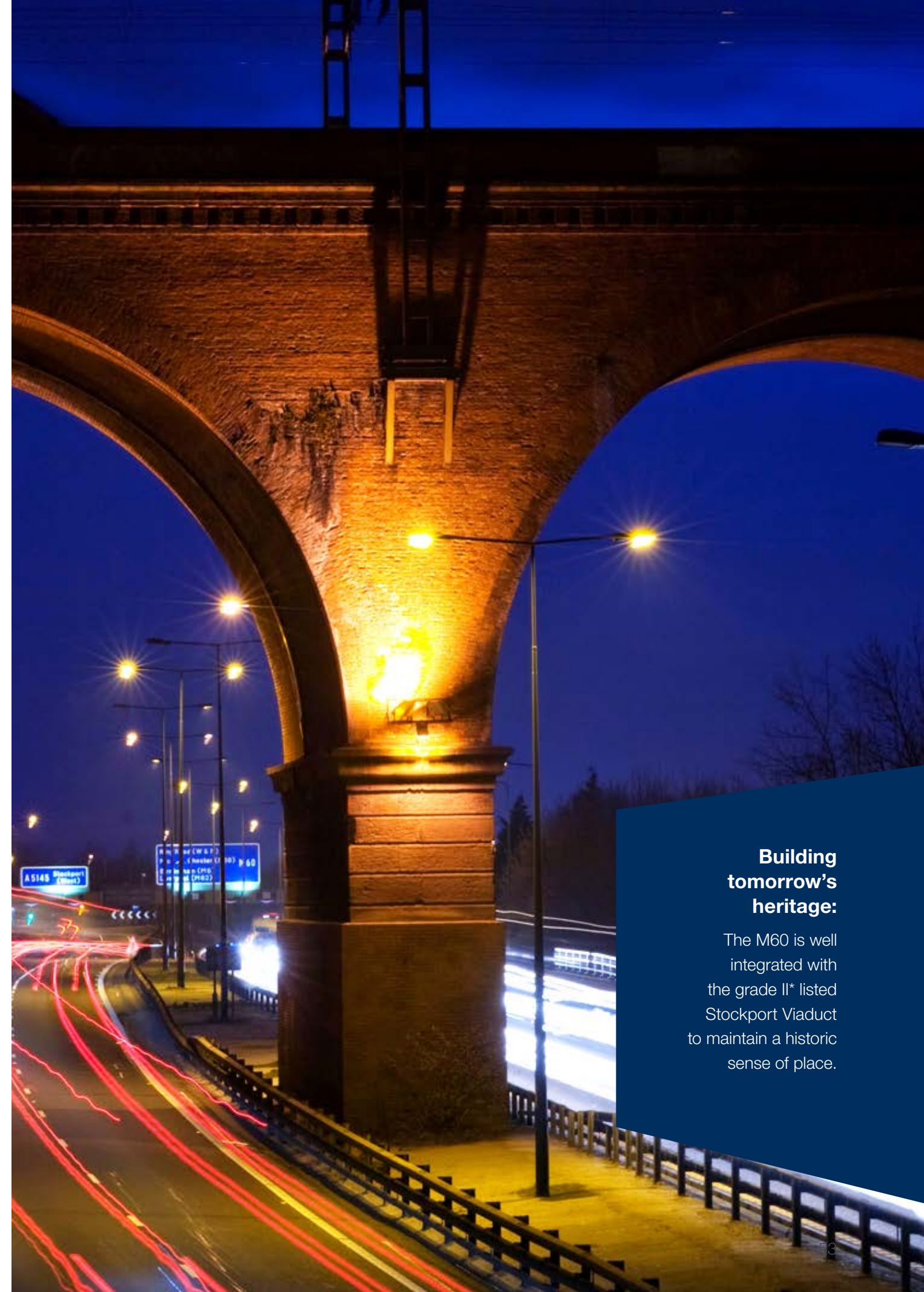
Design life and maintenance is not an 'add-on', but should be considered at all stages of design and integrated with function and aesthetics. Longevity, low maintenance and good aesthetics are all served by high quality design that is: neat, uncomplicated and coordinated; robust and durable in material and form; and accessible, easy and safe to maintain when required. Consequently, road elements should not be designed separately in isolation or be unrelated to an overall design approach. Rather, there should be a unified design of integrated elements, fit for purpose and context and requiring little or no regular maintenance.

Robust and durable materials

Road environments can be harsh and subject to damage from vehicles, weather, salt and vandalism. They need to last and remain safe and functional. In doing so, they need to look as good as when they were built for many years and transcend fashion.

Selected materials and design details should be fit for purpose and place. A higher capital cost may be justified in some cases to reduce long-term maintenance and extend design life. Examples of this include:

- Light, fragile materials such as glass should be used sparingly and protected.
- Planting should be long-lived, hardy and at densities to out-compete weeds.
- Metals should be protected from corrosion and paints from UV deterioration.
- Bridge decks should be protected from water and salt penetration.



Building tomorrow's heritage:

The M60 is well integrated with the grade II* listed Stockport Viaduct to maintain a historic sense of place.

Low maintenance natural landscapes

Landscape can require intensive maintenance if not designed and constructed properly. It should be self-reliant and hardy, be as close to its natural state as possible, while responding to its context and changes to the climate and biodiversity.

Planting should be dense enough to withstand weed invasion and looked after until established. Ground conditions, including soil composition and depth, and drainage, should be appropriate to the planting specified in the design. Native species should be selected for hardiness and suitability to the locality and sourced locally if possible. Native seeding should be applied at the correct rates. The mature height and spread of planting should be considered as part of the design, and planting selected to avoid rapid growth within sight lines to reduce maintenance.

Quality elements and maintainable components

Major components (bridges, tunnels, rest areas) and individual elements (walls, barriers, lighting, gantries, signs) should be designed as a whole corridor composition, and be durable and aesthetically pleasing by themselves.

Consider locating, aligning and designing bridges to fit unobtrusively with other elements of the context, be simple and elegant to complement, or distinctive to contrast and create a counterpoint. Bridges associated with entry to urban areas or other special areas should be planned and designed carefully as they can form 'gateways' and landmarks in the landscape.

Bridge elements and families of bridges should form part of a unified design. Non-structural elements should be avoided, but where necessary, be designed as part of the whole structure.

Tunnel portals should be distinctive and elegant, address their context and clearly and safely mark the transition between open road and enclosed tunnel.

Noise barriers should avoid too many different designs within a corridor, otherwise they can appear uncoordinated and be difficult to maintain and replace if damaged.

Lighting should be simple, resistant to vandalism and selected to reflect the context and overall design approach. Light spill beyond the road and energy use should be minimised.

Signage should be considered in terms of the overall design approach, as over-use, and inappropriate layout and sizing can diminish the overall quality of the corridor.

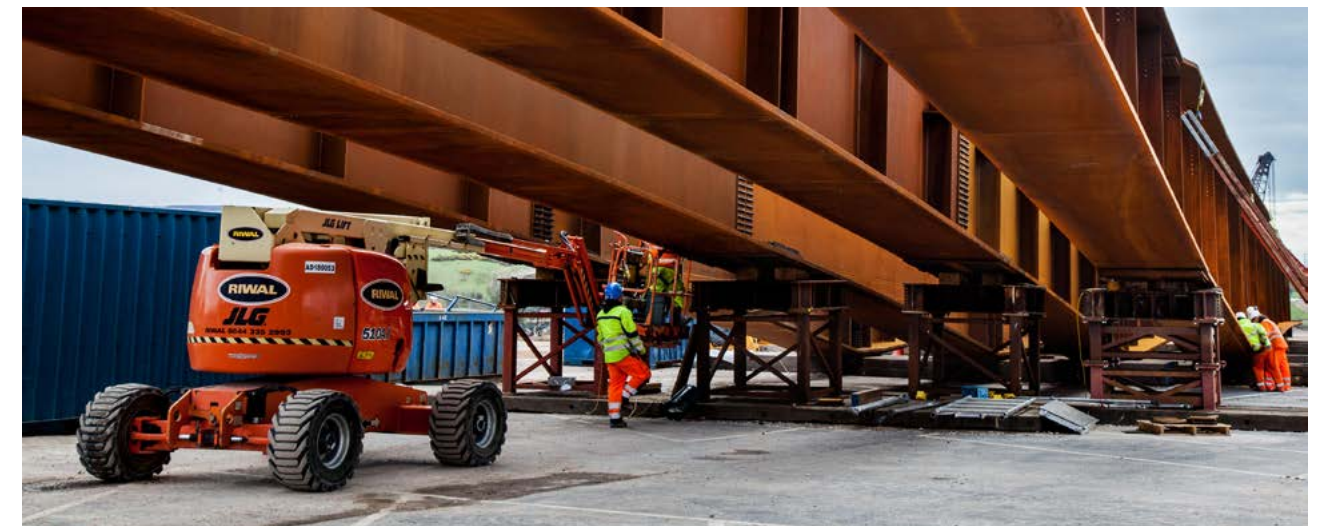
The number of signs should be minimised where possible and their location should not undermine the scale and character of an area, dominate the skyline or block significant views for road users and the community. Variable message signs should be located away from key views of the landscape as they can be visually intrusive due to their scale, design and prominence of the messages.

Roads are long in their planning and should also be robust, resilient and long-lasting in operation.

Whole-life

Whole-life design considers carbon, land acquisition, environmental impact, construction, operation, maintenance and the eventual refurbishment or disposal of the road and its elements. Any additional cost for whole-life design should be saved in construction and long-term maintenance. An integrated whole-life approach to design, construction, operation and maintenance, with input from contractors, can improve safety, sustainability and quality; increase buildability; reduce waste; reduce maintenance and subsequently increase value.

The greatest opportunity to influence whole-life performance is at the early stages of a project. A commitment to whole-life design should therefore be established early on. This commitment needs to be maintained throughout the design process to deliver benefits in construction, operation and eventual disposal.



Low maintenance: The protective oxide film on the surface of weathering steel means it does not need to be painted, reducing future maintenance and risk.

Supporting good design



Supporting biodiversity:

The green bridge over the A556 in Cheshire connects both farmland and woodland for the benefit of local wildlife.

A

Design for context

Context is the setting of a road and the character of its immediate and wider surroundings, shaped by people and nature. Roads that respond to their context will be well-grounded, be more accepted by communities and have less environmental impact. Design that evolves from its geographical, environmental, and socio-economic context helps foster a sense of belonging, contributes to well-being and inclusion and creates a positive legacy for future generations.

With many different aspects, the notion of a sense of place is complex and experienced by people in different ways. Physically, places can be defined by landscape, buildings and infrastructure. History, culture and activity add non-physical aspects. The richness of experience of place affects all senses, not only visual.

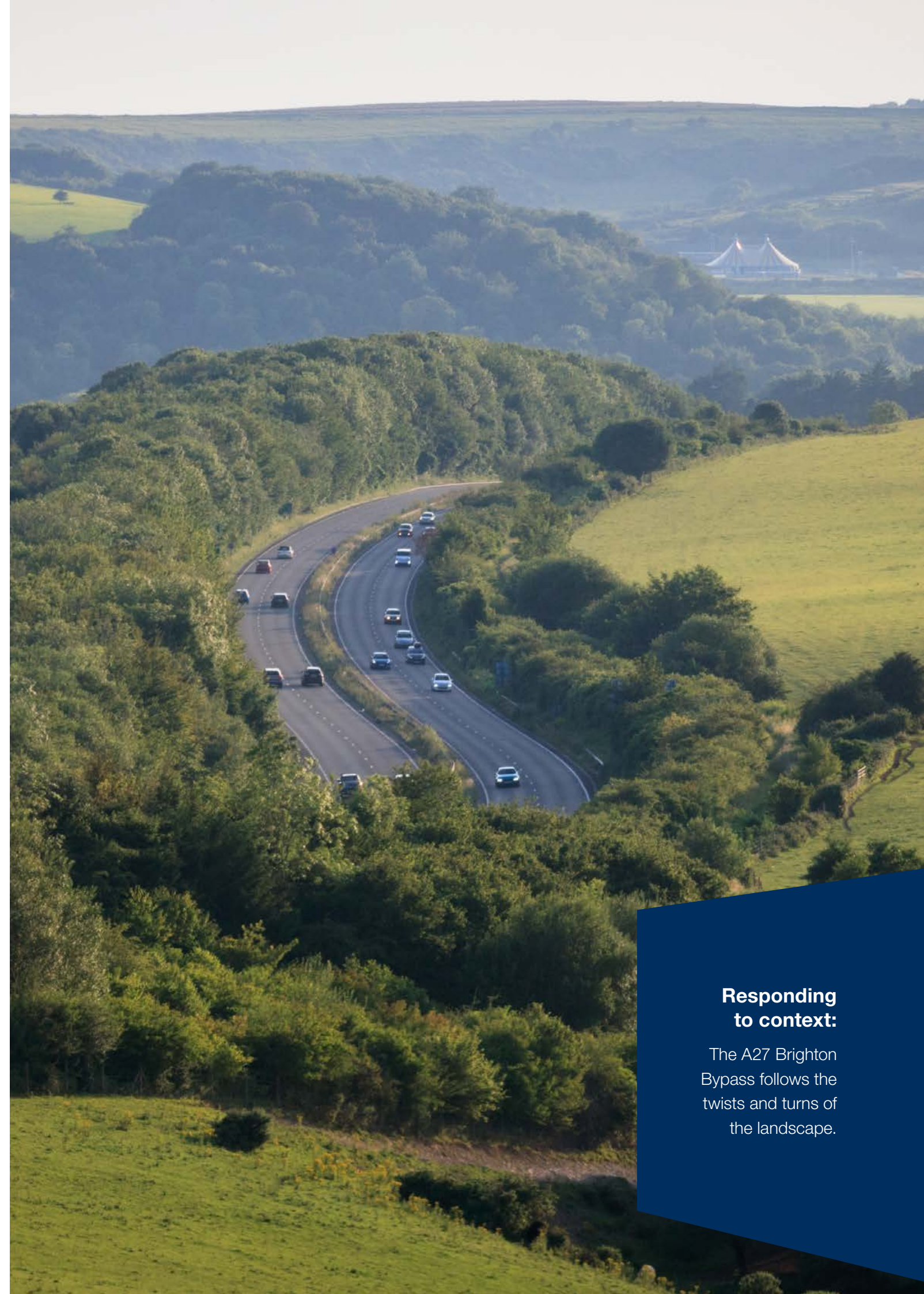
The assets and intrinsic qualities of context will include statutory designations. Ordinary features will also have much value for local people. These can be the most difficult to identify, but often the most important to respond to - not in terms of legal requirements, but acceptance of a road by people and communities.

If the qualities of a place are poor, that is not an excuse for poor design. Good road design should always seek to enhance positive qualities, even if these are limited, and improve the negative. Through working with communities, a new road may even be an opportunity to create a new sense of place in some circumstances.

The context can frame design aims or goals and help inform decisions to achieve balance with safety, function and cost. Having due regard to the geographical, environmental and socio-economic context is also a requirement of our Licence.

Analysis should be undertaken at the start of the design process and supplemented throughout. An interdisciplinary approach will not just focus on environmental issues – it will also include social, cultural, economic and transport issues. This holistic understanding of context should be the foundation for a holistic approach to design.

The analysis of context is an integral part of the design process, but is not linear. As a design progresses more detailed analysis of some aspects of context may be needed, while others may prove to be inconsequential. Time spent understanding the context at the start of the process should reduce changes and delays later.



Responding to context:

The A27 Brighton Bypass follows the twists and turns of the landscape.

Geographical

The geographical context is primarily physical and focuses on location and its characteristics. Landform, topography, geology and ground conditions are potential design drivers. Whether an area is hilly or flat can influence road alignment, as will water bodies or courses. The pattern of land uses and activities, including settlements and their character (age, scale, layout and density), is also important.

Whether an area is predominately urban or rural can influence the design. The character of existing built development, including form, appearance, details and materials, could influence structural design for example. As roads should reflect the character of the landscape or landscapes through which they pass, an early understanding is critical. This will include visual landmarks and views to, from or across the landscape as part of the context.

Access, movement and accessibility of both motorised and non-motorised users will form networks and lines across the landscape. An understanding of this connectivity and the links between places and people will help define the geographical context.

Environmental

The environmental context is primarily physical and focuses on natural and other features that represent both constraints and opportunities for good design.

Environmental designations will include, but not be limited to, national parks, areas of outstanding natural beauty, ancient woodland, sites of special scientific interest, national nature reserves, air quality management areas, noise important areas, dark skies, ancient monuments, conservation areas, listed buildings and historic parks. Drainage, water quality and flood risk will also inform the environmental context, as will air quality and noise and local heritage. An understanding of local biodiversity and ecology, combined with other features such as drainage, microclimate and landscape, will allow for a holistic view of natural systems to emerge.

The environmental context is not an environmental impact assessment, although such assessments can help define it. The focus of the environmental context should be identifying constraints as well as opportunities for good design, not mitigation.

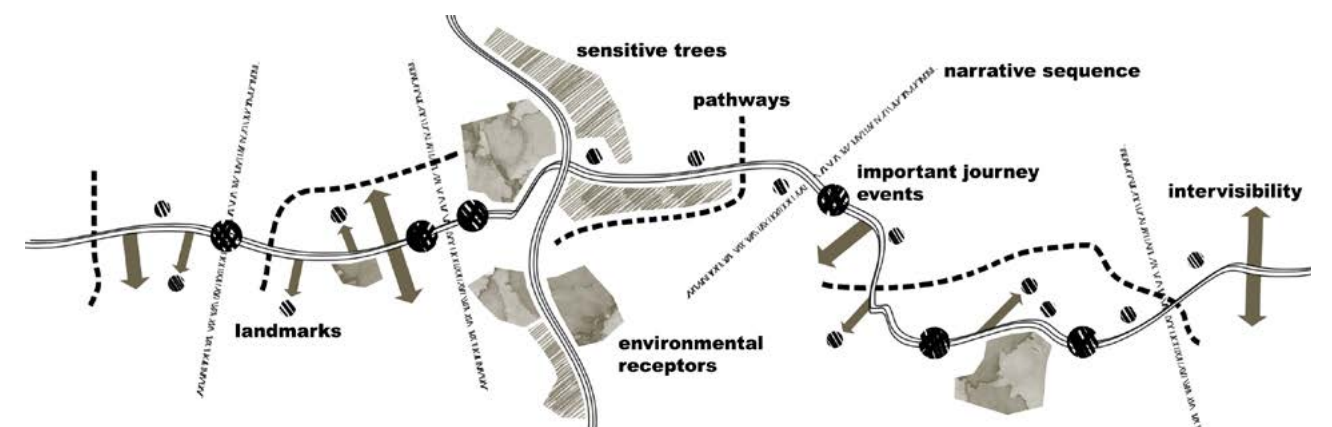
A holistic understanding of context should be the foundation for a holistic approach to design.

Socio-economic

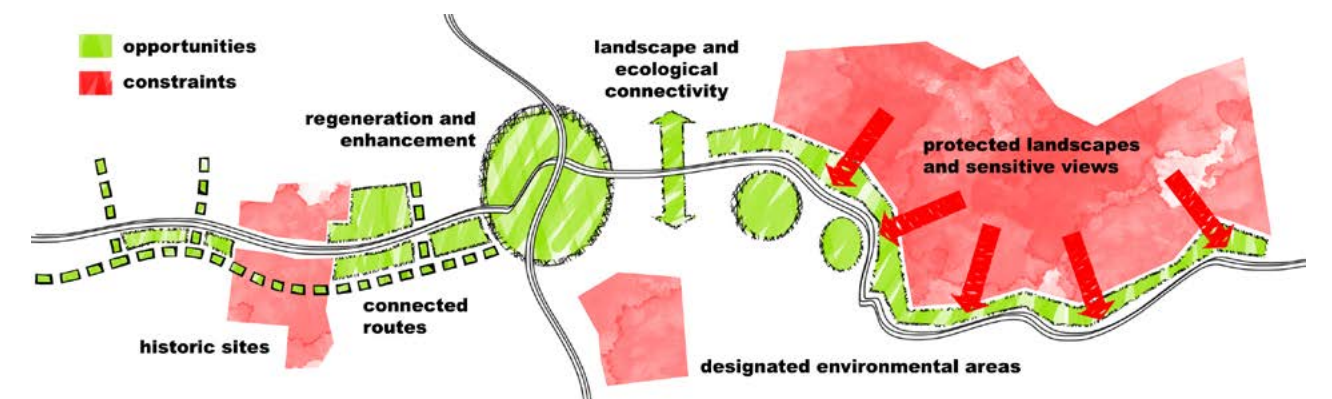
The socio-economic context is primarily non-physical and focuses on the relationship between social characteristics and economic activity.

The function and development of settlements, along with their relationship to an existing or proposed road, should be understood. Demographic information relevant to design could include age, health, employment, wealth, deprivation and car ownership, particularly where these differ from national averages. Social context also includes the views, concerns and aspirations of local stakeholders and communities. These should begin to be captured from the start of the process. Political boundaries and local government structure should also be understood at an early stage.

As well as people, the character of the local economy can be a design driver. Is there a dominant economic activity in an area or a mix of activities? What is driving demand for movement. What are the characteristics of that movement and composition of traffic? Areas of employment, economic attractors and centres of activity should also be identified. Plans (neighbourhood, local and regional) for economic and housing growth will identify the potential for development in an area and establish patterns of growth, decline or regeneration to which the road design can respond.



Mapping context: understanding a place and its characteristics is a key starting point for good road design.



Mapping opportunities and constraints: an understanding of context will generate both opportunities and constraints for design.

B

Design for climate change

Roads are long in their planning and should be long-lasting in operation. Designers therefore have to anticipate long-term changes to the technological, social and environmental context of the road. Road designs should be resilient to change and anticipate different scenarios under which a road might need to operate to continue to be relevant and maintain high value.

Technological changes will include the move to zero emission, connected and autonomous vehicles and increased online working and shopping. Social changes may be driven by concerns for energy and carbon, the environment and health and well-being. Environmental conditions will change through the impact of global warming. Warmer, wetter winters and hotter, drier summers are projected, with extremes of heat, rainfall and flooding likely to become greater risks in the future, along with winter storms and winds. The pace of change in these events and their frequency is also likely to increase over time.

The challenge presented by climate change should be addressed by everyone and cuts across all 10 of our good road design principles. Good road design can help both minimise greenhouse gas emissions and their impact on the climate and adapt to the actual or anticipated impacts of climate change to ensure future resilience.

The design of the landscape to integrate sustainable drainage systems for example is an opportunity to adapt to climate change while also improving the well-being of users and communities. Similarly, although road use rather than road operation or construction is currently by far the largest generator of carbon emissions on the network, good design can help mitigate all three.

Good road design for climate change should:

- be resilient - integrate measures to ensure the network, including landscape, is designed to adapt and be resilient to future changes in the climate
- be low carbon – integrate measures to support low carbon construction and maintenance into design at an early stage
- support users - support travel choice, promote active travel options and the move to zero tailpipe emission vehicles



Powering the future:

Wind turbines adjacent to the A14 will one day help power a mostly electric vehicle fleet.

Climate change and the 10 principles of good road design

Climate change is one of the most significant long-term risks and design challenges for the network. It is not just an environmental challenge, but one that should be addressed by all disciplines in all areas of design, construction and maintenance. All 10 of the good road design principles should be applied in this context.

1. Roads that are more resilient to climate change will be **safer** and continue to be **useful** during and after intense weather events. Ensuring adaptation in design will allow the network to maintain its strategic function well into the future.
2. **Inclusive** roads are designed for both current and future generations, those who will be most impacted by climate change. Good road design also supports choice of travel, including walking and cycling, to help reduce user emissions.
3. Reducing clutter to make roads **understandable** also lowers the carbon impact in construction and maintenance through a reduction in the volume of materials consumed. Less clutter also means there is less potential for damage with extreme weather events.
4. Understanding and integrating natural systems to **fit** a road into its **context** can reduce and diffuse the impacts of extreme weather events - for example slowing storm water runoff. Planting strategies may need to be adapted to ensure the landscape remains resilient to future changes in the climate context.
5. Reusing existing infrastructure, building as little as possible and emphasising the use of recycled materials is **restrained** and low carbon design. The natural characteristics of a place, particularly drainage systems, should be reflected in the design to aid resilience.

Good road design should seek to reduce greenhouse gas emissions via the hierarchy of: 'build nothing', 'build less', 'build clever' and 'build efficiently'.

6. Roads should be resilient to climate change and multifunctional in their use to be **environmentally sustainable**. Incorporating natural systems and creating green corridors will make the road network and its environs more resilient as well as offering increased biodiversity benefit.
7. Climate change should be **thoroughly considered** in all design and decision making from the early planning stages, through to construction and operation, using the latest climate datasets. Responding to climate change as an afterthought is a less efficient and more costly approach.
8. Climate change demands **innovative** and creative solutions to be able to mitigate and adapt to its impact. These solutions will not all be technological, but also include challenging past approaches to design, construction and operation.
9. Mitigation and adaptation for climate change does not stop at the highway boundary. Natural systems which can be regional in scale and crucial for both adaptation and offsetting emissions will require **collaboration** with others.
10. The climate is changing, and road infrastructure should be designed to be **long-lasting** to ensure it remains safe and useful for future generations. This will include the use of robust, durable, low carbon materials, allowing for longer term changes to operating conditions and planting of appropriate native species for potential extremes of heat, water and drought in the future.



Multi-functional green infrastructure: Attenuation ponds supporting biodiversity while managing storm water runoff, A5-M1 link Bedfordshire.

C

Design beautiful roads

Roman architect and engineer Vitruvius deemed good design as 'firmitas, utilitas and venustas' and this was translated into English by Henry Wotton in the 17th century as 'firmness, commodity and delight'. They remain the basic tenets of good design (and 'delight' relates to the aesthetic qualities associated with style, proportion and visual beauty). For roads, these three essential qualities of good design can be interpreted as safe, functional and elegant.

Good design in general combines utilitarian, technical, and economic considerations with aspects of place and culture. All good design is thus a balance and coordination of aesthetic, functional and technological considerations. However, road design or 'road architecture' is more bound to place and function than other design fields, with specific demands of technical design and safety that need to be met. Since aesthetic considerations have to accept these demands, the potential for variation is more challenging.

The aesthetics of road design is further distinguished as many of its qualities are dictated by place itself. Road design therefore demands a deeper understanding and response to place to create a quality aesthetic experience for the user and wider community.

The typical approach to the national landscape, particularly in rural areas, is to conserve what's there. This has helped preserve the scenic beauty of our landscapes, but presents a challenge for roads that will inevitably cause change in some form.

In addition to the 10 principles, road design should be driven by the following architectural and visual aspects of design. These should help define and stimulate thinking about road design aesthetics and are not instructions for how to design a road. They should act as objective prompts for both the designer and a reviewer.

Good design combines utilitarian, technical, and economic considerations with aspects of place and culture.



Place making:

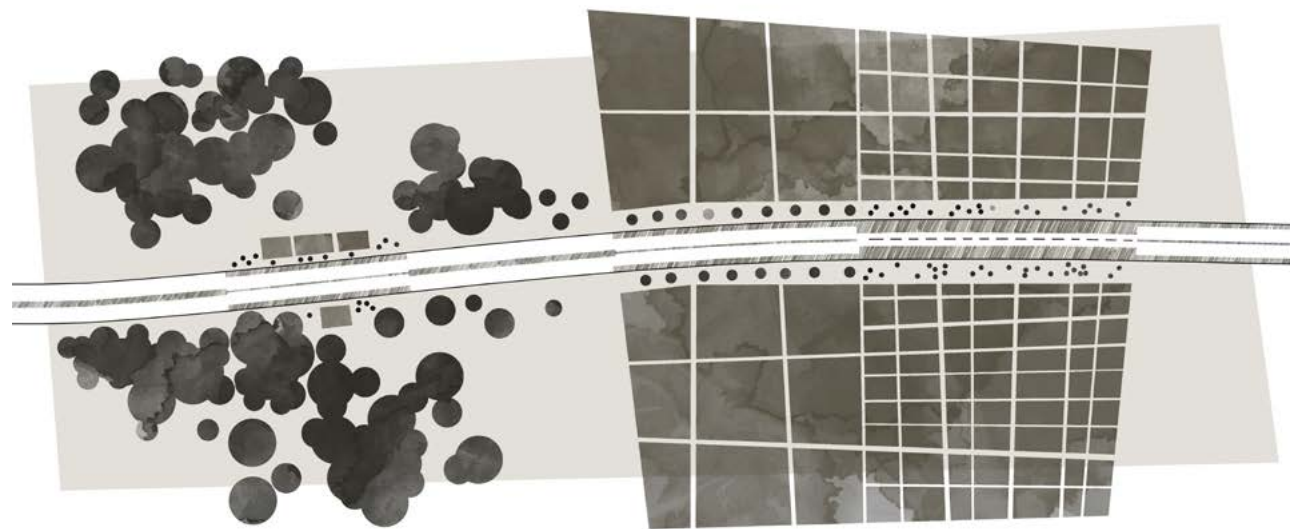
This split carriageway on the A30 on Bodmin Moor responds to the landscape while also creating a memorable moment in the journey.

Scale

Road design consists of different types of scales, often existing in the same space. Perceivable scale relates to elements that can be judged easily in comparison to the size of a human body, such as windows on a building. Non-perceivable scale relates to elements for which the human body cannot be used as a comparison of size, such as a large hill, bridge, or viaduct. Dynamic scale relates to speed and its effect on the perceived size of roadside objects – an effect illustrated by the need for signs to be larger on a high-speed road so they can be seen and read easily by drivers.

There is an agreement of scales when elements are of the same scale. Roads in an open landscape belong in the landscape's large scale, and agreement is achieved by making the road fit using elements on the same scale, for example a forest. A contrast of scales is achieved by mixing elements of very different sizes, for example pedestrian and cycle facilities adjacent to a high-speed road. A unity of scales is achieved when elements of increasing size create a transition from one scale to another in road design. This is often achieved through landscape design.

Proportion is the relationship between the size of various parts of an individual element of road design, not the whole. The width of a bridge relative to its height for example.



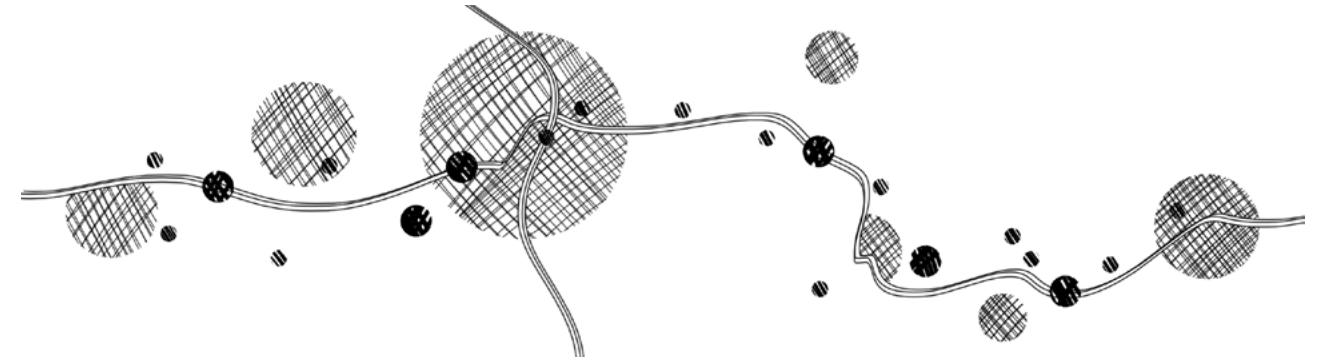
Scale: an agreement of scales will help a road fit in context.

Good design combines utilitarian, technical, and economic considerations with aspects of place and culture.

Structure

Describing the way in which an urban or rural landscape is composed, structure refers to a pattern, but not necessarily one that is repeated. The rural landscape's structure can vary a great deal and is an important consideration for road design since observed landscape elements such as watercourses and hills usually define the context. In urban areas, structure is shaped by the geometry, scale and density of built form, road widths and the road network itself. It is this movement network of different roads, each with a special purpose, which will define the context.

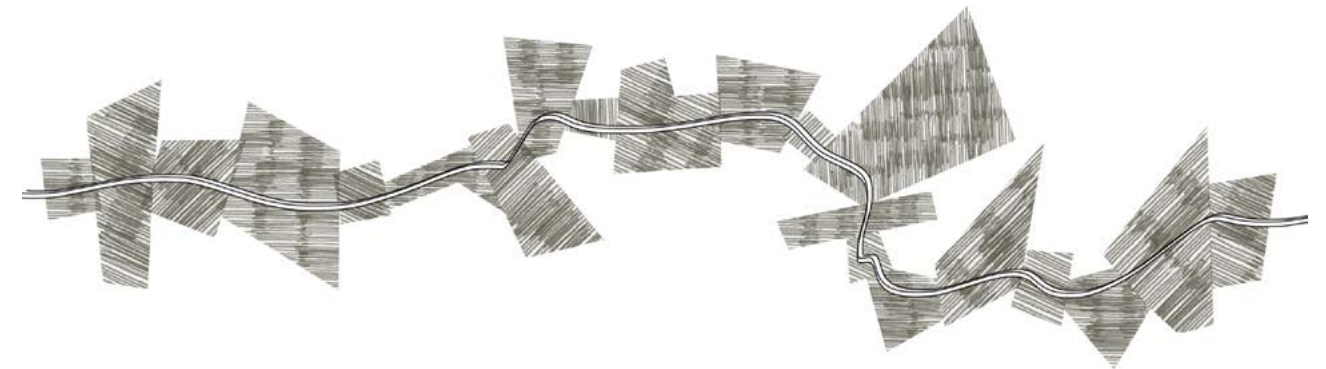
A road's structure reflects the principles according to which it was built, for example the spacing of bridges, gantries, trees, etc. Older roads often appear to have a random design structure having evolved over years, but the structure of new roads can and should be designed to an overall vision. Structure is needed for road environments to be clear and understandable.



Structure: a road can help structure a place by defining connections and boundaries.

Space

An understanding and use of space is a key concept in road design. The urban and rural landscape provide the road user with a variety of spatial experiences, most commonly perceived as the extent of visual range into the wider landscape. Changes in the alignment of a road or its degree of enclosure can provide spatial variation, providing a richer experience, a greater appreciation of place, and a sense of progression along a journey, as well as influencing driver behaviour.

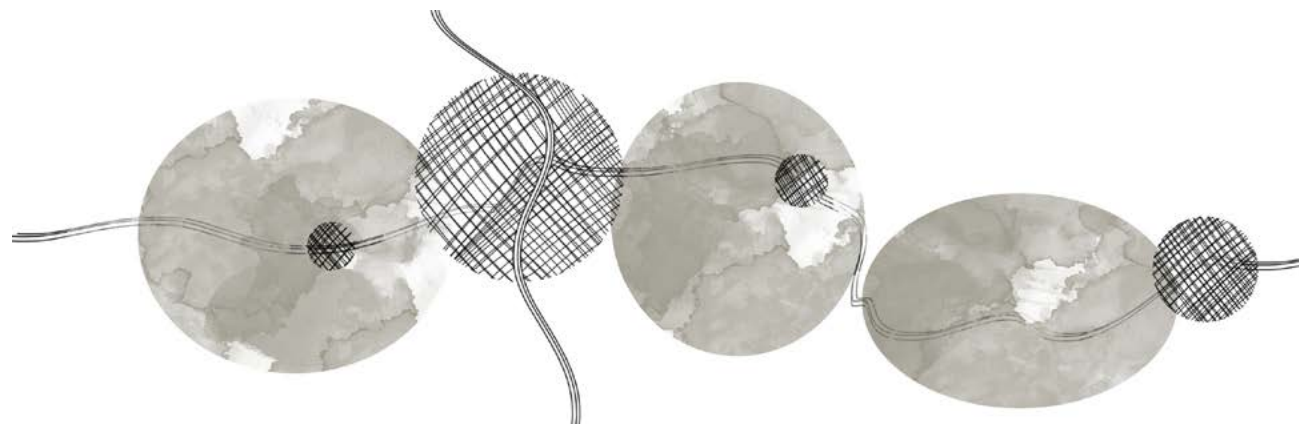


Space: open and closed views from the road help shape the user experience.

Identity

A road draws its identity or character from its unifying aesthetics, the places it connects, and the experience of journey it provides. A road can acquire identity by being associated with the urban or rural landscape or an iconic element such as a bridge.

When we say that an urban or rural landscape has its own identity, we are attributing characteristics to it. Moorland is an example of a landscape with a strong identity. It is difficult to change such landscapes without causing them to lose their identity. The road design can contribute to or be dominated by an existing identity. Alternately the road could give the landscape a new identity.

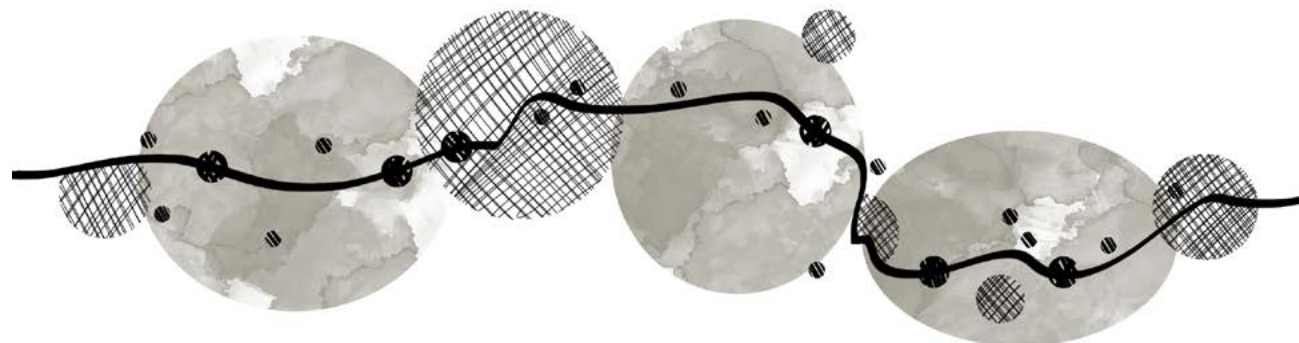


Identity: roads can pass through and connect different character areas.

Unity

Unity is an important element in our view of the natural and built environment and a key concept for road design. It is achieved by having an overall governing design idea or unifying element and through consistency or compatibility of the character of the various parts of the road.

Roads can themselves create new unities, but are experienced largely together with their context and should therefore be coordinated with their surroundings and disparate elements avoided. Also see variety and contrast.

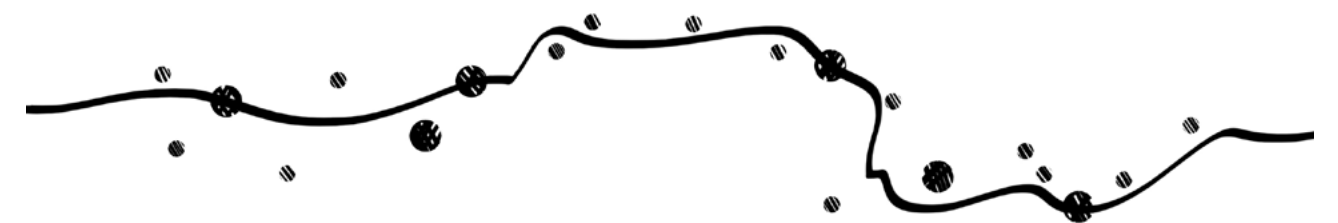


Unity: roads can pass through and connect different character areas.

Order

Design is a process of producing order out of competing issues; aesthetic order as a reflection of practical order. Where there are existing features, these should be used as a framework into which new elements are added to help produce a systematic, logical and controlled arrangement. In visually chaotic situations or where there are few existing positive features, road design can and should bring order. However, order without diversity can result in monotony.

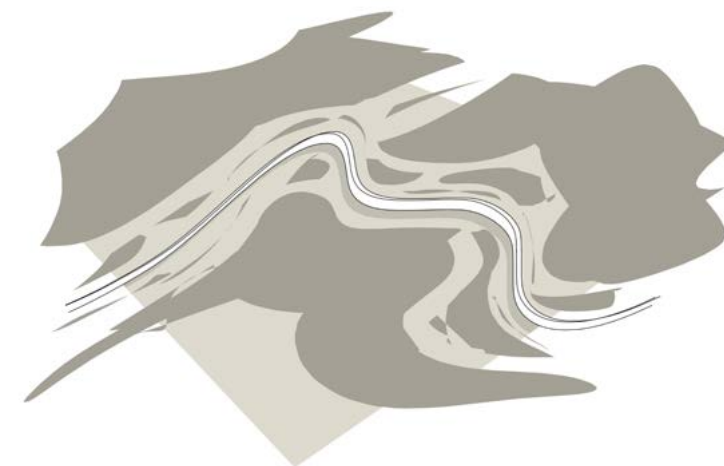
A number of ordering principles can be used to create order, including symmetry, hierarchy, rhythm or repetition and also datum, where the road by its continuity and regularity serves as the ordering element.



Order: a road can be an ordering element in the natural and built environment.

Harmony

A road can be in harmony with its context in diverse ways. If the aim is a road dominated by its surroundings, it may not be necessary to change or reinforce the existing landscape to keep its character. The road can also be independent in relation to its context and still be unchanged as the urban or rural landscape changes. If independent, a strong design or architectural statement needs to be made to emphasise this character. The road needs to give a beautiful experience by itself and provide its own unity. Both concepts can yield distinctive and beautiful results, but design uncertainty will produce an unsatisfactory experience.

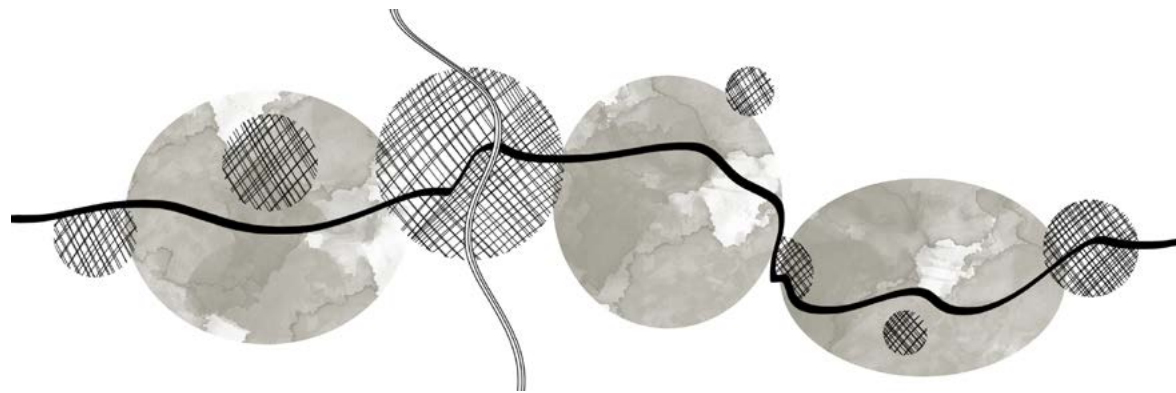


Harmony: a road can be in harmony with its context or deliberately independent.

Contrast

The juxtaposition of different forms, colours and textures can create visual interest for both the user and the wider community. Care should be taken however, when the overall design concept is one of harmony when considering contrast.

Some contrasting elements such as landscape will be easier to accommodate than structures such as bridges. For structures, consideration should be given as to whether they should be seen as contrasting objects or made to fit into their context. Contrast at times will be unavoidable due to scale – a large or high bridge for example – and should be embraced to create a landmark.

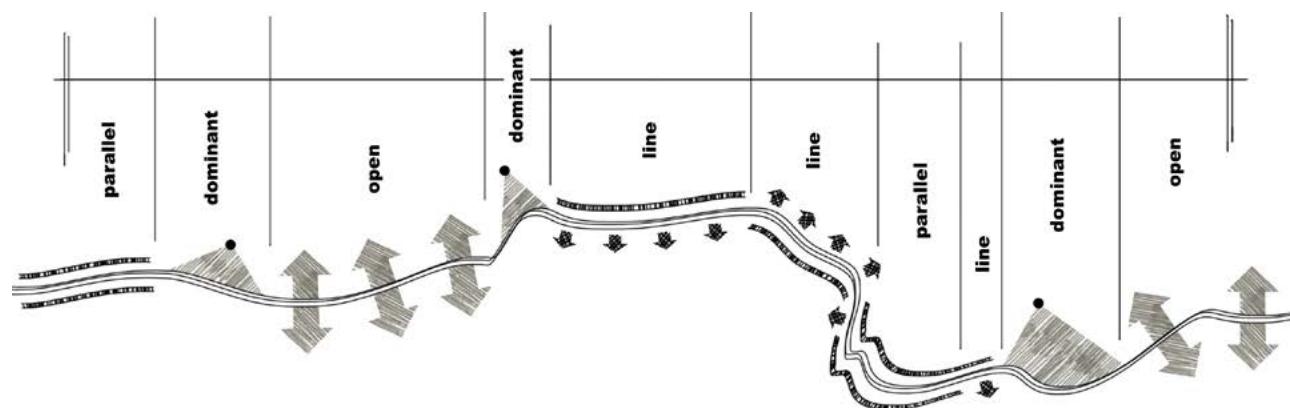


Contrast: contrasting elements will bring attention to the road.

Variety

The user often experiences road design as a cinematic event. It is important to introduce variety to maintain interest through a series of connected spaces and events which form a sequence as one moves.

Variety can relieve monotony and be achieved through the introduction of different components or landscape elements, perhaps reflecting context, while maintaining some unifying elements or details to maintain visual order. Change for the sake of it should be avoided however, particularly in complex contexts where it is important that the road is easily understood.



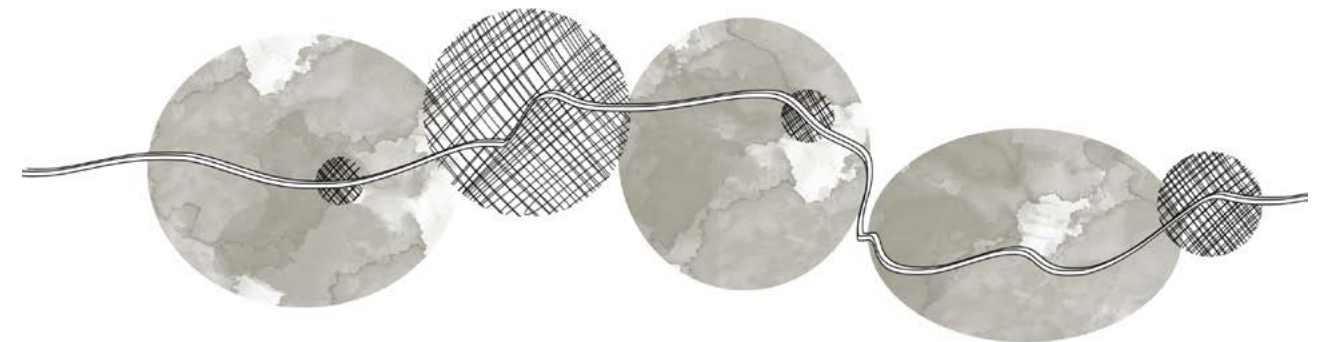
Variety: a sequence of differing experiences along a road will relieve monotony.

Materiality

In addition to scale, order and form, the character of a road and place will be defined by materiality – materials, colour, texture, details – and landscape planting. Light modifies our perception of materiality and materiality can change through time, due to weathering of the surface or vegetation growth.

Neutral and recessive colours and tones for example can increase sense of space and merge elements into a landscape. Alternatively, bright colours and high contrast can increase sense of enclosure and provide visual focus and stimulation.

Whatever the approach, materiality should be appropriate to the context and in both urban and rural landscapes an excess of difference should be avoided. Honesty is also important – materials should generally look like what they are



Materiality: materials, colours, textures, details and landscape planting all contribute to the character of the road environment.

Road design or 'road architecture' is more bound to place and function than other design fields.

D

Design the view from the road

In their 1965 publication *The View from the Road*, Donald Appleyard, Kevin Lynch and John Myer offered that the shaping of visual form should be of fundamental importance to road design. They advocated the organisation of motion, space and view to make the user experience a positive one; one that could also establish spatial coherence and order on a regional scale. The provision of visual stimuli and the creation of a progressive sequence of events are the primary means of achieving this and should be considered alongside, but not to the detriment of, the view of the road, which so often dominates current road design and seeks to hide it.

Consider heightening the user experience by highlighting landmarks and points of interest throughout a journey. This can be especially important over long distances which require extra visual stimulation to reduce driver fatigue and aid orientation, or where the surrounding landscape is homogeneous and potentially boring.

Visual stimuli can take the form of distinctive over-bridges or other elements, views of natural features such as hills and distinctive landscape design appropriate to the context. The use of lighting, materials, colour, art or other place markers, can also complement the visual experience, but such devices should not be 'gimmicks' and be appropriate to an overall design approach and endorsed by the local community.

The view from the road and within the corridor contributes greatly to the user experience in movement and time. This should be incorporated into a fully 'choreographed' design. A sequence of events should be designed that, while distinct and memorable, is also progressive and flowing, calm and coherent to users.

Consider a contrast between a sinuous flowing route and straight sections and visual events that occur or need to be designed at logical intervals and critical points. By using a considered range of design elements, materials and colour, the design should be thematic and vary with context, rather than be repetitive. Short sequences of interest may occur within larger ones. For example, the approach to a city or the experience along a short stretch of dramatic landscape within a longer journey.

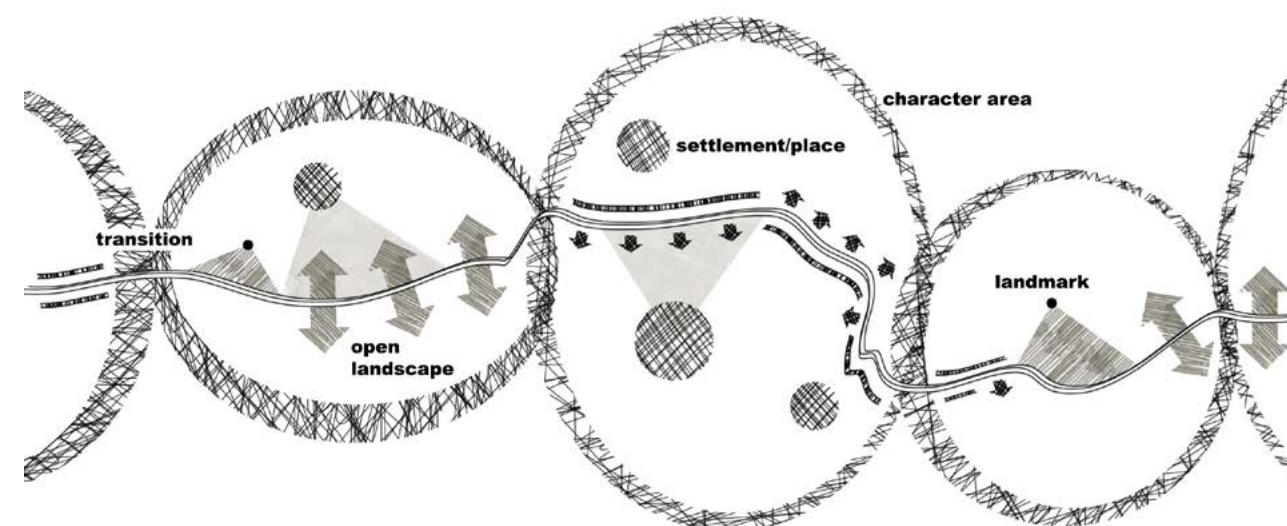
The shaping of visual form should be of fundamental importance to road design.

User decision points should be visually clear and distinct and capable of being anticipated. Change should not be sudden, jolting or stressful, but part of a 'planned' event. Road safety should not rely on engineering such as signage alone, but reinforced with this design 'choreography' that is more instinctive and intuitive.

Useful ways to alert drivers to changes ahead may include visual clues such as creating transitions in road character when approaching a different environment. A good example of this would be the road becoming progressively more enclosed along the approach to a junction, drawing attention back from the surrounding landscape to the immediate road environment. Gateways to urban areas could also be formed by the use of components such as bridges or the formal planting of trees.

As many road schemes do not consider the entirety of a route, it is for the designer to consider both the experience of the user within the scheme, and in the context of the wider journey, beyond the scheme extents. The designer should ensure they are contributing to a coherent narrative and not degrading the sequential experience of the wider journey for the user.

It is also important to consider the structure of the sequential experience – not all moments in a journey are equal, and some will require a longer build-up and payoff than others to be satisfactory to the user.



Mapping the view from the road: character areas, places, landmarks, closed and open views.

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