Developing Design Principles for National Infrastructure

Contents

Foreword

The National Infrastructure Commission set up the Design Task Force to advise on how best to ensure quality design in future major infrastructure. We have reviewed experience of infrastructure design, interrogated infrastructure professionals, and looked at examples from the UK and beyond. Our work has been supported by three important pieces of research, including this report on the value of design principles for national infrastructure and how they might be prepared.

Our recommendations for improving the design of major new infrastructure are included in the National Infrastructure Assessment. They include the National Infrastructure Commission establishing a small, agile, independent National Infrastructure Design Group to act as a design champion. Members would be openly recruited and drawn from a wide range of disciplines. An early task will be to prepare new national infrastructure design principles. We are also asking for all national infrastructure projects to include a design champion in their senior governance and for each to be subject to review and consideration by an independent Design Panel.

May I thank all those who have contributed to this work and the members of the Design Task Force, Lucy Musgrave, Isabel Dedring, Hanif Kara and our advisor Tony Burton.

Professor Sadie Morgan
Commissioner, National Infrastructure Commission

1   Introduction

The National Infrastructure Commission has established a
Design Task Force who are working to put design at the heart of
the country's future infrastructure planning and to ensure quality
design in future major infrastructure. The Design Task Force has
set out a definition for design that goes beyond the aesthetics of
a project to include:

- Thinking creatively about the processes involved in
  providing infrastructure
- Problem-solving from the outset of a project
- Making infrastructure human-scale and user friendly
- Enhancing the environment and improving quality of life for
  local people and nearby communities

Publica was commissioned to provide a scoping report informed
by sector engagement setting out an approach to the first
design principles for national infrastructure, and how they should
be developed. It is envisaged this will be taken forward following
publication of the National Infrastructure Assessment and that
the design principles will be developed for publication in 2019.

Two additional research studies have been undertaken
concurrent to this one: a sector review of attitudes to design
(also conducted by Publica); and a portfolio of examples of
good infrastructure design addressing the major barriers.

The definition of infrastructure used in this report is that of the
National Infrastructure Commission's remit, which encompasses:

- Transport
- Energy
- Water and sewerage
- Flood risk
- Digital
- Waste

2   Research Approach and Methodology

The findings from this report are the result of a robust research methodology that included desk-based research, sector interviews and a workshop with key stakeholders. A workshop with design and infrastructure professionals was held in June 2018. Eight semi-structured interviews with key stakeholders working in design in infrastructure at a senior level were carried out to inform the scope and development of principles. Existing examples of national and regional infrastructure design principles were researched to understand how a programme for the development of national infrastructure design principles could be set out.

Interviews

Views were gathered through eight semi-structured interviews with senior individuals who have experience working at a senior level with design processes of large infrastructure projects. These individuals were selected for their involvement in the development of design principles, their positions on design panels for projects that have used design principles, and their experience in the delivery of large-scale infrastructure projects.

Interviewees

David Kester	Managing Director, DK&A and lead for the development of HS2 design principles
Deborah Denner	Director, Frame Projects, secretariat to HS2 Independent Design Panel
Selina Mason	Head of Masterplanning, Lendlease
Madeleine Kessler	Project Architect, Haptic Architects and NIC Young Professional
Martin Stockley	Deputy Chair of the HS2 Independent Design Panel and the Highways England Design Review Panel
Les Sparks	Architect and town planner
Martin Knight	Director, Knight Architects
Sam Richards	Head of Urban Integration, Crossrail

2   Research Approach and Methodology

Workshop

A two-hour workshop was held to discuss the possibilities presented by national infrastructure design principles, and the scope and issues these principles would have to consider.

The discussion covered a number of issues related to the use of design principles, including:

- Public and industry perceptions of design
- Silos in infrastructure development
- How good design might be measured
- How design is considered in infrastructure project budgets
- The purpose and breadth of design principles
- The weight that design principles should have in policy
- The importance of local context to infrastructure
- Communicating design to non-designers
- Experiences from major infrastructure projects
- Balancing social benefits and disbenefits from infrastructure
- The role of embedded skills and leadership

Workshop Attendees

Alison Caldwell	Principal Engineer, WSP
Annette Jezierska	Co-founder, The Future Fox
Charlotte Mitchell	Associate, Quod
Sakthy Selvakumaran	Civil Engineer, University of Cambridge
Daisy Froud	Strategist and academic, Bartlett School of Architecture
Esther Kurland	Head of Urban Design, TfL and Director, Urban Design London
Chaired by	Anna Mansfield, Director of Strategy and Research, Publica
Supported by	Raja Moussoui, Head of Communications, Publica
	Emma Brunskill-Powell, Research Assistant, Publica

3   The Rationale

The Design Task Force has identified a need to provide design principles for national infrastructure. These will provide a benchmark for all national infrastructure projects. They will be prepared and managed by the new National Infrastructure Design Group to be established by the National Infrastructure Commission.

The Design Task Force's early analysis identified four perceived barriers to quality infrastructure design:

1   A lack of champions in the way projects are governed

2   A lacuna in design knowledge among those running national infrastructure projects

3   A failure to embed design in the day to day working practices of those responsible for programme delivery

4   A deep-seated perception that good design adds cost and poses risk to delivering projects on time and on budget

In addition to investigating the barriers listed above, Publica's sector review of attitudes has identified five additional barriers:

1   Multiple conflicting perspectives over the role of design in infrastructure and who should deliver it

2   Cultural barriers between disciplines

3   A lack of infrastructure delivery experience among design teams

4   Poor project briefs and short-sighted planning

5   Inflexible planning policies

This report outlines a rationale for the use of design principles to address the identified barriers, key considerations for principles in regards to these issues and therefore an early identification of key themes to be included.

The design and construction of infrastructure presents a unique set of challenges – with very large project teams and a wide range of specialist and highly valuable skills contained within them. In addition specialist teams often move together onto a

3   The Rationale

new infrastructure project (both within and outside the UK) and given the average length and scope of a major project it is unlikely that many designers or engineers will be involved in the whole lifecycle of a project. Therefore agreed principles become very important, creating a shared resource for diverse teams with disparate objectives, giving clarity over expected outcomes and allowing greater engagement with the processes of infrastructure design.

With the steady pace of urbanisation, there will be many more infrastructural projects in cities, where the benefits and impacts will be felt by large populations. There will be an increasing expectation on major projects that they deliver more than their primary benefit and that their response to both urban and rural contexts is ambitious. The UK's infrastructure development has historically provided many of our most prized and respected buildings and structures, marrying advanced engineering with brilliant design. We are now some way from that situation and although there are still outstanding projects, there is an inconsistency in approaches.

Design principles specifically reflect a collective knowledge. This scoping report is informed by an approach to design principles as 'sets of generally applicable laws, guidelines, human biases, and design considerations, all of which reflect the accumulated knowledge and experience of practitioners and researchers. They serve as a starting point for the creation of new designs to solve problems.' (Interaction Design Foundation, n.d.).

Principles should not be confused with guidelines, which instruct designers in implementing the design principles. A design principle sits before the design guideline, which is followed by a standard rule for implementation.

Vitruvius' treatise on architecture, *De Architectura*, set out some of the earliest principles of good design: *firmatis* (durability) – it should stand up robustly and remain in good condition; *utilitas* (utility) – it should be useful and function well for the people using it; and *venustatis* (beauty) – it should delight people and raise their spirits.

3   The Rationale

The criteria for good design is often found in national policy, but national design principles that would help engineers, architects and designers to create successful proposals and meet this criteria are not as prevalent, with very few countries developing national design principles. They have been developed in India and in South Korea, however they are primarily in place to instill a design culture in education, and not as a set of principles to follow specifically when building infrastructure, although infrastructure may well subsequently benefit from the emergence of a more skilled design workforce.

One of the best national examples is from the UK, from the Government Digital Service (GDS) which sits within the Cabinet Office and works with government departments to support their transformation to digital platforms and services. In addition to building websites, it works to simplify and improve government services, improve use of technology by government departments, and ensure government data is 'good data'. It works to a set of ten design principles, published in 2012, written engagingly in plain English, supported by clear and creative examples of how they have been used. They exist to ensure consistency (but not uniformity) and a high quality across all departments.

In November 2012, Design Council and Cabe produced *A design-led approach to infrastructure*, providing design guidance for nationally significant infrastructure projects. It sets out ten design principles which encapsulate the recurrent themes that have emerged from Cabe's work on infrastructure, including integrating design thinking early, collaborations between stakeholders, and holistic, big-picture thinking.

In many countries design principles are regional. Switzerland doesn't have overarching national design principles because of its governance structure. 'The supra-local spatial planning is the responsibility of the cantons (member states) which vary in size, culture and landscape as well as in the demands that face each canton' (ETH Zurich, 2008).

3   The Rationale

There are more examples of citywide infrastructure design principles in place than there are national examples. The city of Austin, USA, has published infrastructure design guidelines which include a list of ten core design principles for an integrated infrastructure on which the guidelines are based, including 'sustainable', 'inclusive', 'contextual' and 'hybridised' (integrating multiple programmes and uses) (City of Austin, 2013).

At a project and sector level the effective use of design principles is developing and is currently a key part of several major infrastructure projects:

In January 2013, Thames Tideway Tunnel published its design principles, which underpin the design of the permanent ground level and above-ground elements and spaces of the Thames Tideway Tunnel project. Developed in consultation with local authorities and other stakeholders, the document has three types of design principles:

1   High-level design principles: overarching objectives for the design of permanent structures on all sites

2   Generic principles: general project-wide commitments. However, they must be read in conjunction with the site-specific principles as they are not necessarily appropriate for each site. They are grouped by theme: functional components, heritage design, riparian and in-river structure, landscape design, lighting design, and site drainage.

3   Site-specific principles: these are contextual principles that are unique to each site or which elaborate further on the generic principles

In March 2015, HS2 published its *Design Vision*, setting out nine design principles which are organised under three themes: people, place and time. They were developed from a meeting hosted by the Secretary of State in July 2014 with design experts, academics, and infrastructure professionals. They had to be able to be applied to all elements of HS2: railway stations, landscaping, procurement, sustainability, bridges, tunnels, trains, passenger experience and ticketing.

3   The Rationale

In January 2018, Highways England published *The Road to Good Design*, which establishes ten principles for good road design. Based on universal ideas of good design, they are intended to serve as prompts to improve design quality and outcomes. Like the HS2 principles, they follow three themes: connecting people, connecting places, and connecting processes.

The emergent successful use of design principles for projects and sectors of infrastructure in the UK demonstrates the clear potential for a set of comprehensive national infrastructure design principles. They could elevate the status of design thinking at all stages and across all projects, create a shared and consistent approach (not relying on individuals in organisations to recognise and promote the value of design) and encourage learning between sectors and to raise standards and expertise across the whole industry.

4 Scope for Design Principles for National Infrastructure

This section synthesises the findings of the stakeholder engagement and desk-based research to discuss the scope of design principles for national infrastructure.

Purpose

The study highlighted a range of views on the purpose of design principles for projects. There is an assumption that design is limited to the aesthetic, and a better-articulated definition of design should be included. Often engagement with local users focuses on aesthetics and mitigation, rather than important strategic questions such as location, route or alignment. An additional purpose of national design principles might also be to drive projects which may not have high political or public support, such as Thames Tideway Tunnel.

Principles should act as reminders to the delivery organisation, a steer in the right direction, and a means of restoring focus to the big picture. They should reflect the aspirations and purpose of the client organisation. Design principles should be a point for departure, setting out a common understanding, the issues to be addressed. An additional positive outcome for the development of national infrastructure design principles might be improved capacity for clients to separate good design from bad.

Ambition

Engineers and architects are problem solvers; if you push the industry it will deliver

Selina Mason, Lendlease

Good design principles should be ambitious and encourage excellence. The HS2 principles initially caused concern to some in the construction industry that the bar had been set too high, however the Department for Transport stood by them, enabling them to be pushed forward. The Olympics had a sustainability strategy with principles that were also measurable, such as a commitment that each element would use 50% less carbon than the industry norm; this was increased several times as the bar

4   Scope for Design Principles for National Infrastructure

was met over and over again. Environmental targets are very firm, but there is no equivalent for design. Design principles should encourage infrastructure that embodies the best ambition of our age, in the style of Bazalgette's embankment project in London. The bar set by principles should be a challenge but not impossible, and regularly updated in response to conditions.

A key issue is whether national design principles push for excellence in particular projects where the circumstances are favourable, or whether they focus instead on bringing the general standard of infrastructure design up to a common basic level. The best approach will be able to do both.

A shared approach

The main value of design principles is not the finished document, but the thought process of developing them

Sam Richards, Crossrail

Design principles can play an important role in convening people from different disciplines. The process of setting design principles, which convene a project's key stakeholders at an early stage, can be as important as the outcome of a list of principles. Often different consultants and contractors undertake different, parallel work to get a project through planning processes, and aren't necessarily speaking to one another throughout. The *Design and Infrastructure - Sector Review of Attitudes* research revealed that skills such as procuring design expertise can be strongly represented in certain sectors, particularly those that often face significant public opposition for new projects. Cross-sector working will allow best practice to be shared.

Some issues like safety and security can cause disagreements where engineers and designers have different priorities; it's important to keep communicating and being aware of each other's priorities. It's important to have design skills in the delivery organisation as well – design principles need enough in-house expertise to be implemented.

4   Scope for Design Principles for National Infrastructure

Improvement on what exists

Similar to principles in conservation, new, extended or enhanced infrastructure should 'make it no worse' and offer 'net gain' for the local area. Often the focus is on mitigation of the damage to the local environment caused by new infrastructure, and instead design principles could state that the quality of both the infrastructure and its setting should be improved by infrastructure investment. Betterment could be made a pivotal issue in deciding if funding should be granted. A positive interaction should be encouraged between new infrastructure and the local community - there should be an emphasis on granularity and connectivity.

Although cost-benefit analysis should recognise the overall good of new infrastructure, design principles should also recognise the disbenefits that projects have for some groups, particularly local communities. Positive benefits should be focussed on local communities, rather than emphasising a national benefit - the public can be increasingly suspicious of this argument. Investment in areas which might suffer from infrastructure could deliver greater equity in outcome and encourage greater public support for new infrastructure.

5 Development of Design Principles for National Infrastructure

5.1 Key Considerations

This chapter outlines key considerations for the development of design principles. Potential obstacles to the adoption of national infrastructure design principles, and the methods for overcoming them, are included throughout.

- General vs specific
- Measurable outcomes
- The relationship of design principles to design panels
- The form of the principles
- Flexibility
- Communication
- Ownership of principles
- Embedding the principles

General vs specific

Overarching principles are valuable to ensure focus but can be too broad to be actionable. At the other end of the spectrum, project-based principles have clear objectives and are actionable but are isolated in their impact if not clearly linked to their capacity to address wider challenges. There will need to be a clear relationship and hierarchy between overarching infrastructure design principles, sectoral and project defined principles.

Advantages of high-level, general principles:
- A clear direction at the top of a project which extrapolates to all areas of work
- Principles encompass broad themes and ideas
- Clarity in fewer all-encompassing principles
- Flexibility to respond to different projects and contexts
- A common language across all types of infrastructure to bring the approaches of different disciplines and organisations together

5.1 Key Considerations

Potential risks, to be mitigated against:
- Seen as too abstract, or for communication purposes only
- Lack of clarity in how the principles should implemented
- Could give a false sense of protection for design unless easily applicable and translated into procurement processes
- Local communities find them too broad to engage with
- Difficult to measure outcomes

Participants of the workshop suggested that a small number of all-encompassing, core principles could be developed for all national infrastructure, with more specific guidelines for each sector, or for specific projects, that align with the core principles. A two-tier system was used in the development of the HS2 design vision with three memorable over-arching groups of principles and detailed principles within those categories. Specific design guidance was later developed for aspects of HS2's work including headhouses and public art.

Three sets of principles could exist for a project: high-level principles, sector-specific, and project-specific. There could also be a matrix approach where some principles are shared and some specific to a sector, which could allow the principles to work across sectors.

Measurable outcomes

Measuring outcomes for design principles will be critical. Infrastructure projects are immensely sophisticated with vast design and engineering teams. Most aspects of a project (constraints, budget, planning requirements) are clearly laid out with quantifiable targets and project management for infrastructure is built around meeting these key outcomes. Therefore principles need to be capable of having measurable outcomes; vague and unmeasurable language gives vague responses.

Testing outcomes will be important in ensuring that design principles are valued and respected across the diverse disciplines delivering infrastructure, for many of whom quantifiability is a key tenet. However the need for clarity of

5.1 Key Considerations

expectations does not mean that the principles should become didactic or overly pragmatic, the point of design principles is to create and safeguard room for invention, beauty, innovation and delight. Rather it means to think of ways to apply specifics to open or sometimes difficult to define elements. An example that was discussed in the workshop:

A way in which design could be specific and quantified might be to agree that every passenger on a new rail line, no matter where they are located on a train, should have 'at least three breath-taking views on each journey between London and Manchester'.

Daisy Froud, UCL

The National Planning Policy Framework (NPPF) states that a project needs to have demonstrable benefits in order to be initiated. This is the moment to consider how to measure good design in an infrastructure project.

The aims of design principles should be clearly defined to ensure that they are meaningful. In addition, being translatable into key performance indicators (KPIs) can be a good way to ensure measurable outcomes. Meeting design principles could become part of the evaluation criteria for both procurement and for planning approval.

The relationship of design principles to design panels

Design panels can play a role in evaluating design principles, and ensuring adherence to principles throughout projects, particularly if they engage with a project a number of times to allow for responses to recommendations to be evaluated. A reciprocal relationship with design review and design panels should be in place in all design projects, although the stakeholders explained that this often doesn't currently happen in infrastructure projects.

Depending on the measurability of the design principles, design panels could review projects against any KPIs or project-specific principles that arose from the national design principles, particularly those that are harder to measure, such as aesthetic design considerations. A positive design panel report could be a KPI in itself.

5.1 Key Considerations

National design principles should be regularly reviewed by the National Infrastructure Design Group to allow them to adapt to changing conditions, including new and emerging fields of technology, and respond to feedback from use. Design panels could also be a useful way to check that national and project-specific design principles were still relevant and useful for the work being undertaken and could feed their experience into the National Infrastructure Design Group.

Form of design principles

Design principles shouldn't be dense documents; they should be accessible

Madeleine Kessler, Haptic Architects

Design principles should be simple, exciting and clear

Selina Mason, Lendlease

Design principles take a variety of formats, with clarity, ease of use and accessibility as the main objectives. In the case of HS2, the final outcome was a 'vision' rather than a report, not intended to sit on a shelf, but to form an active part of the decision-making process. Design principles could take the form of a series of questions asking if people have considered key design concerns. The single-sentence definition of sustainable development used in the Report of the World Commission on Environment and Development: Our Common Future (sometimes known as the Brundtland Report) - 'sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs'- could also be a useful model. Summarising the aims of the principle in a single sentence could ensure it was memorable, but also capable of being linked directly to design outcomes.

Views diverge as to the value of case studies. Some of the stakeholders said that case studies, and particularly visits to examples of well-designed infrastructure, could be used to educate clients on the value of good design and demonstrate how design benefits projects. Moreover showing clients

5.1 Key Considerations

examples where good design is lacking can also be extremely effective. However case studies were avoided in the production of the HS2 to avoid them being taken as exemplars for all of their attributes; international examples were used as part of the background evidence base instead. For HS2, no images of design projects were included in the vision as it was decided that this could place a judgement on anything that was included.

Flexibility

Strengthening the policy around design is welcome, but there's a risk it could limit innovation; design changes but policy doesn't

Alison Caldwell, WSP

Design principles should be flexible enough to make provision for a variety of contexts and to anticipate substantial change. Stakeholders questioned whether national principles could have the flexibility needed for projects with such long design and implementation periods. Strengthening the approach to design can give it weight and force but could limit creativity and innovation and risks becoming cumbersome and restrictive.

Another key issue is the applicability to the project as it changes - flexibility needs to be built into principles. Over the life of a project, conditions and context could change substantially while policy and principles are fixed for much longer. Future proofing national design principles is difficult but it is important that they are prepared with a clear view to the long-term impact and therefore over-arching principles set out the paramount objectives in achieving good design and project principles set out a more granular level of detail. Technology advances quicker than the planning and delivery of infrastructure, so review periods should be built in from the outset to allow principles to be developed and updated. It is important for national design principles to have mechanisms to incorporate learning from current and previous projects.

5.1 Key Considerations

Communication

The public knows good design, and the conversation should be opened up to allow people a say

Madeleine Kessler, Haptic Architects

Design principles become important when they are shaped by local communities

Daisy Froud, UCL

National infrastructure design principles should be easy to understand and avoid jargon, which could put off both the public and those responsible for delivery. Jargon can also encourage closed feedback loops of ideas within small groups of people, and the use of simple vocabulary should allow these to be broken. Design principles should be presented in plain, simple language that sits between general language and technical language.

Improved education on some of the issues could encourage the public to engage more widely in discussions around infrastructure provision and its design at earlier stages. In Switzerland the population votes directly on projects and infrastructure, including the Fund for National Roads and Urban Traffic in 2017.

There is a need to better communicate the 'human' elements of infrastructure design, the issues that affect local and user experience, which should also increase engagement.

The parsimony of the three aspects of the HS2 principles, 'People, Place and Time', enabled clear communication. For the HS2 design vision, a short film was used to outline principles, and a strong brand identity was developed which helped the principles to endure and gain traction.

5.1 Key Considerations

Ownership of principles

Engagement is crucial to the ownership of design principles; legitimacy comes from those who shape them. Design principles should in effect be 'owned' by client, consultants, contractors, communities and the users of infrastructure.

In any project, the client should have clear regard to design principles and keep them at the centre of decision-making processes throughout the project. This becomes more complex in large projects, particularly when they move into delivery phases and there are multiple 'clients'.

Good principles can balance the incentivisation within contracts to deliver projects more quickly and cheaply by compromising wider benefits, without limiting opportunities for design, particularly at delivery stages.

In order to ensure design principles are carried through a project, a design champion could be included from the outset, to maintain consistent focus on design and innovation. Within delivery organisations a particular group or individual could be nominated to have ownership, and responsibility for seeing that they are met. An organisational structure and skills need to be in place to drive design principles through all aspects of a project.

Embedding the principles

We need to involve everyone from the beginning. Currently, design principles often don't follow all the way through - this only happens when we all work together and understand decisions being taken

Sakthy Selvakumaran, University of Cambridge

It is important to embed principles into the structure of projects from the earliest stages. Design principles are only useful if they are carried through the life cycle of the project, otherwise their value risks being lost.

5.1 Key Considerations

Design principles should be clearly introduced into the project to ensure buy-in, and principles could be added to the agenda at the beginning of each meeting. Inclusion of principles in procurement processes is vital.

In HS2, where the principles are a key part of the tendering process; the design principles sit at the front end of all procurement briefs. Monthly lunch and learn sessions are provided by HS2, and a design group was established, along with a design forum for senior leadership. They are also integral to the work of HS2's Independent Design Panel.

Design principles should be applied throughout the progression of projects, because good design typically either develops or is not addressed at all.

Design principles are relevant from the very first site decisions; in fact, they are of use even earlier, in the consideration of whether this is the right project. They can enable users to ask if they can design a better outcome, and determine whether they are answering the right question.

5 Development of Design Principles for National Infrastructure

5.2 Initial Themes for Principles

This section outlines several themes that could be included in the design principles.

Context

The response to context should be key. Infrastructure design must look beyond its immediate site boundaries. This is potentially difficult because of the way projects are funded and taken through the complex planning process, but they should seek to make a positive impact on their context.

Communities

Infrastructure should benefit all users but particularly local communities near the site so that design not only mitigates the effect of new infrastructure but improves their quality of life. Communities should have a say in the development of design principles for local projects.

Resilience

Infrastructure should be designed to withstand long-term change to serve future generations.

Value the process

Design principles should make provision for issues of process, like mandating the use of multi-disciplinary design teams as equal partners rather than single consultants, and encouraging the right degree of flexibility. Time to design should be built into the project.

Security

Security, including cyber security, should be designed into infrastructure.

5.2 Initial Themes for Principles

Functionality

Infrastructure design should consider the 'view from', or the user experience, in addition to the 'view of', or the aesthetic qualities of infrastructure. There should be a pleasure and simplicity in using infrastructure, as well as in looking at it.

Sustainability

Design principles should drive a sustainable approach to design and delivery of infrastructure including environmental performance, ecological gain, landscape and heritage.

Ambition

Design principles should seek to create infrastructure of enduring quality embracing: admirability, a quality that represents the nation, cultural significance, and civic endeavour.

Inclusivity

Infrastructure should be easy for everyone to access and use, in alignment with principles for inclusive design.

6   Indicative Programme

Programme for development

This section identifies and explains some of the key stages which should be part of the programme for the development of successful national infrastructure design principles. These were identified through the stakeholder engagement, both based on the experiences of individuals, and their ideas for how to develop national design principles. The development of the HS2 design vision is included as a case study, which was described by David Kester in an interview, who led the team responsible for its development.

It is envisaged that the first national design principles for infrastructure will be published in 2019. The HS2 principles were developed over a period of between 18 months and two years. This indicative programme therefore identifies opportunities to build on existing knowledge and streamline processes to ensure that the development of principles can be undertaken in the given timeframe.

- The design principles for national infrastructure should build on existing knowledge and use examples of established design principles to avoid duplicating work
- By collaborating with teams who have been involved with the development of major project design principles, lessons can be learned which will improve the evidence base in a tight timeframe

6 Indicative Programme

Case study: HS2 design vision

The Design Vision for HS2 was developed between 2013 and 2015 and sets out the design aspirations to guide all aspects of HS2 Ltd's work. The vision was established by DK&A. The nine design principles are applicable to a broad range of areas, from station design and tunnels to ticketing and digital platforms and will last throughout the project's 20-year duration.

Evidence base

DK&A built on their own organisational knowledge and experience from David Kester's role leading the Design Council for ten years, during which time a substantial repository of information on best practice had been amassed. The DK&A research team also researched other projects with high design values like the 2012 London Olympic Games.

Having run the Design Council for ten years, I was sat on top of a lot of information on best practice, which we looked at because we had a research team, on design management and design direction across global corporates and businesses in the UK. So I drew from our own research.
David Kester, DK&A

Stakeholder engagement

Stakeholder engagement was a key aspect of the development of the HS2 design principles. On 3rd July 2014 a workshop was held which convened leaders in all the areas of design that related to HS2's work, and the input of 'the great and the good' conferred credibility on the design principles for HS2. Stakeholder mapping meant that the HS2 principles were able to demonstrate that contributions had been provided from a range of people across the sector.

We did some high-level stakeholder consultations, working directly with the ministerial team and with the Director General at the DfT, and also the board members of HS2 and other senior key stakeholders. Then once we had some directions and some thoughts, we held a one-day design vision development workshop. It was a full day hosted, or effectively sponsored by the Secretary of State who came along and addressed everybody, and we put together a group, very carefully selected, so that we had representation not only of the internal stakeholders, but also experts across every field of design. So we had everything from civil engineers and architects to product designers. Every single dimension of design was represented; landscape, digital, you name it. We recognised that all those disciplines were going to be really key to making HS2 really successful...in effect, what we were asking here was what would make us the most brilliant design client in the world.

David Kester, DK&A

6   Indicative Programme

Identification and drafting principles

Discussion with stakeholders helped to identify and narrow down the list of design principles. For example, through discussion with the Department for Transport, it was decided to weave value for money throughout the principles and in the introduction, rather than including it as its own principle. This was not because it was unimportant, but because it was inherent in the project, as it is taxpayer-funded. It was also argued that it isn't strictly a design consideration, and design needs its own criteria.

…this was not because it was unimportant, but because it was inherent in the project and written clearly and unequivocally into strategic objectives and government sponsor requirements. The core criterion for the design principles was be additive rather than repetitive. Value for money needed to be an explicit but embedded message.

 We argued that [value for money] was a condition of the whole project, which design needed to help achieve. It should be an outcome. The design principles should steer the behaviours and processes that will achieve great and effective design results.

David Kester, DK&A

Testing

A draft of the design vision was thoroughly tested. This meant examining its legal standing and its relationship with policy, involving consultation with a QC. It also involved further consultation with stakeholders to refine the principles. The team also identified potential objectors and targeted them for consultation to better understand and address their concerns.

We put together a putative version of the design vision. We then did a consultation process, re-engaged with the key stakeholders, and tested the proposition, whilst simultaneously involving the legal team of HS2 as the project is going through the bill process, so we needed to make sure nothing we came up with contradicted anything the government was doing, or broke any promises. We needed to make sure everything was aligned, we had key conversations with the QC and others, and once we were sure we had smoothed out elements, we also did the round of consultation with who might be considered 'naysayers'; we involved and addressed a number of key interest groups like the environmental lobby, Natural England, Friends of the Earth, National Trust, all sorts.

David Kester, DK&A

6   Indicative Programme

Buy-in

Buy-in, particularly from the UK government, was useful for the HS2 principles. It provided the principles with legitimacy and gave the team a degree of push-back when some in the construction industry suggested they were too stringent, and set the bar too high. The extensive consultation ensured that the principles were also endorsed by key individuals in the industry, such as Prof Sadie Morgan, who participated in the development of the principles, and was later tasked with seeing them carried through in her role as HS2 Independent Design Panel Chair. *We got full buy in, and endorsements for the approach we were taking from the secretary of state, from the industry and also from potential naysayers. Only then did we sign off… we were encouraged by DfT at the time to stick to our guns.*

David Kester, DK&A

Publication

The HS2 Design Vision was published in March 2015. It took the form of a 25-page vision document, rather than a report; they argued that no one will read a long report. They instead produced a clear set of principles that the organisation can live by, organised into three memorable themes.

The principles had a strong visual and verbal identity, important for them to endure. DK&A produced a number of assets, including a booklet and a film, branded in the same way. It was written in simple language, eliminated jargon, and offering clarification for any technical terms. The Design Vision did not include images of design because this was seen to create judgement around that element.

We needed to sell it in and for it to endure. We knew that HS2's own brand wasn't necessarily robust enough, and that it might not endure, which it didn't. So we created a number of assets, a booklet for example, filmic assets as well. When we went into implementation phase we also carried forward the visual identity, so the design vision would appear as the front end to lots of different materials. We worked on the implementation of guidelines for the handbook, landscape guidelines, if we were putting guidelines on stations etc. For all these elements, we started with the design vision and then we looked at how this might translate to the next layer of guidance, so all elements would be seamless. The design vision was seen almost as a lens through which you would approach all projects, and indeed had to be the underpinning for the design panel itself.

David Kester, DK&A

6   Indicative Programme

Embedding

Embedding the principles into the day-to-day running of HS2 was key to seeing them delivered. Training activities were undertaken to enable HS2 staff to effectively use the design principles in their work, and to create the structures to see them endure. Design guidelines have been being produced since the publication of the Design Vision for specific elements of HS2 such as public art, bridges, and landscape, based on the design principles. These took the Design Vision as the starting point, looking at how this might translate to the next layer of guidance. The Vision was seen as a lens through which to approach all projects.

The visual identity was carried forward into the implementation phases, with the design vision appearing at the front end of lots of materials.

Part of our responsibility was to embed [the design vision] in the organisation and build an understanding to help create those structures that would endure and live by this design vision… there was a period of time where we were running training activities, such as a monthly lunch around design training, and design thinking days every quarter.

David Kester, DK&A

Feedback

Positive feedback from users of the design principles has emphasised that they have been a useful element in keeping focus and perspective in large-scale, complex projects.

We have had interactions with many organsiations like Arup who have been using the design vision and feedback has been around how useful and helpful it's been to have a coherent view of the organisations approach to design. It provides a definition for what we mean by design, it provides the principles we live by in design, and an articulation of what success looks like.

David Kester, DK&A

6   Indicative Programme

Date	Activity
July 2018	Publication of National Infrastructure Assessment
July 2018	Publication of scoping study for the development of design principles
Summer 2018	Development of evidence base, development of Government, institutional and industry support for design principles
Autumn 2018	Stakeholder workshop(s) Draft principles produced and publicised Testing and developing Government, institutional and industry buy-in to the main principle themes
Winter 2018-2019	Analysis of consultation responses and further discussion with key stakeholders Revision of principles
Spring 2019	Completion and agreement of national infrastructure design principles
2019 onwards	Promotion of principles by National Infrastructure Design Group

7   Summary of Recommendations

Design principles for national infrastructure should…

- capture an expansive definition of design that goes beyond the aesthetics

- be clear, easy to use, and accessible, avoiding jargon

- be flexible enough to make provision for a variety of contexts and to anticipate substantial change

- encourage excellence as well as bringing the general standard of infrastructure design up to an agreed standard

- prioritise and reward innovation

- be an integrating force, requiring different disciplines to work together for their drafting and delivery

- create improvements in quality of life for communities

- have different tiers, with overarching principles clearly linked to more specific principles for sectors and/or projects

- be capable of having measurable outcomes

- support and integrate with the existing process of design review in infrastructure projects

- be 'owned' by client, public, contractors and stakeholders, through their input

- be embedded into the structure of project from the earliest stages, and carried through the life of the project

8   References

City of Austin Design Commission, *Interim Infrastructure Design Guidelines*, September 2013, available: ftp://ftp.ci.austin.tx.us/GIS-Data/planning/Design_Commission/Infrastructure_Guidelines_Docs/Working%20Group%20IDG%20draft-130917%20DA.pdf

Design Council, Cabe, *A design-led approach to infrastructure*, November, 2012. Available: https://www.designcouncil.org.uk/sites/default/files/asset/document/A_design_led_approach_to_infrastructure_Cabe.pdf

ETH Zurich, *Spatial planning and development in Switzerland*, 2008, Available: https://www.ethz.ch/content/dam/ethz/special-interest/baug/irl/chair-of-spatial-development-dam/documents/projekte/diverses/ch-eva-en.pdf

Fletcher, Howard, The Design Council, CABE, *The Principles of Inclusive Design,* 2006, available: https://www.designcouncil.org.uk/sites/default/files/asset/document/the-principles-of-inclusive-design.pdf

Government Digital Service, *Government Design Principles,* April, 2012, available: https://www.gov.uk/guidance/government-design-principles

Highways England, *The Road to Good Design*, January 2018, available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672822/Good_road_design_Jan_18.pdf

HS2, *Three principles for designing HS2*, UK Government, August 2015, available:
https://www.gov.uk/government/speeches/three-principles-for-designing-hs2

HS2, *HS2 Design Vision Booklet*, UK Government, April 2017, available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/607020/HS2_Design_Vision_Booklet.pdf

8 References

Interaction Design Foundation, *Design Principles*, nd., available:
https://www.interaction-design.org/literature/topics/design-principles

Kwon, Mee-yoo, *Design to Make Seoul Global City*, The Korea Times,
available:
http://www.koreatimes.co.kr/www/news/nation/2010/01/117_47429.
html

Seoul Metropolitan Government, *Application for UNESCO City of
Design: Seoul*, 2009, available: http://www.unesco.org/new/fileadmin/
MULTIMEDIA/HQ/CLT/images/CNN_Seoul_Application_en.pdf
Design to Improve Life, Design Seoul, September 2011, available:
https://designtoimprovelife.dk/design-seoul/

Thames Tideway Tunnel, Thames Water Utilities Limited, *Application
for Development Consent: Design Principles*, January 2013, available:
https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/
uploads/projects/WW010001/WW010001-001202-7.17_Design_
Principles.pdf

Appendix

9   Appendix: Case Studies

Case Study: *Interim Infrastructure Design Guidelines*, City of Austin Design Commission, USA

Published, 17 September 2013 (adapted from 2009 guidelines)

About

The Manual of Infrastructure Design Guidelines is intended to compliment both the city's Urban Design Guidelines, and the *Imagine Austin Comprehensive Plan* and includes 10 core principles for an integrated infrastructure. The design principles are meant to give a broad vision so that city departments can continue to make specific guidelines that are most applicable to them.

The Infrastructure Design Guidelines address the design character and construction of components and systems that structure and support the ongoing development and growth of the City of Austin and aim to enable the City to attain its vision of becoming the most livable city in the country. Design excellence in infrastructure contributes to sustainable growth and supports Austin's civic identity.

Infrastructure plays two primary roles in the design of urban environments: performative, and connective. Performative in this context refers to the capacity of the infrastructure to accomplish the technical function for which the system has been designed, be it the distribution and collection of water, electricity, transportation, etc., or the provision of systems of public space, streets, sidewalks, etc. Performative standards and criteria are the purview of City Staff and City Departments. Connective refers to the ability of infrastructure to integrate disparate urban development components and projects into an integrated system.

Principles

1   Contextual   Infrastructure should be thoughtfully designed and adapted to enhance surrounding neighborhoods and environments.

2   Connected   Infrastructure should be strategically planned to so as to facilitate multi-modal linkages and pathways through the city.

3   Integrated   Infrastructure should be designed to accommodate competing interests in the urban environment.

4   Compact   Infrastructure should be designed to promote sustainable urban environments.

9   Appendix: Case Studies

5	Sustainable	Infrastructure should aspire to improve the quality of life for its citizens, while living within the carrying capacity of the supporting eco-systems.
6	Hybridized	Infrastructure should be designed for the efficient integration of multiple programs and uses.
7	Humane	Infrastructure should contribute to the creation of a vibrant public realm with superior public spaces.
8	Ecological	Infrastructure should provide for healthy natural environments.
9	Timeless	Infrastructure should recognize the historic significance of important buildings and places.
10	Inclusive	Decisions about infrastructure should be made with the participation of the effected community.

Source:
ftp://ftp.ci.austin.tx.us/GIS-Data/planning/Design_Commission/Infrastructure_
Guidelines_Docs/Working%20Group%20IDG

9   Appendix: Case Studies

Case Study: *Government Design Principles*, Government Digital Service, UK

Published, 3 April 2012

About

The UK government published its design principles, written by the Government Digital Service and covering infrastructure and service design across the UK. These are principles that the government itself adheres to. The purpose of these principles is to share open and honest methodology in government infrastructure and service design. The design principles also guide the Governmental Digital Service in all aspects of their work.

Principles

1   Start with user needs

2   Do less

3   Design with data

4   Do the hard work to make it simple

5   Iterate. Then iterate again

6   This is for everyone

7   Understand context

8   Build digital services, not websites

9   Be consistent, not uniform

10   Make things open: it makes things better

Source:
https://www.gov.uk/guidance/government-design-principles

9   Appendix: Case Studies

Case Study: *Design Seoul*, Seoul Metropolitan Government, South Korea

Established, 28 May 2008

About

The Seoul Metropolitan Government started to develop guidelines in 2007 that would set the standards for urban design in response to such necessities. Design Seoul Guidelines were established on May 28, 2008 following a public hearing. The Seoul Metropolitan Government then distributed a checklist along with the guidelines to the headquarters, business sites, affiliated organizations and each autonomous district in Seoul to make sure that managers can confirm the application of the guidelines.

Design Seoul established five principles in addition to the set of guidelines. The purpose of the principles was to ensure that all citizens can safely and conveniently enjoy pedestrian roads and public spaces such as parks, plazas, health centres, and welfare facilities.

One of the outcomes of the Design Seoul project was that Seoul was designated the UNESCO Creative City for Design in 2010.

Seoul is the first city in the world to establish public design guidelines. Service design is directly related to the satisfaction and happiness of citizens. It is not only concerned with aesthetics but is also a cognitive process that considers and provides for the needs of the citizens. – (Seoul UNESCO City of Design Application, 2009).

Principles

1   Airy
2   Integrated
3   Preserving
4   Collaborative and Sustainable Design

Sources:
http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CLT/images/CNN_Seoul_Application_en.pdf
https://designtoimprovelife.dk/design-seoul/
http://www.koreatimes.co.kr/www/news/nation/2010/01/117_47429.html

9   Appendix: Case Studies

Case Study: *The Principles of Inclusive Design*, Design Council, UK

Published, 11 May 2006

About

Inclusive design aims to remove the barriers that create undue effort and separation. It enables everyone to participate equally, confidently and independently in everyday activities. An inclusive approach to design offers new insights into the way we interact with the built environment. It creates new opportunities to deploy creative and problem-solving skills.

The adoption of these inclusive design principles will help people use developments safely, with dignity, comfort, convenience and confidence. People will be able to make effective, independent choices about how they use a development without experiencing undue effort or separation. They will be able to participate equally in the activities that the development offers.

Principles

1   Placing people at the heart of the design process

2   Acknowledging diversity and difference

3   Offers choice

4   Flexibility in use

5   Buildings and environments that are convenient and enjoyable for everyone

Source:
https://www.designcouncil.org.uk/sites/default/files/asset/document/the-principles-of-inclusive-design.pdf

9   Appendix: Case Studies

Case Study: *HS2 Design Principles*, UK Government, UK

Published, 24 October 2016 (updated, 10 November 2017)

About

The HS2 Design Principles were formulated following a design workshop in 2014, held by Patrick McLoughlin MP and David Kester. Announced in a speech in August 2015, the three clear principles that would govern the way that HS2 was designed were then written into a number of HS2 reports and into policy. The design principles had to be able to be applied to all elements: railway stations, landscaping, bridges, tunnels, trains, passenger experience and ticketing.

In order to achieve the design vision, an independent panel was established in November 2015.

Principles

People: designing for everyone to benefit and enjoy

1   Design for the needs for our diverse audiences

2   Engage with communities over the life of the project

3   Inspire excellence through creative talent

Place: designing for a sense of place

4   Design places and spaces that support quality of life

5   Celebrate the local within a coherent national narrative

6   Demonstrate the commitment to the natural world

Time: designing to stand the test of time

7   Design to adapt for future generations

8   Place a premium on the personal time of customers

9   Make the most of the time to design

Sources:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/607020/HS2_Design_Vision_Booklet.pdf
https://www.gov.uk/government/collections/design-at-hs2
https://www.gov.uk/government/speeches/three-principles-for-designing-hs2

9   Appendix: Case Studies

Case Study: *A Design-led Approach to Infrastructure*, Design Council, UK

Published, November 2012

About

The Design Council merged with Cabe in 2011 and in 2012 produced the *Nationally significant infrastructure projects: Design guidance*, which includes ten design principles to guide the development of infrastructure throughout the UK.

To ensure that the UK's infrastructure will continue to support economic growth and boost environmental efficiency, massive investment in national infrastructure is required… However, large infrastructure projects are often prone to a prolonged pre-construction process during the design, consultation and planning stages, and strong local opposition often hold up projects. Holistic design thinking at the outset, as promoted by Cabe and the Design Council, can help mitigate the planning risks.

The 10 design principles were intended to help Nationally Significant Infrastructure Project applicants design successful proposals as set out in the criteria for good design in the National Policy Statements.

Principles

1   Setting the scene

2   Multi-disciplinary teamwork

3   The bigger picture

4   Site masterplan

5   Landscape and visual impact assessment

6   Landscape design

7   Design approach

8   Materials and detailing

9   Sustainability

10   Visitor centre

Source:
https://www.designcouncil.org.uk/sites/default/files/asset/document/A_design_led_approach_to_infrastructure_Cabe.pdf

9   Appendix: Case Studies

Case Study: *Thames Tideway Tunnel Design Principles*, Thames Water Utilities Ltd, UK

Published, January 2013

About

In January 2013, Thames Tideway Tunnel published its design principles. These principles underpin the design of the permanent ground level and above-ground elements and spaces of the Thames Tideway Tunnel project.

Principles

Developed in consultation with local authorities and other stakeholders and are split into three categories:

1   High-level design objectives: overarching objectives for the design of permanent structures on all sites

2   Generic objectives: general project-wide principles that should be read in conjunction with the site-specific principles as they are not necessarily appropriate for each site. These principles are grouped by theme:

   a Integration of functional component principles

   b Heritage principles

   c Riparian and in-river structure principles

   d Landscape design principles

   e Lighting design principles

   f Site drainage principles

3   Site-specific objectives: sets of principles that are unique to each of the 24 sites and which elaborate further on the generic principles

Source:
https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/WW010001/WW010001-001202-7.17_Design_Principles.pdf

9   Appendix: Case Studies

Case Study: *The Road to Good Design,* Highways England, UK

Published, January 2018

About

Highways England published *The Road to Good Design*, which establishes 10 principles for good road design. Developed in coordination with their Strategic Design Panel, the principles are based on universal ideas of good design and are intended to serve as prompts to improve design quality and outcomes.

Principles

Connecting people

1   Good road design makes roads safe and useful
2   Good road design is inclusive
3   Good road design makes roads understandable

Connecting places

4   Good road design fits in context
5   Good road design is restrained
6   Good road design is environmentally sustainable

Connecting processes

7   Good road design is thorough
8   Good road design is innovative
9   Good road design is collaborative
10   Good road design is long-lasting

Source:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672822/Good_road_design_Jan_18.pdf