Concrete Structures

Strategic Procurement Strategy (SPS)

Section 1 - Category Scope

- Demand forecasting/consumption data
- Application across National Highways

Section 2 – Carbon Opportunities

Section 3 – Feasibility

- Confidence ratings
- Blockers
- Enablers

Section 4 – Commercials

- Cost impact (positive/negative/neutral)
- Potential procurement models
- Potential contractual/performance mechanisms needed

Section 5 Market Capacity

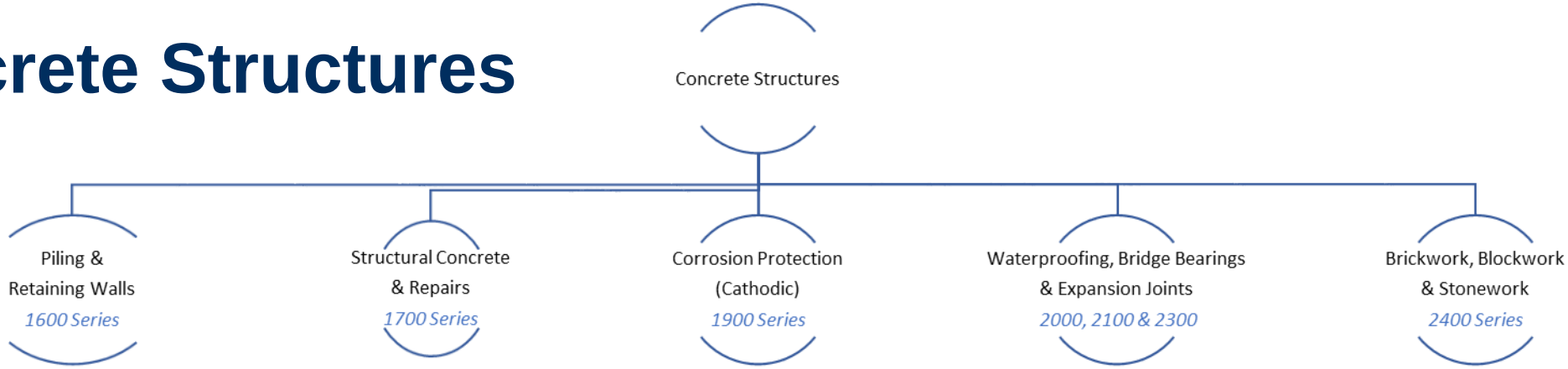
- Current carbon option availability
- Future state (capacity over time)
- NH requirements vs capacity

Section 6 – Prioritisation of Carbon Opportunities

Section 7 - Timeline

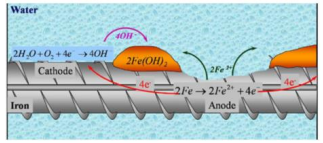
V1.0
July 2021

Concrete Structures



Retaining Walls – used as geotechnical stability for structures (mainly utilised in Major Projects). Many forms of retaining walls exist, selection is determined by the geotechnical data (as well as site access constraints).

Structural Concrete & Repairs – the use of concrete for structures and the repair thereof. Epoxy and other resin based products are applied to repair and protect. New products and techniques are an emerging feature.



Corrosion & Protection – the application of new protection products and treating emerging corrosion. Corrosion occurs due to factors such as carbonisation, chloride ions and dissimilar metal corrosion.

Waterproofing, Expansion Joints & Bridge Bearings – using protective products to waterproof, maintaining expansion joints and bridge bearings (which are a wearing part) which help connect the flexible elements of a bridge to fixed structures. All receive wear due to traffic and weather conditions.

Brickwork, Blockwork & Stonework – used as incidental materials in concrete structures.

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Sign-off Matrix for Strategy & Approach

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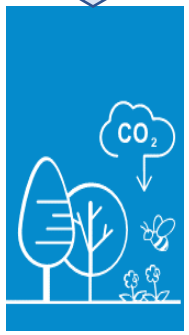
Executive Summary

Current Status:

The sub-categories of Concrete Structures are delivered by preferred delivery partners. Major Projects utilise Tier 1 Main Contractors who manage the delivery of investment programmes. Operations sub-categories such as waterproofing and corrosion protection there are a number of preferred suppliers selectable as part of the frameworks awarded across the regions.

Driving supplier performance and cultivating innovation from the supply chain, wider industry and other industries to meet our goals. Safety, carbon reduction, customer experience and delivering better for value are the key aims of the Concrete Structures strategy.

Creating a cradle to grave approach feeding back best practice and innovation from those that maintain the assets, through to new build delivery to better inform choices in lower carbon, safety, asset life, and ultimately an improved customer experience.



Challenges:

- **Safety:** Ensuring new technologies and working techniques improve safety practices.
- **Implementation:** Driving change can be slow, efforts are duplicated and data is poor. Recognising quality, safety and customer impact are all factors.
- **Supply:** Opportunities not necessarily capitalised on and thinking as a collective (HE and supply chain) does not come naturally.
- **Demand:** Currently demand planning is weak offering little useful information to the business or our partners.
- **Carbon Targets:** Risk of not achieving our targets unless we actively seek out change, speed up trials and implementation.
- **Early Engagement:** Early engagement of project management & design team with suppliers.
- **Standardisation:** Standardisation has been slow to take shape, benefits for all need capturing and understand the operational impact of changes and build need consideration.
- Working together: Establishing working groups across the sub-categories in Major Projects and Operations Directorate.

To fully address the challenges and to align with our imperatives the strategy recommendations are as follows:

- Improved Safety through Concrete Structures products and programme planning. Taking practices from Operations and Major Projects and sharing best practice.
- Effective demand planning to unlock market opportunities which could benefit all investment programmes
- Continue to drive implementation of change through the various working groups, Innovation Reapplied, SES & identified Investment Programmes.
- Increased engagement with suppliers through the Supplier Communities set up for specific sub-categories.
- Increased focus on introducing low carbon technology, such as low carbon concrete & modern methods of construction. Coupled with environmental considerations when assets are maintained.
- Delivery of Concrete Structures cost saving opportunities described in this strategy within the RP2 period.

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Key aims of our strategy

Standardisation of design, components and installation where feasible to unlock supply chain benefits. Channelled through the Digital Products Catalogue and Innovation Reapplied. The use of off-site manufacture and modulisation alongside optimised logistics should also be considered with factors such as safety improvements and quality assurance part of the decision making.

Carbon reduction embedded in decision making from cradle to grave. Understanding possibilities and impacts but HE also being the pathfinder to trialling new techniques and products.

Supply chain performance in line with HE aspirations and delivering continuous improvement with a view to how the wider HE business can benefit from efficiencies, improved safety and quality.

Capturing innovation to create value. Unlock supply chain ideas from end to end processes to new technologies and products. Innovations that support improved safety, customer experience and delivery. Working cross functionally with SES, Lean, Innovation Reapplied as well as MP and OD investment programmes.

Market opportunities optimised standardisation and improved demand to open up opportunities in economies of scale, spot purchases, off peak manufacture, modulisation and risk mitigation (shortages in supply).

Smart demand planning utilisation to maximise buying opportunities and minimise market risks. Ensuring all schemes benefit by working on total requirements. Getting this right is imperative to unlocking the potential of other opportunities.

- Our proposal is to pursue these themes through the **14 solutions** identified to deliver increased safety, productivity and cost reduction from the RP2 spend forecast.
- Potential savings across Operations and all investment programmes.
- There is already a Retaining Walls Implementation Group (WIG) set up and supplier community groups formed.

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Carbon Strategy

For further information on some of the various solutions we are looking at please click here Achieving Net Zero – Concrete Structures

Key drivers of carbon emissions in category	Corporate emission	Maintenance & construction emission	Road user emission	Estimated Carbon emissions per year associated with key driver [tons of CO2]
1. Concrete products in structures		x		Need calculation from HE
2. Other products and materials used in the other sub-categories of concrete structures		x		Need calculation from HE

Identified measures to address key drivers in category	Expected impact / CO2 reductions [tons of CO2]	Timescale	What is needed to implement measure (investment/support, etc)?
1. Carbon Capture	390.97 (61% carbon reduction)	2021	Industry support, understanding of upfront cost impact versus material cost
2. Low Carbon Concretes	76.28 (12% carbon reduction)	2021	Baseline, trial investment programmes, cross functional working
3. Reduced maintenance/more environmentally friendly repair materials	Unknown at this stage and requires further research	2022/2023	Supplier community groups set up, innovation captured, HE implementing
4. Technology (preventative maintenance AI)	Unknown at this stage and requires further research	2022/2023	Technology investment, maintenance programme review, changes embedded

The sub-categories of Concrete Structures contain varying environmental factors. Concrete in Major Projects has a big carbon impact but likewise maintenance regimes, materials & products need consideration.

Reducing carbon is being explored through various supplier community groups and centrally through the Sector Improvement Project (SIP).

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Achieving Net Zero through category management

Category Management will consider the opportunities to reduce carbon in all aspects, cradle to grave. This is achieved by working with the supply chain (all tiers) and across all National Highways vested interest functions to capture, assess, understand impacts and deliver carbon initiatives

Design – making whole life decisions on carbon impact and reduction. Including the supply chain to effect idea generation

Products – alternative materials, less materials, recycled materials, sustainable materials and supply chain

Production – economical quantity production runs, carbon captured manufacture processes, standardised systems, alternative methods

Logistics – effective movements, less movements, optimised loads. Alternative fuels

Build – effective productivity, automation, modulisation, right first time, maintenance enhancements built in (corrosion resistance for example)

Maintain – Intuitive prevention of defects, maintenance issues considered at build (full circle analysis). Longer life/embedded carbon

Recycle/Re-purpose – to utilise on our networks or in other industries

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Snapshot on our future vision

Short-Medium Term

Cross Functional Collaboration

impacts

Shaping the market

- Set up working groups around the sub-categories and put in the building blocks for; capturing, trialling and rolling out best practices and innovations. Innovation can come in the form of improved customer experience, better safety practices and productivity,
- Early contractor involvement when contemplating standardisation or new ways of working – assessing from desk top to on-site how changes effect all aspects. Evaluating whole scheme impact (positive and negative) when improving one aspect (standardised retaining solution for example). Recognising the impacts in standards, safety, quality and time.

Medium-Long Term

Change Procurement Approach

impacts

Shaping the future

- Standardisation through the Digital Product Catalogue, better design and programme planning to alleviate capacity issues.
- Optimisation market opportunities through consolidated products and kit of parts, aggregate concrete spend over several related areas, off site manufacture, modular solutions and digital design.
- Continue to drive performance in the SDF incorporating efficiencies and best practice that comes from this through to the wider business.
- Influence and encourage innovation through all aspects of the supply chain to encourage innovations and reducing carbon.

This is a high level picture. We will develop different aspects further with stakeholders across all solutions as our implementation plan progresses

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Phased high-level Implementation Plan to deliver our key aims

Short-term
(RP2 Year 2)

- Establish Supplier Communities (MP)
- Set up Retaining Walls Implementation Group (WIG) (MP)
- Trial scheme rollout of standardised retaining wall (MP)
- Performance measures agreed for SDF Lots ready for award (Ops)

Early involvement of Tier 2/3 in standardisation discussion critical to unlocking innovation. Full scheme impact needs to be considered; productivity, safety, cost , customer impact and carbon reduction.
Selecting appropriate suppliers and the right measures to drive performance of the awarded SDF lots.

Mid-term
(RP2, Years 2-3)

Phase 1:

Deliver actions from WIG through SMA

Phase 2:

Rollout to RDP/LTC/CIP through Innovation Reapplied

- Establish Supplier Communities (Ops)
- Supplier Communities developing innovations (Ops)

HE becoming an informed customer with data and supply chain engagement to realise market opportunities.
Continue to bring the organisation together through communities and innovation rollouts.
Trialled innovations building case studies for wider rollout and influencing the construction sector.

Long-term
(beyond RP2, Years 4-5+)

- Innovations embedded and working across all programmes
- Intelligent demand understood and market opportunities being realised
- Strategic input to future SDF for Operations Directorate
- Supplier communities yielding operational benefits but also shaping future schemes

Embedded new ways of working and innovations being realised. HE and the supply chain fully embracing philosophy of continuous improvement. Foundations of demand, carbon reduction, supply chain performance working well and fully prepared for RP3.

Rollout of short-medium term solutions

Carbon**

Innovation

Implementation Groups

- Concrete Repairs Implementation Group (CRIG).
- Waterproofing, Bridge Bearings & Expansion Joints (WBEJIG)

- **Other benefits: n**ot only capturing and implementing new ways of working, products and “innovation” to yield efficiencies but feeding back into future designs to reduce maintenance

Standardisation

Trial & Embed standardised designs for Retaining Walls

- .Standardised designs agreed, supply chain engaged, trial schemes identified and findings produce modifications and case study for further rollout

- **Purpose: a**t this stage savings are not greatly achieved as this is the ‘sandbox’ stage – outputs from this stage enable savings medium to long term as standardisation is implemented wider

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Rollout of medium-long term solutions

Carbon**

Smart Demand Planning	**Utilising more intuitive data to capitalise on market opportunities in:** • Retaining Walls (MP) • Structural Concrete (MP)	• **Other benefits:** risk mitigation in material shortfalls, opportunities in off-peak manufacture, supply chain investing in new technology
Supply Chain Performance	**Drive performance, & capture efficiencies in:** • Structural Concrete & Repairs (Ops) • Waterproofing, Joints & Bridge Bearings (Ops) • Corrosion Protection (Ops)	• **Other benefits:** take best practice and proven efficiencies across all HE. Feedback maintenance innovations to new build design
Standardisation	**HE-wide rollout of standardised Retaining Walls** • .Standardised designed agreed, Digital Product Catalogue fully utilised. All schemes default to standardised solutions (unless valid reason not to)	• **Other benefits:** unlock market opportunities, reduce component requirements, spot purchases, HE wide spend aggregation
Market Opportunities	**Aggregating Spend** • .Concrete products from Retaining Walls and Structural Concrete are using standardisation and demand data to maximise purchasing potential	• **Other benefits:** maximise manufacture opportunities, capitalise on off-peak demand, front of the queue customer

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Opportunity Analysis: High-level Implementation Plan

Opportunities	2021	2022	2023	2024	2025	2026
Standardisation - Trial	Standardised solutions agreed/supply chain collaboration	First scheme trial April 2022, further trials thereafter**				
Standardisation - Rollout			Evolutions of trial solutions (Gen 2),			
Smart Demand Planning	Improve data, Supply chain knowledge, scheme designs complete (quantities known)					
Market Opportunities			Aggregated spend, off site manufacture, spot buying opportunities, alternative products, innovations and agile buying			
Supply Chain Performance	Performance metrics agreed SDF Awarded	Measuring performance, driving behaviours, improving ways of working/ new technologies/efficiencies				
Innovation	Retaining Walls supplier community	CRIG, WBEJIG formed and capturing efficiencies, trialling, expanding, embedding				
Carbon Reduction*	Market research, supply chain opportunities, collaborations, trials, case studies building, wider rollouts, continuous investigation of reducing carbon possibilities					

Please note: This is a very simplified version of events. Each opportunity has (or is due to have) it's own delivery plan. For instance, Retaining Walls already has an implementation group that has been established – now developing deliverables, opportunities, timescale, actions.
*Carbon Reduction: opportunities are already being researched and the Sector Improvement Programme (SIP) working group on Carbon Reduction will act as the catalyst for discussions, process for change, collaborative trials, etc.
** Timeline follows the 5x25 innovation delivery strategy.

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Next steps

Actions	Timeline
Final review of Concrete Structures Strategic Procurement Strategy (SPS) and CCF Stage Gate 3.	15th July 2021
Progress the Retaining Walls Implementation Group (WIG) to identify trials, schemes, evaluation criteria and delivery plan for increasing productivity, efficiencies and identifying waste (group formulated already and plan in place): Workstream one: Standardised design and solutions. Workstream two: Supply Chain reviewing further innovations. Workstream three: Trial scheme rollout, measurement of success, trial lessons learnt and changes needed. Workstream four: Expansion from trial to wider application.	Q2 2021
Agree Supplier performance measures for SDF Lots due to be awarded	Q2/Q3 2021
Set up Supplier Communities with supply chain awarded to SDF Lots: • Implementation Group for Structural Concrete & Repairs (including Corrosion Protection). • Implementation Group for: Waterproofing, Expansion Joints & Bridge Bearings.	Q4 2021

Concrete Structures Strategy

Executive Summary

Category Profile

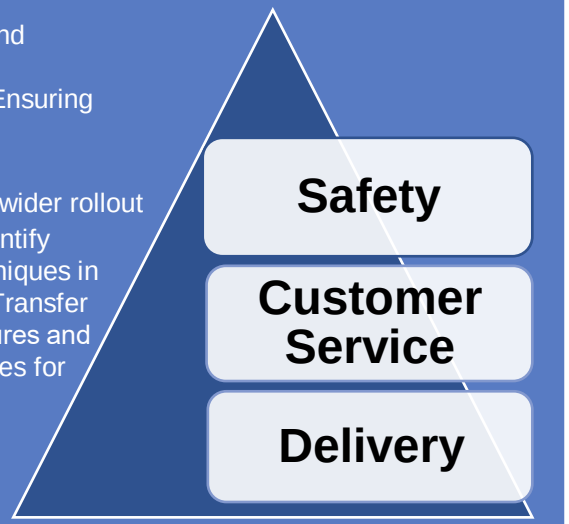
Vision: To identify a strategic category approach for Concrete Structures that will meet the demands of all our HE investment programmes whilst delivering the safest and most efficient solutions. Drive efficiencies in design, procurement and production of assets to increase productivity and improve scheme delivery which will enable HE to target opportunities with a 5% efficiency saving with a stretch goal of 10% of HE total spend.

Goals: To provide a effective strategy, derived from a detailed analysis and holistic approach to risk and opportunity identification, that can be embedded across the HE business.
Offer solutions on how to achieve the greatest innovations and efficiencies for the future that shape the future of the sector. Implementation of standardisation, innovation, innovation reapplied and digital product catalogue suite of components fit for purpose across the wider HE business
Tier 2 direct engagement to have a voice for continued efficiency
and continuous improvement by monitoring and enhancing KPIs

Business Need

Scope: Concrete Structures cover a wide range of sub-categories; Piling & Retaining Walls, Structural Concrete and Repairs, Corrosion Protection, Waterproofing, Bridge Bearings & Expansion Joints, Brickwork, Blockwork and Stonework. Spend is derived from Major Projects and Operations and has wide spectrum of stakeholders. Ensuring total life costing and build quality in any asset is key.

Opportunities: SMA as demonstrator, and wider rollout through Digital by Default & Innovation Reapplied. Identify Operations schemes applying new products and techniques in corrosion & protection and rolling out via Knowledge Transfer Packs (KTP's). Develop implementation plans, measures and review to demonstrate scalable opportunities and routes for deployment and delivery.



Market Intelligence

Landscape: The subcategories all have elements of:

- Materials - vary in competitive and non-competitive (restrictive market) levers
- Labour - can be specialist (cathodic protection) and more traditional broader skills
- Design - not only a programme and price impact (retaining walls) but has a through life impact
- Installation - influenced by design, site access, programme and price
- Maintenance – Operations live with what is built so 360 analysis is vital – build with total maintenance cost in mind
- Manufacture – wide range of opportunities; lower carbon products, off-site/pre-cast, economies of scale , etc.
- End of life disposal – recycling and refurbishment opportunities

Categories such as Retaining Walls are managed by Tier 1 Main Contractors with many sub-suppliers available to undertake the works. Efficiencies in design right first time, site installation and corrosion protection are specialist markets with fewer suppliers
Bridge Bearings and expansion joints can be split between supply (competitive pricing can be employed)

Strategic Approach

Objectives	Year 1	Year 2-3	Year 4+
Strategic Sourcing	Set vision & goals: implement strategy	Embed & deliver: strategic savings	Identify & develop: future technologies
HE rollout	Collaboration with SMA and Operations to support their related requirements	All HE investment programmes (RIP, CIP & LTC)	All parts of the business working as one with a fully optimised approach to sharing best practice
Efficiencies	Standard design and Digital Kit of Parts	Better protection of assets & building learning into future standardised designs	Standardised materials, optimised economies of scale and off-site solutions

Stakeholder Engagement

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Statement of Need

A Safer Network

Reduced health and safety risk through improved installation and maintenance methods

Improving Customer Satisfaction

Reduction in installation and maintenance time / impact on road users/

Delivering the RIS

Resilient supply chain able to meet RIS Programme requirements with minimal risk to supply

The Requirements

- To identify a strategic category approach that will meet the demands of all our HE investment programmes whilst delivering the safest and most efficient solutions
- Promote collaboration, continual improvement and efficiencies across the whole of HE business and the market sector
- Improve safety

The Objectives

- To provide a effective strategy, derived from detailed analysis and holistic approach to risk and opportunity identification, that can be embedded across the HE business
- Offer solutions to achieve the greatest innovations and efficiencies for the future that shape the future of the sector

The Challenges

- Immaturity of Strategic Procurement Division. Obtaining accurate detailed data demand and spend to be able to drive efficiencies
- Lack of availability of actual spend vs forecast spend
- Lack of control in being able to enforce use of standardisation with Tier 1s – IPR design rights
- Tier 1 & 2/3/4 maturity of collaboration with each other as well as with HE

The Outcomes

- A strategic approach that meets the needs of the customer, tailored to suit all sectors of the business. One that safely delivers value as well as meeting the delivery timescales of our individual investment programmes
- Improved health and safety record for the sector by better sharing of best practise through collaboration and innovation within the industry
- More visibility of the various sub-category outcomes from our various programmes

Conclusion: through the strategies identified in this document there is a realistic chance to support individual investment programmesin their objective to meet HE efficiency targets, and contribute to their scheme/area efficiency registers evidenced to the Office of Rail & Road (ORR). We will work in collaboration with Innovation Reapplied to identify and increase our productivity by 30% in RP2, and deliver between 5-10% cost reduction.

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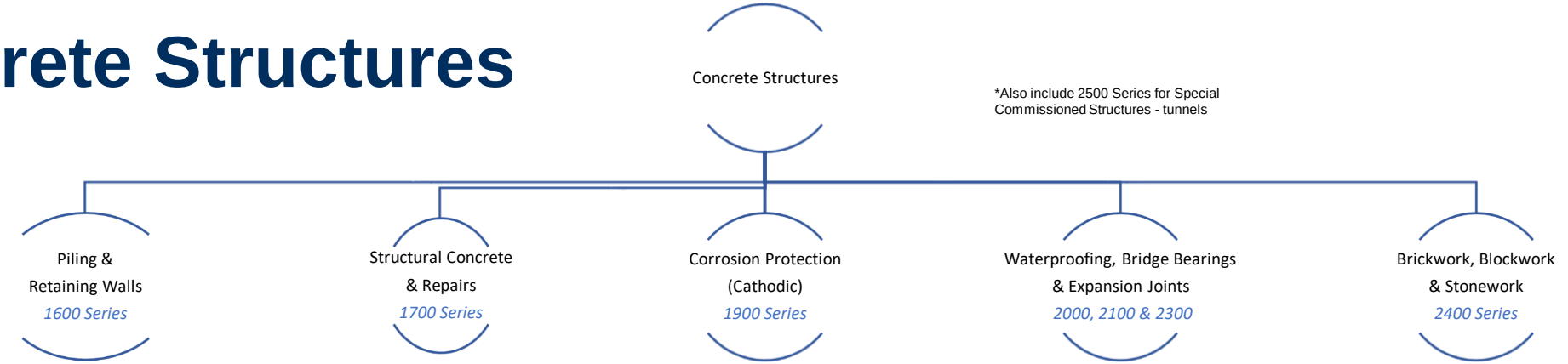
Concrete Structures



1
Statement of Need
Define the outcome needed by the business and what is needed to deliver it

Structures

With a few exceptions, Highways England is responsible for all bridges on the Strategic Road Network (SRN) in England. Highways England is also responsible for most other structures associated with these roads, such as large culverts, sign gantries, masts and retaining walls. The exceptions are bridges carrying railway lines over trunk roads and certain privately-owned structures, which are maintained by the relevant owners.

To enable analysis of information on structures assets, the data should be reported including the structure type to differentiate the range of structures that are managed and maintained. Each type provides broadly different functions to the network operation and may have varying operational costs. The main structure types included within our data are listed in the text below.

- **Bridge and large culvert** – bridge, buried structure, subway underpass, culvert and any other similar structures with a span of more than 3 metres.

A structure supporting the highway as it crosses an obstacle (e.g. river, valley or flood plain) or a service (e.g. local road, railway or canal).

OR

A structure supporting the passage of a service (e.g. local road, railway, canal) over the highway.

- **Mast** – mast structures providing various functions:
  - Cantilever mast for traffic signal
  - High mast for lighting
  - Mast for camera, radio, speed camera and telecommunication transmission equipment
  - Catenary lighting support system
  - Highway signs on posts
- **Retaining wall** – earth retaining structures.

A structure associated with the highway where the dominant function is to retain earth.

- **Road tunnel** – an enclosed length of road of 150m or more.
- **Sign and/or signal gantries** – portal and cantilever gantries that support signs and/or signals.
- **Small span structures** – small culverts, small span structures other than culverts, and small span bridges with a span less than 3 metres and typically below 1.8 metres.
- **Service crossing and other structures** – other structures that are within the footprint of the highway, e.g. service/utility crossings.

It is noteworthy that there is range of structure assets within each type. For example, bridges can vary in length from short structures over small watercourses to major river crossings and significant structures such as the Severn Bridge. Any assessment of the high-level information should take account of these differences.

The source data for the structures asset counts is Highways England's Structures Asset Management System – IAM IS 'Structures'.

These figures are valid until 31st May 2021.

22,059
Structures

- **8,857**
  Bridges and large culverts
- **3,184**
  Masts
- **2,638**
  Retaining walls
- **4,416**
  Sign/signal gantries
- **2,276**
  Small span structures
- **676**
  Service crossings and others
- **12**
  Road tunnels

Business Requirements and Objectives

Requirement	Low Importance	1	2	3	4	5	High Importance
Assurance of supply	Disruption to supply has a minor impact on operations and/or brand perception					x	Security of supply is critical, disruption will affect safety and damage reputation
Quality	Quality issues have minimal impact on operations and/or					X	Quality performance has a major impact on our operations and effects the total life cost of an assets. It is also important in design as anecdotal evidence suggest Retaining Walls for instance have a 50% re-design rate
Regulatory, Ethical, Environmental	Compliance to ethical, environmental or regulations have a minimal impact on our operations or our brand				x		Compliance to regulatory, ethical and environmental issues has high impact on our operations and will effect our customer perception
Service	Flexibility in delivery dates and service levels can be accommodated with minimal impact.					x	Late deliveries/poor service has a major impact on operations/brand. This needs to be considered for major projects as well as maintenance as both impact the customer.
Cost	Cost competitiveness is not a major requirements.				x		Cost competitiveness is highly important for the business as is the ability to understand costs drivers of product/service
Innovation	R&D capability or investments in innovation has minimal impact on operations and/ or brands.					x	Excellent R&D/product engineers and investments to innovate are critical to our operations and/or brand

Conclusion: Highways England is responsible for maintaining, operating and upgrading England's Strategic Road Network (SRN). The SRN is an essential part of the National infrastructure. The strategic procurement/category management approach will enable the sector to develop new innovative materials/solutions and to take those innovations to the whole of HE. Being a conduit for best practice not only across the business areas but within Strategic Procurement itself, sharing best practice.

HE Directorate	Specific Objectives
SMP	• Standardisation and right first time approach (this requirements full supply chain involvement not just Designers) • Identifying opportunities for lower carbon products, installation and reductions in product wastage • Improve productivity/reduction of closures • Earlier and more integrated collaborations to ensure efficiencies are possible and are embedded through the process • Ensure designs, products and installation methods are transferable to all schemes • Design out on-site programme logistics and consider maintenance requirements and logistics • Engage and maintain Tier 1, 2 3 relationships to cultivate efficiencies
RIP, CIP & LTC	• Deliver sustainable, efficient solutions, • Understand innovation opportunities and identify net zero carbon opportunities • Translate innovation and market opportunity into design standards • Reduce site time to improve customer satisfaction by 50% • Earlier and more integrated collaborations to ensure efficiencies are possible and are embedded through the process • Engage and maintain Tier 1, 2 3 relationships to cultivate efficiencies
Operations	• Commitment from supply chain to deliver solutions and net zero Carbon agenda. • Identify Sustainable innovations in products and process. • Ensure maintenance issues are considered in the upfront deign of new assets • Ensure supplier performance is maximised • Improve asset management and improvement in programming

MP Transformation Delivery Programme & SEG

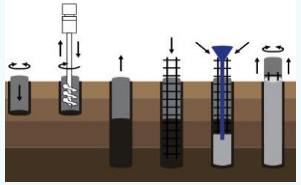
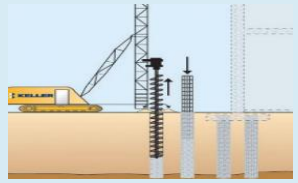
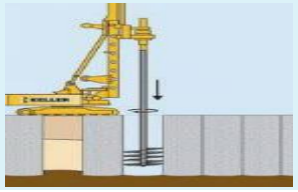
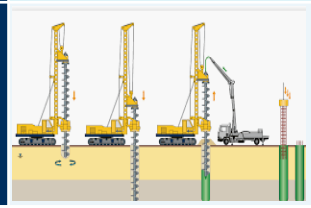
Innovation Reapplied	Safety	Sourcing Model	Economy of Scale	Specification Simplification	Standardisation	Offsite & MMC	Customer Benefits	Installation Productivity	Logistics	Quality	Environmental	Maintenance
Value Levers: (priority areas)	Eliminate & reduce safety risks through alternative methods of design and assembly	Work closely with the alliance to influence innovations and efficiencies up front and also work with Operations to unlock opportunities within the regions	Demand planning and standardised designs will unlock economic levers	Standardised designs, installation and manufacture and make available in the Digital Product Catalogue	Simpler manufacture and installation with quality products- reflects whole life value from design and build through to maintenance and repair	Increase offsite manufacture , use of digitialised design of components and MMC	Minimise delays, increase safety and give value for money over the lifetime of the asset	Alternative methods with off-site manufacture, standardised products and a focus on logistics to optimise on-site productivity	Just in time approach with minimal to no waiting time and use of Construction Logistic Plans	Eliminate re-design an assess new products for cost vs life span	Reduction in carbon – products, manufacture and logistics	Establish cost of product vs life span. Alternative methods of application and maintenance issues resolved at the build stage

Requirement	Low Importance	1	2	3	4	5	High Importance
Assurance of supply	Disruption to supply has a minor impact on operations and / or reputation				X		Security of supply is critical, disruption will affect safety and damage reputation
Quality	Quality issues have minimal impact on operations and/or reputation				X		Quality performance has a major impact on our operations and/or reputation
Regulatory, Ethical, Environmental	Compliance to ethical, environmental or regulations have a minimal impact on our operations or our reputation				X		Compliance to regulatory, ethical and environmental issues has high impact on our operations and/or our reputation
Service	Flexibility in delivery dates and service levels can be accommodated with minimal impact			X			Late delivery / low quality has a major impact on operations / reputation
Cost	Cost competitiveness is not a major requirement				X		Cost competitiveness is highly important as is the ability to understand costs drivers of product / service
Innovation	R&D capability or investments in innovation has minimal impact on operations and/ or wider government aims				X		Excellent R&D / product engineers and investments to innovate are critical to our operations and/or reputation

Business Owner	Structures Efficiency Group (SEG) Themes
SMP	• Improved productivity • Better knowledge of assets, geology and ground profiles • Maximise use of existing infrastructure • Challenging standards (Digitally Ready)
RIP, CIP & LTC	• Improved productivity • Certainty in delivery • Designing out waste
Operations	• Building low/minimal maintenance structures • Incorporate any corrosion protection • Continue to research and develop cathodic products and application

Product Description - Retaining Walls

1
Statement of Need
Define the outcome needed by the business and what is needed to deliver it

Name	Description	
Rotary Bored Piles		Rotary bored piling methods are used when the large diameter piles are required to provide high load capacity or for dealing with difficult ground conditions such as boulders and rocks. The system uses a telescopic Kelly bar and temporary steel casing where necessary. When the pile is bored to the required founding strata a reinforcement cage is inserted and the pile is usually concreted using the tremmie technique and the temporary casing is removed.
CFA Piles (also known as continuous flight auger piles or auger cast piles)		This is a low noise and vibration free system in comparison to Driven Piling. The method involves drilling the pile to a design depth and pumping high slump concrete through the central auger stem as the auger is withdrawn. The system is controlled by on-board computer which measures depth, concrete flow, torque and pressure. When the bore is supported by the augers during the pile constructions it eliminates the requirement for temporary casing support fluids and is therefore particularly well suited to water bearing ground conditions. Reinforcement is installed after concreting operations are completed by plunging or vibrating the cage into the wet condition.
Driven Precast and Steel Piles		Driven piles may be Steel H, Steel Sheet, Tubular or Precast Concrete. Driven piles are an economical piled foundation in comparison with other systems on the market. It is a ‘displacement’ system in that he existing soils are ‘displaced’ in the ground by the pile being driven in rather than soil being removed from the ground by boring of the material. This is one of the many advantages of using driven piles in that there is no spoil to be removed from site. Other advantages : off-site manufacture of the piles under controlled factory conditions. Direct loading capacity being determined whilst the pile is installed.
Secant and Contiguous Retaining Walls		Both types of walls can be designed to cantilever or propped (anchored external or internal) to restrict displacement of the wall. Secant walls will provide protection against water up to Type A in accordance to BS8102. Sequencing of installation is important with both types of wall. These walls maximise space of the basement footprint which is beneficial as land prices continue to escalate.
Bored Displacement Piles		Bored displacement piles are used where low vibrations and minimal spoil generation are important in project delivery. Typically bored piles are selected due to low vibration during installation compared with driven replacement systems. Bored systems generally produce spoil as the material is removed from the bore and replaced with concrete. Bored displacement piles have the advantage of low vibrations as they are formed by rotating and pushing a displacement tool into the ground . Not all ground conditions are suited to this type of piling and its use is generally better in granular rather than cohesive soils.

Product Description – Retaining Walls

1
Statement of Need
Define the outcome needed by the business and what is needed to deliver it

Name		Description
Earth Retaining Structures		Earth retaining structures are designed to overcome significant variation in ground levels to provide either a sloping or flat ground on retained side. Earth retaining structure can help provision of workable space for other civil engineering structures to be built. They are also designed to stabilize unstable natural slopes or to provide more space for road construction.
Sheet Piled Solution		Sheet Pile Walls are retaining walls constructed to retain earth, water or any other filling materials. A sheet pile wall consists of a series of sheet piles driven side by side into the ground. This results in a continuous vertical wall for the purpose of retaining an earth bank. They may be designed to both retain temporary excavations and to act as the permanent retaining structure, often in conjunction with the base slab which offers propping to the wall. Sheet pile retaining walls have distinct advantages over concrete contiguous and secant walls. Sheet Pile walls are cost effective, they require no curing time before excavations can commence.
Contiguous Bored Solution		A contiguous bored pile wall is formed by constructing a series of individual vertical RC piles. The diameter of each pile in a contiguous piled wall is usually not less than 300mm diameter. Contiguous piles are suitable where the groundwater table is below excavation level. It is normally the most economic and rapid option. The walls consist of discrete piles typically installed at centres 150mm greater than their diameter, leaving gaps where soil is exposed during excavation. Permanent works require additional reinforced concrete lining wall. Once all the piles have been constructed the top of the piles are usually joined together by a RC capping beam.
Diaphragm Wall solution		Diaphragm walls are suited to deep retaining walls and provide a high level of leak protection. Diaphragm walls provide rigid cost effective solutions for permanent retaining walls and shafts, with less construction joints than bored pile walls. They are particularly suitable for large, more open sites where structures greater than 25m deep are required.
Gabion Basket Wall		Gabion walls have few drawbacks apart from access to local stone. In the UK however this is rarely a issue as a multitude of suitable stone types are easily available from local quarries. Gabion baskets are not vulnerable to drainage issues as they permeable so water cannot build up and cause structural failure to the retaining wall. Gabion baskets are perfect for creating a retaining wall which is sympathetic to natural surroundings as vegetation is able to grow through the baskets, whilst restoring the landscape to original grandeur. Gabion walls are inexpensive because construction does not involve going into the ground.
L Shaped Retaining Wall & King Post Walls		L Shaped pre-cast concrete retaining walls. L- Shaped wall units are ideal where space is at a premium and a vertical system is required. They are very quick to install and sizes range from 1.0m up to 3.75m. They are widely used in a range of applications. They are a stock item so time for delivery and installation can be very short. King post walls are also known as soldier piles and are some of the oldest forms of retaining systems used in deep excavations. They are cost effective can be used a permanent or temporary solution, which be constructed using concrete panels, timber sleepers beams or steel panels.

Product Description – Structural Concrete & Repairs

1
Statement of Need
Define the outcome needed by the business and what is needed to deliver it

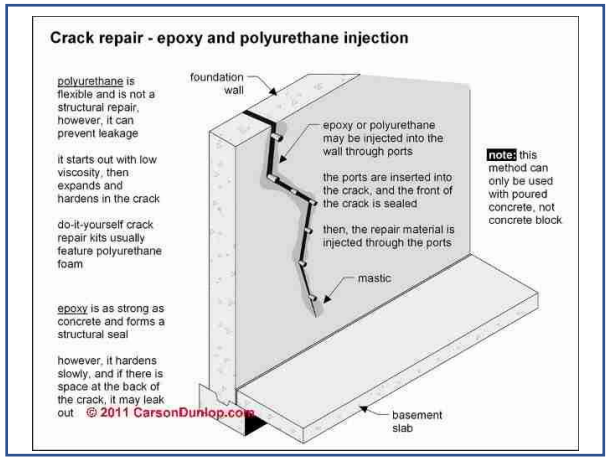
Structural Concrete & Repairs – the use of concrete for structure building and the repair of structures using epoxy and other resin based products. New products and techniques are an emerging feature.

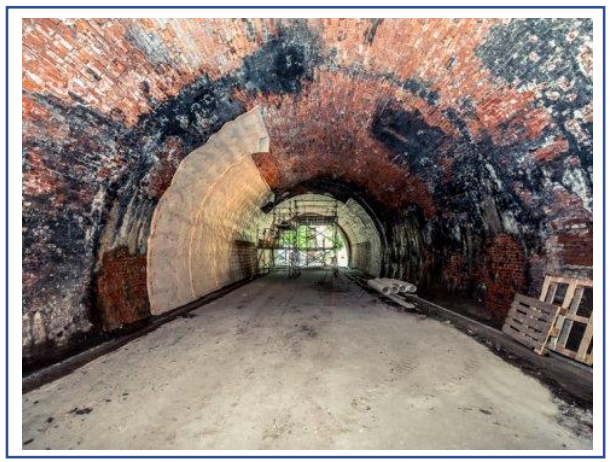
Cemprotec MCI® 2020 from Flexcrete. A clear, water based, organic surface treatment for existing concrete structures. Formulated to migrate into concrete, by liquid and vapour diffusion, to form a protective monomolecular layer on steel reinforcement, which helps to reduce corrosion.

Metallised zinc cathodic protection systems from Metallisation. Metal or thermal spraying the concrete with zinc or a variety of zinc alloys:

https://flexcrete.com/flexcrete-products/concrete-repair-products/concrete-repair-corrosion-inhibitors/cemprotec-mci-2020/
https://www.metallisation.com/applications/cathodic-protection-of-steel-in-concrete/

Information Technology around condition monitoring is key to the next stages of preventative maintenance and getting a picture of our assets perform. Measurement instrumentation within structures to understand design life versus actual performance will not only aid preventive rather than reactive maintenance but may lead to over engineered solutions being re-thought for future built assets.





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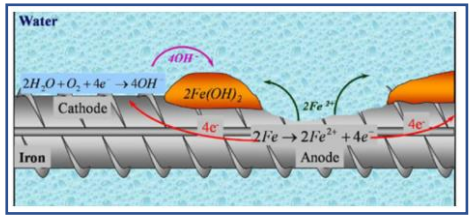
Product Description – Corrosion & Protection

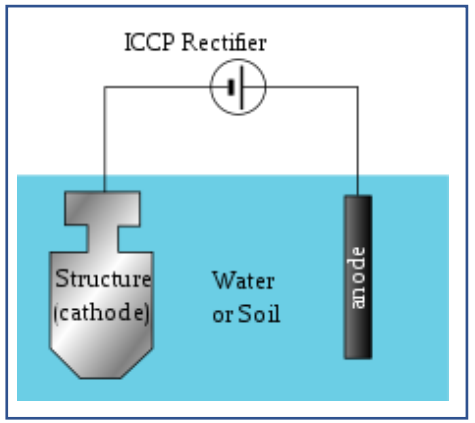
1
Statement of Need
Define the outcome needed by the business and what is needed to deliver it

The application of new protection products and treating emerging corrosion. Corrosion occurs due to factors such as carbonisation, chloride ions and dissimilar metal corrosion.

Cathodic protection (**CP**) is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. A simple method of protection connects the metal to be protected to a more easily corroded "sacrificial metal" to act as the anode. The sacrificial metal then corrodes instead of the protected metal. For structures such as long pipelines, where passive galvanic cathodic protection is not adequate, an external DC electrical power source is used to provide sufficient current.



Galvanic
In the application of *passive* cathodic protection, a *galvanic anode*, a piece of a more electrochemically "active" metal (more negative electrode potential), is attached to the vulnerable metal surface where it is exposed to an electrolyte. Galvanic anodes are selected because they have a more "active" voltage than the metal of the target structure (typically steel).



Impressed current
Impressed current cathodic protection (ICCP) systems are used. These consist of anodes connected to a DC power source, often a transformer-rectifier connected to AC power. In the absence of an AC supply, alternative power sources may be used, such as solar panels, wind power or gas powered thermoelectric generators. Hybrid systems have been used for over a decade and incorporate the coordination, monitoring and high restorative current flow of ICCP systems with the reactive, lower cost and easier to maintain galvanic anodes.

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Product Description – Waterproofing, Expansion Joints & Bridge Bearings

Waterproofing, Expansion Joints & Bridge Bearings – using protective products to waterproof, maintaining expansion joints and bridge bearings (which are a wearing part) which help connect the flexible elements of a bridge to fixed structures. All receive wear due to traffic and weather conditions.

Waterproofing Systems

Expansion Joints

Bridge Bearings

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Product Description – Brickwork, Blockwork & Stonework

Pre-cast as well as built up solutions can be employed to add to concrete structures either as part of a foundations, culverts and capping units. These systems can also be known as formwork (taken from the WBS)

Historical Spend

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Demand Profile – Concrete Structures

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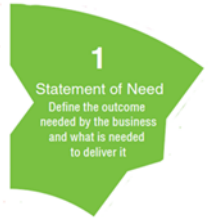
Future Spend – Major Projects



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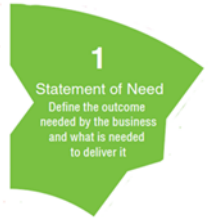
Future Spend – Major Projects



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SDF Structures Forecast Spend (OD)

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Value Chain Analysis - Retaining Walls

1 Statement of Need
Define the outcome needed by the business and what is needed to deliver it

Value Chain Objectives

- Create of a set of standardised retaining wall solutions, production processes and productivity benchmarks.
- Incentivise offsite construction methods where possible, to maximise safety and environmental benefits.
- Understand the value of carbon – footprint, opportunities, reduction and impact.
- Maximise the benefits of standardisation by taking an organisational view of demand and requirements rather than a project or programme view.
- Inform the development of new category strategies for retaining wall solutions, based on potential for standardisation, volume and supplier risk/capacity/capability, including the potential for bulk purchase of standard products.

	Value Chain	Value Factors	Current Situation	Changes Needed
Needs & Requirements	Design	• Efficiency - making optimum use of standardised designs and modular solutions • Efficiency - design for rapid construction and ease of maintenance	• Scheme designers not using standardised designs and undertaking specific designs for each circumstance • Too much variation and duplication in scheme designs	• Simplify design and construction by using a standard suite of solutions
Delivery Unit / Procurement	Product Selection	• Efficiency - standardisation of retaining wall products and selection processes, based on a minimum number and variety of solutions	• Too much variety of retaining wall solutions being used, not all of them the most efficient and effective	• Get more modular solutions certified to be used on the SRN • Reduce variation by developing a catalogue of the most efficient and effective products to cover the majority of conditions • Implement a selection process to enable these to be rolled out across all schemes • Gain agreement across contractors on the best solutions
	Procurement	• Efficiency - savings from bulk procurement of standard products and mass production opportunities	• No programmatic bulk procurement of products, only scheme by scheme procurement	• Investigate possibilities for programmatic, bulk procurement
	Manufacturing	• Safety - offsite manufacturing to reduce time on site and accident frequency rates • Efficiency - fewer defects through mass production • Environment - offsite manufactured products reduce raw materials on site, minimise waste and potential for environmental incidents from hazardous materials	• No incentive for offsite manufacturing • Mass production opportunities not realised due to lack of bulk procurement	• Develop a strategy to incentivise offsite manufacturing • Investigate possibilities to enable mass production through bulk procurement
	Installation	• Safety - reduced time on site and lower accident frequency rates through rapid construction methods using standardised modular solutions • Efficiency - reduced installation time and reducing TTM through efficient, standardised methods	• Inconsistent installation methodology, using a variety of retaining wall solutions	• Implement a slick, consistent and repeatable methodology for installing retaining walls using standardised designs and products, enabling knowledge to be built and familiarity with the process to be established
Maintain & Operate	Operation	• Delivering Enhancements for Economic Growth - improving network availability by reducing installation and maintenance times		
	Maintenance	• Network condition - standardised solutions, designed for ease of maintenance	• Non-standardised retaining wall solutions	• Use of standardised products and components to simplify maintenance by reducing the number of different solutions

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Value Stream Mapping - Retaining Walls

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Supply Chain Mapping - value and objectives

1 Statement of Need
Define the outcome needed by the business and what is needed to deliver it

Link to the relevant intelligence documents can be found here: http://share/share/llisapi.dll/properties/91420167

Concrete Structures covers Concrete Repairs, Piling & Retaining Walls, Waterproofing, Bridge Bearings & Expansion Joints, Corrosion Protection (inc Cathodic Protection).

Highways England/Other Contracting Agencies

Tier 1 – Design Suppliers

RAMBOLL, amey, Mott MacDonald, Atkins, BWB

- Such companies mainly offer project design and engineering services; **they can be leveraged to incorporate Concrete Structures design knowledge** from specialist contractors to improve works efficiencies.
- Efficiencies may include ECI and early site investigation to determine the most effective requirement.
- Some offer specific design limited to certain structures e.g. Gantries

Tier 1 – Management Suppliers

Costain Galliford Try Smart Motorways Joint Venture, amey, Kier, bmJV, Balfour Beatty, VINCI

- Tier 1 management companies provide contract and project management services, and offer expertise to manage operational needs of the client.
- Primarily integrators, they receive contracts, manage the project from scratch and sub-contract construction work to Tier 2 suppliers.
- In-House capability provided by specialised divisions

Skanska, nmcn

Tier 1 & 2 – Work Contractors

Bachy Soletanche, Cementation, Skanska, VolkerLaser, bam ritchies, Taziker, Hankinson Whittle Programmed Maintenance, Balvac Balfour Beatty, Route One Infrastructure, CRL Concrete Repairs Limited

- The primary delivering suppliers for Concrete Structures.
- They provide the Plant, operating labour and potentially design / ECI input.
- They operate largely at Tier 1 CWF with the exception of Piling & Retaining Walls which are managed by Tier 1 contractors.

Tier 3 – Material/Product Suppliers

SK Bearings, ABI Equipment Limited, casagrande uk, USL Ekspan, Freyssinet

- Materials range from widely available concrete to specialist bearings and waterproofing materials.
- Labour is the principal resource, plant can be required for e.g. working at height and concrete provision.
- Piling is the key user of plant, piling rigs being required to manipulate the soil / excavation.
- Some suppliers also manufacture the products eg. design, manufacture and install bridge bearings.

Conclusion: the market for Concrete Structures, as operated by Highways England, covers a multitude of suppliers, services and products. There are no dominant suppliers.

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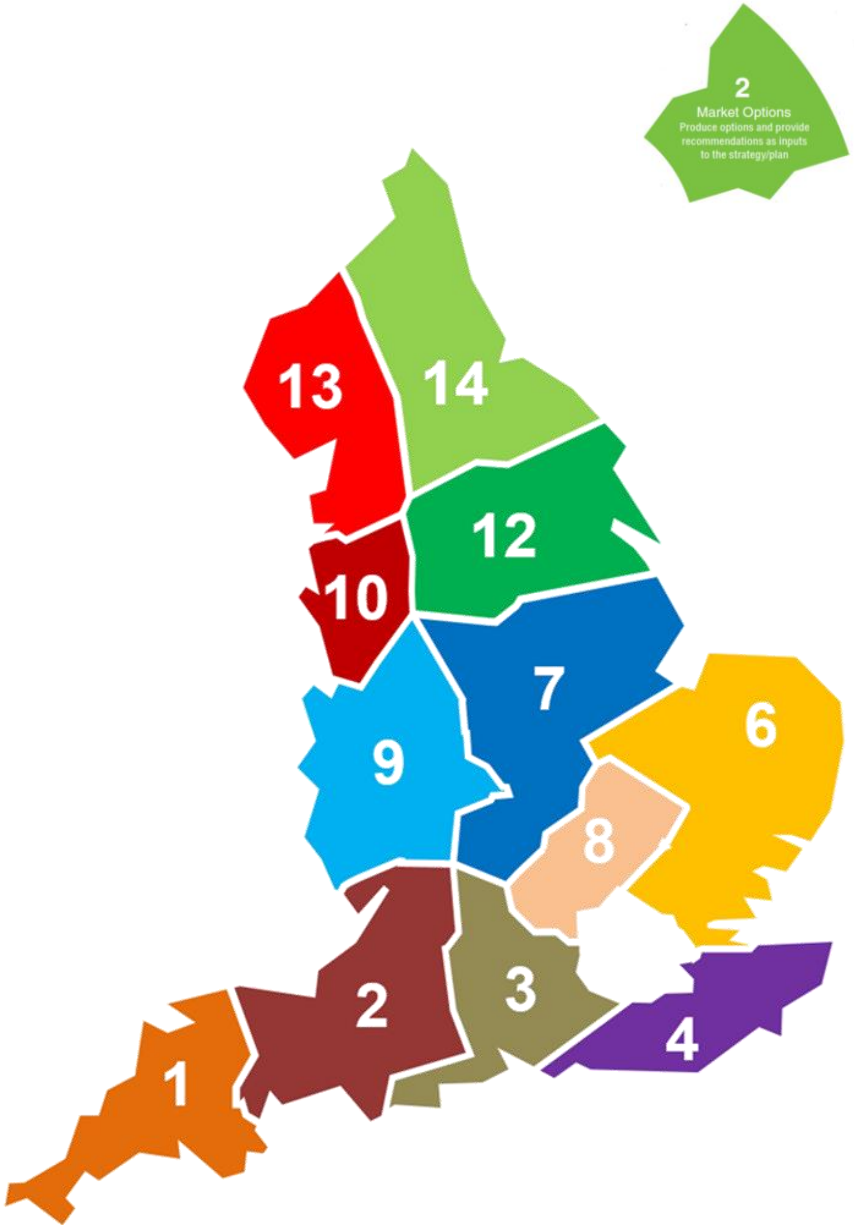
Market Insight and Landscape

- Highways England is in a favourable position across these sub-categories; being able to draw from multiple suppliers offering similar services. Key advantages are our large beginning power resulting from stable funding and steady requirements
- Highways England's needs for Corrosion Protection, Concrete Repairs and Waterproofing, Bridge bearings & Expansion Joints are currently largely (CWF) confined to Areas 13 & 14, 7 and the SW.
- CWF frameworks only appoint small numbers of unique suppliers, suggesting a lack of supplier ability to either perform the required services or pass tenders.
- Our ability to substitute these works is **low**. This is due to our requirement to maintain our structures, including bridges, in a safe condition.

Threat of New Entrants	Bargaining Power of Suppliers	Rivalry in the Industry	Bargaining Power of Buyers	Threat of Substitutes
Low — High	Low — High	Low — High	Low — High	Low — High
Accessible markets (+ve)	Multi-disciplinary service offerings e.g concrete waterproofing & repairs & protection (+ve)	Vital maintenance services (+ve)	Highways England is financially able to place large orders (+ve)	Can substitute within category e.g. types of waterproofing, new technologies (+ve)
Organic expansion i.e. groundworks into piling (+ve)	Hard to substitute piling (+ve)	Similar service offerings within sub-categories (+ve)	Large supplier base (+ve)	Piling & retaining walls driven by new building. Ceasing work runs counter to expansionist aims of RIS2: not considered viable (-ve)
Capital investments in plant or manufacturing to complete with established suppliers (-ve)	Large supplier base (-ve)	Large supplier base (+ve)	Ongoing maintenance requirements, not optional services (-ve)	Maintenance of structures required for safety & operational reasons (-ve)
Established manufacturing economies of scale (-ve)	Similar service offerings within sub-categories (-ve)		HE has limited Demand – only certain Areas of the Network require these services	



Conclusion: the markets covered are open to entry are the lower end utilising domestic or commercial business opportunities. The similarity of suppliers and service offerings makes all markets price-sensitive despite the non-optional nature of the services.

Supplier Capability and Capacity – including industry accreditations

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Supplier Financials

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Supply Market – Concrete Production

Industry Definition:
Companies in the Ready-Mixed Concrete Manufacturing industry manufacture ready-mixed concrete and mortars, and deliver batches to customers in an unhardened state.

Industry Products and Services:
- Standard ready-mixed concrete
- Rapid-set concrete
- Self-consolidating concrete
- Other specialist products
- Other

UK industry statistics:
Market Size: £3bn
Number of Businesses: 827
Industry Employment: 11,233

Market Insight:
Average industry growth 2020-2025: industry operators are expected to continue facing challenging conditions into the medium term as persisting uncertainty surrounding the terms of the UK's exit from the European Union and the COVID-19 (coronavirus) pandemic weighs on downstream construction activity. Nevertheless, opportunities are anticipated to remain, supported by ongoing policy support in residential markets. Furthermore, ready-mixed concrete (RMC) manufacturers are likely to benefit from planned government expenditure aimed at upgrading the UK's infrastructure network, boosting demand from civil engineering construction industries.

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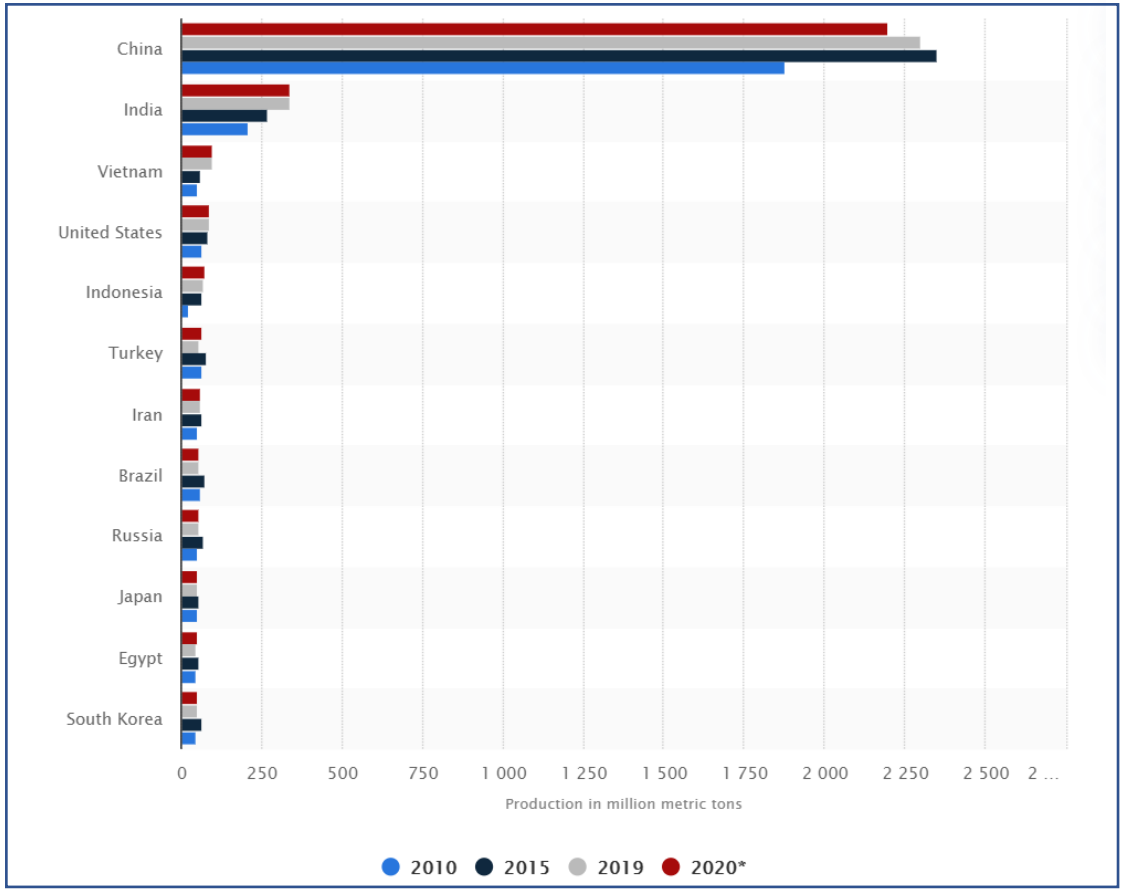
Global Concrete Production & European Market Factors

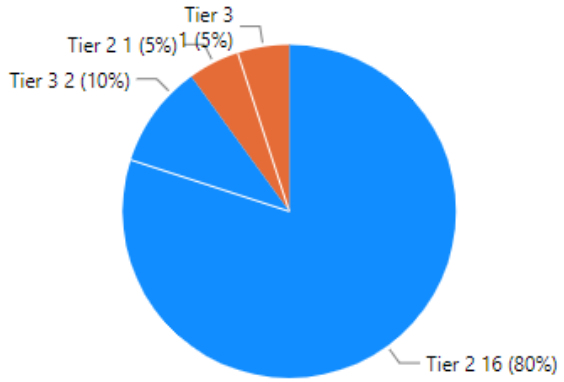


China produces the most cement globally by a large margin, at an estimated 2.2 billion metric tons in 2020, followed by India at 340 million metric tons in the same year. China currently produces over half of the world's cement. Global cement production is expected to increase from 3.27 billion metric tons in 2010 to 4.83 billion metric tons in 2030.

- **Cement production** - the majority of EU cement producers operate on a global level, giving them access to global best practice and technology. Raw materials are extracted mainly onsite, which avoids transportation costs and environmental damage.
- **Environment** - cement uses carefully selected wastes from other industries such as secondary raw materials or alternative fuels. This helps decrease the environmental impact of other industries.
- **Investment** - the cement industries are capital intensive with the cost of laying down a cement production installation equivalent to around three years' turnover.
- **Innovation –** innovation in the sectors includes the increased use of wastes as an alternative to raw materials and fuels, the development of new products such as energy and CO_2 efficient buildings, adaptation to climate change, and seeking new market opportunities for cement-based products.
- **Trade** - cement is a high-density product with a relatively low selling price. Transport costs are therefore a determinant to trade. The EU exports mainly to the US and imports come mainly from East Asian countries like China, Thailand, and the Philippines.
- **Non-EU countries** – EU cement producers own almost 60% of the cement and lime production capacity in the US, and have significant production facilities in the rest of the world.

Supplier Market Deep Dive – Piling & Retaining Walls

Schemes by Division (tooltips for £value)



Approx Tier involvement

Tier 2

23

Count of Subcontrator

Tier 3

5

Count of Subcontrator

Live

Mapped unique data

28

Count of Subcontrator

18

Count of Scheme

A selection of Tier 2 & 3 Suppliers were asked which industries will see the bulk of their work over the next 3 years, these were their answers:

Industry or sector	Percentage range
Rail	5% up to 50%
Water & Utilities	5% up to 30%
Residential	20% up to 30%
Commercial	20% up to 40%
Energy Projects	5%
Industrial	25%
Highways	25% up to 40%
General infrastructure	30% up to 50%

Tier 1 – Management Suppliers*

- Balfour Beatty
- Sinklagan
- Bachy Soletanche
- CR Civil Engineering
- Galliford Try
- Costain
- Balvac
- Skanska
- Dawson Wam
- Kier
- Morgan Sindall
- BAM Nuttall

** Some Tier 1's can also provide the works themselves*

Tier 2 & 3 – Work Contractors

- Foundation Piling
- Martello Piling
- BAM Ritchies
- Keltbray Sheet Piling
- Fussey Piling
- Ivor King
- Van Elle
- Sheet Piling UK
- Aarsleff
- Bauer

Conclusion: it is a **highly competitive environment**. This could be beneficial economically, but can be devastating for the supply chain when decisions are based purely on price (not total cost). It should be noted that some **Tier 1 suppliers can also provide the material and works themselves**. The focus of who we work with needs to be based on suppliers who are prepared to innovate, be open and transparent and look for continuous improvement working with HE.

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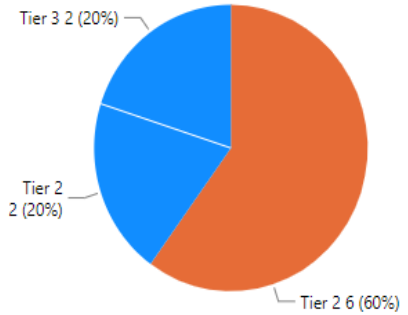
Supplier Market Deep Dive – Structural Concrete & Repairs

Structural Concrete

Schemes by Division (tooltips for £value)



Approx Tier involvement

Tier 2
22
Count of Subcontrator

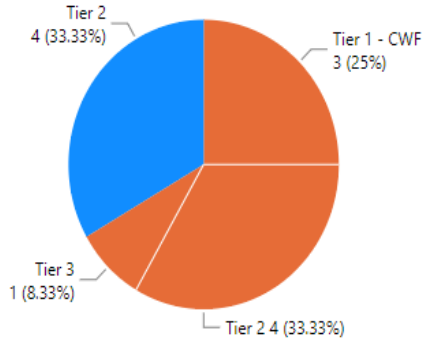
Tier 3
6
Count of Subcontrator

Live
Not Started

Mapped unique data
28
Count of Subcontrator
9
Count of Scheme

Concrete Repairs

Schemes by Division (tooltips for £value)



Approx Tier involvement

Tier 1 - CWF
4
Count of Subcontrator

Tier 2
15
Count of Subcontrator

Tier 3
1
Count of Subcontrator

Ended
Live

Mapped unique data
17
Count of Subcontrator
11
Count of Scheme

Conclusion: some competition in the market place, although not as sub-contracted, Many main Contractors can provide the services themselves. Competition appears to be around appointments of main Contractors. Structural Concrete and Concrete Repairs is in the SDF lot for RIS2. There has been a positive uptake of participation from the market. Further supplier data, analysis and opportunities can be explored once the lots have been awarded.

Tier 1 – Management Suppliers*

- *Balfour Beatty*
- *Barrett Group*
- *Skanska*
- *Breedon Group*
- *Cemex*
- *Bemac Construction*
- *HDG Group*
- ** List not exhaustive see Supply Chain Management V1.1*

Tier 2 & 3 – Work Contractors

- *Balvac*
- *G S Foam Concrete*
- *Midland Reinforced Concrete*
- *Structural Systems*

Tier 1 – Management Suppliers*

- *Balfour Beatty*
- *Centura Group*
- *Koninklinjke*
- *Curral Lewis*
- *Vinci*
- *RPM International*
- *Smart Inclusions Group*
- *Hostombe Group*

Tier 2 & 3 – Work Contractors

- *Concrete Repairs Limited*
- *Balvac Limited*
- *Volkerlaser*
- *Fressinet*
- *APA Concrete*
- *LMS*

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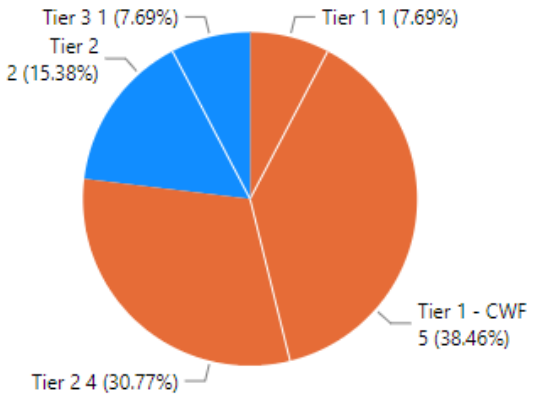
Supplier Market Deep Dive – Corrosion Protection (Cathodic)

Schemes by Division (tooltips for £value)



Approx Tier involvement

Tier 1
1
Count of Subcontrator

Tier 1 - CWF
6
Count of Subcontrator

Tier 2
17
Count of Subcontrator

Tier 3

Live

Mapped unique data
23
Count of Subcontrator
12
Count of Scheme

Tier 1 – Management Suppliers*

- *Hostombe*
- *Koninklinjke*
- *Vinci*
- *RPM*
- *Philtech*
- *Jack Tighes*
- *Hankinsen Group*
- *Centura*
- *Curall Lewis*
- *Forth Midco*
- *Steel Protection Consultancy*
- *ND Support Services*

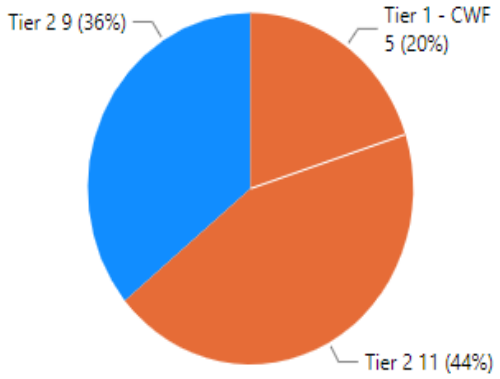
Tier 2 & 3 – Work Contractors

- *Whittle Programmed Maintenance*
- *Concrete Repairs Limited*
- *Taziker*
- *GPL Civil Engineering*
- *Cathodic Protection Co*
- *Freyssinet*

Conclusion: some competition in the market place, although not as sub-contracted, Many main Contractors can provide the services themselves. Competition is mainly around the main Contractor. Corrosion Protection is in the SDF lot for RP2. There has been a positive uptake of participation from the market. Further supplier data, analysis and opportunities can be explored once the lots have been awarded.

Supplier Market Deep Dive – Waterproofing, Bridge Bearings & Expansion Joints

Schemes by Division (tooltips for £value)



Approx Tier involvement

Tier 1 - CWF

3
Count of Subcontrator

Tier 2

15
Count of Subcontrator

Live

Mapped unique data

16
Count of Subcontrator

24
Count of Scheme

Tier 1 – Management Suppliers*

- *John Graham*
- *Koninklinjke*
- *Route One*
- *RPM International*
- *Matrail*
- *Maurer*
- *Bouygues*
- *Lucian*
- *Vinci*
- *LMS*
- *Auquaflow*

Tier 2 & 3 – Work Contractors

- *Volkerlaser*
- *Ekspan*
- *Universal Sealants*
- *Allied Infrastructure*
- *Freyssinet*

Conclusion: Some competition in the market place, although not as sub-contracted, Many main Contractors provide the services themselves. Materials could be separated form service if it proved cost effective. Waterproofing & Expansion Joints are in the SDF lot for RP2. There has been a positive uptake of participation from the market. Further supplier data, analysis and opportunities can be explored once the lots have been awarded.

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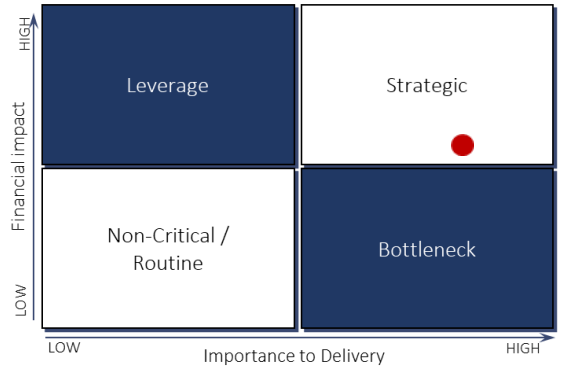
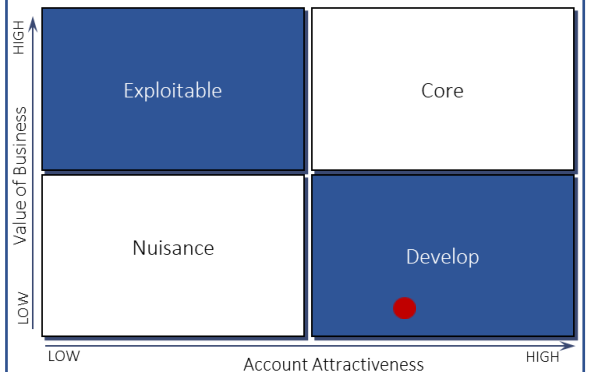
Supplier Analysis

2
Market Options
Produce options and provide recommendations as inputs to the strategy/plan

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
• Highways England is an established company and a government body so it benefits from a strong credibility and trust from investors. • Highways England has a strong competitive advantage with its knowledge, economies of scale and past contracts with main players in the industry. • Trained personnel and specialised workforce in the UK.	• Slowness of internal development and approvals makes innovation implementation a very long process. • Overlaps between some area of the business which makes it difficult to have a single point of view and makes the decision process more complicated. • Standardisation of Retaining Solutions will only extend so far into HE as there are site access constraints that can dictate the type of structure available. • Highways England requirements are mandatory and binding so can be a barrier to entry for potential suppliers; especially small companies. However, we cannot tolerate any failure on competence and skill required to fabricate so reducing would require careful consideration. • Demand planning not in great shape – confidence needs to be gained in the supply chain over our data.	• Incentivise innovations to drive industry H&S improvement. • Collaborative way of working and portion the work. • Emphasise long term value considering whole life cost and total cost of ownership. • Political willingness to improve safety on the roads; that implies using more innovations and technology. • Aggregated concrete requirements over several concrete products could bring economies of scale • Standardisation could bring reduced components, lower carbon, aggregated material spend, productivity improvements, safety improvements • Use of the Digital Product Catalogue will reduce design costs • Reduction in re-design and programme impact	• Influence /impact of DfT or central government decisions on programme or funding • Procurement/Competition law • Material and labour shortages • Supply chain maturity/appetite for change in culture • Industry restrained capacity • Competition from other sectors – LA and nuclear • Reduced transparency of cost and loss of value without a commercial framework for Gantries • Customers might not be ready yet for some innovations • Supply chain not ready or able to change • HE not ready or wanting to change • Suspicion from the supply chain over "cost cutting" rather than focus on value

Political	Economic	Social-Cultural
• Growing influence of lobbies and rise in political involvement in major infrastructure • Roads Investment Strategy (RIS): defined objectives and efficiencies to be reached • Strong role and influence of Government Departments & Agencies (Office of Rail and Road (ORR), Department for Transport (DfT), Crown Commercial Services (CCS)) • Effect of pandemic on supply chain and future investment in the roads infrastructure	• Impact of GDP / Economic Growth • Roads Investment strategy • Stability of the Currency (£) • Resource use efficiency (planning to maximise cost efficiency) • Cost pressures (supply and demand led) • Industry cost factors (pensions, oil, equipment materials) • The highways industry is moving fast both in terms of regulation and innovation thus there is a need to adapt to stay a relevant player on the market	• Mistrust of change • High customers expectations • Innovation driven environment • Work of Universities and Academics on infrastructure – Increasing interest for this industry • Better Road Safety awareness – Highways England ad campaign • Specific trainings on technology usage
Technological	**Legal**	**Environmental**
• Obsolescence of Technology • Fast pace market • Connectivity and wireless network are key elements for the development of future Smart Motorways • New innovative technologies (Stopped Vehicle Detection)	• Health and Safety requirements • Procurement rules and Competition law • Highways England policy, IAN's on fatigue and working regulations • Environmental protection standards and law • Highways industry is moving fast in terms of regulation	• Growing consideration of "new" pollution (noise pollution for instance) • Sustainable solutions considered in every sector of the business • Influence of the public on environmental key topics





Conclusion: there is an appetite and opportunity to develop and make the market in collaboration with the supply chain. Currently there are a couple of strategic suppliers reliant on HE work percentage that creates a risk for both HE and them. There are greater opportunities for HE to work with the Supply Chain to change the shape of the market place and increase efficiencies, including the introduction of new entrants to produce a wider strategic supply chain.

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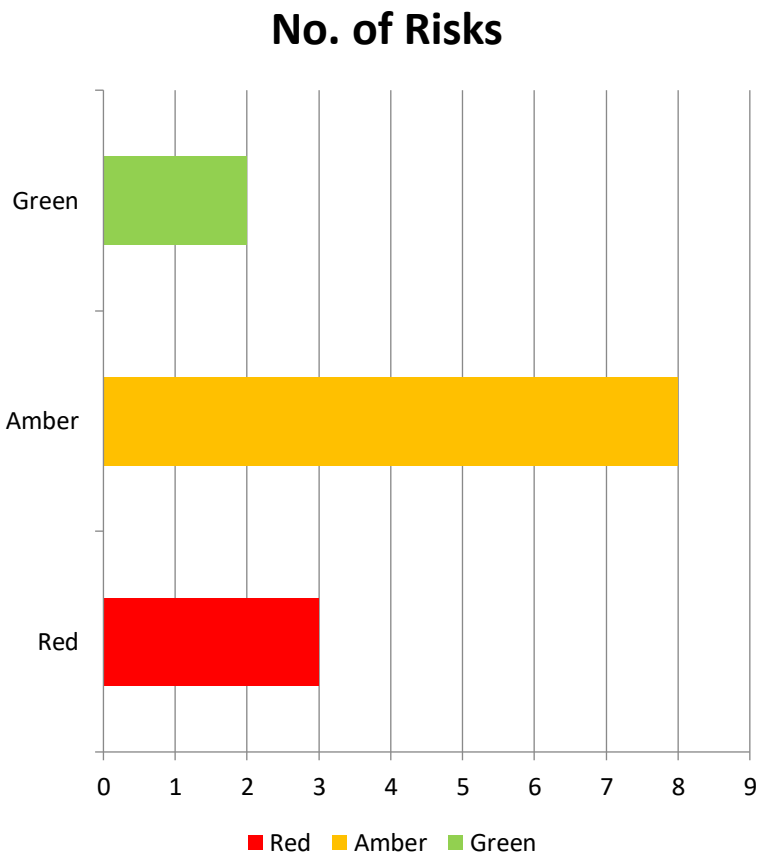
Category Risk

Link to the Risk Register can be found here: http://share/share/llisapi.dll/properties/90120773

5			• Demand Data		
4		• Incomplete Cost Data	• Opportunity validation • Solution delivery	• Market factors	• Solution delivery
3		• Tier 1 Engagement • Resource	• Monitor & Measure • Carbon Reduction programme • Opportunity saturation	• Innovation rejection	
2					• Tier 2 Engagement
1					
	1	2	3	4	5



Conclusion:

- Ability to obtain granular data has an impact on successful category management.
- Opportunity saturation & duplication is a concern - a lot of idea generation but risk delivering none or focus on a few and deliver to show it is possible
- Buy in - stakeholder engagement, buy in and ambassadorship of delivering opportunities.
- Market factors - upturn in construction is fueling demand and outstripping supply.
- Labour and material constraints may play a factor with so many large scale projects happening at once (within HE and external (HS2), housing growth initiatives).

Concrete Structures Strategy - Deliverables

3
Develop Strategy/Plan
Create the strategy that will deliver the statement of need

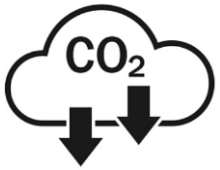
Standardisation

Smart demand planning

Market Opportunities

Supply Chain Performance

Innovation



Carbon

Standardise design, components & techniques to reduce the number of variations of solutions: • Automated where possible (DPC) • Digital design and off-site modulisation • Reduce component choice • Reduce on-site inefficiencies (zero re-design) • Reduced design cost (off the shelf design selected) • Reduction in re-design (anecdotally 50% usually) • Explore off site modular solutions • Give real life case studies of successful standardisation and where else across HE it could apply • Work cross category to look at synergies of standardisation	**Taking current demand predictions, working with the supply chain to understand in greater depth HE's requirements and firming data from prediction to close to accurate demand outlook for RP2 by doing so:** • Yield market opportunities • Ability to aggregated material purchases • Highlight HE demand versus market constraints (with the aim to avoid major material shortages) • Help HE become the customer of choice as we are able to show demand curves and what the supply chain may be able to invest in or bring on the back of knowing our requirements	**Standardisation (reducing number of components) and improved demand planning will open up possibilities of working with the supply chain to:** • Map the peaks and troughs and mitigate shortages • Take spot buy opportunities • Explore lower demand manufacture periods and if it gives commercial gain • Work cross category to aggregate spend • Work within the category (concrete products) to aggregate spend • Give opportunities to experiment with no products, practices and innovations	**Ensuring the supply chain acts and performs on innovations and efficiencies via supplier communities and implementation groups:** • Performance will be tracked through the supplier performance team • For Tier 1 suppliers we need more involvement in how they measure performance of their supply chain • Best practice to be captured, trialled and rolled out to all applicable areas of HE • Realise % against spend efficiencies across the SDF lots and Tier 1 frameworks	**Drive innovation through the supplier community groups, SDF performance and Implementation Groups:** • Capture, workshop and trial innovations • Build up case studies for best practice and innovative endeavours to support wider endorsement and embedding innovations to become standard practice • Drive efficiencies through cross collaborations groups in the supply chain but also cross category and cross MP/Ops	**Reducing carbon needs to be considered across all sub-categories:** • Less components and material needed • Alternative lower carbon products • Alternative repair methods • Better demand and aggregated to utilise more energy efficient manufacturing practices • Off-site pre cast versus logistics off site • Condition monitoring – preventative maintenance as a strategy

Sub-Category Delivery Plan

Sub-category	Spend RP2	Market options	Strategic Solutions	Timescale
Piling & Retaining Walls		Major Projects (SMA) Competition - out to tender CIP & RIP Optimise – Work with the existing supply chain	• Set up Supplier Community Groups • Develop opportunities within the community to capture efficiencies and innovations • Share demand data to maximise opportunities • Record & track cost reductions • Implement innovations on trial schemes and scale up opportunities once proven • Embed best practice & lessons learnt to ensure successfully proven opportunities become standard approach	Start Q1 2021
Structural Concrete & Repairs		Competition - out for tender in the current SDF	• Set up Supplier Community Groups • Develop opportunities within the community to capture efficiencies and innovations • Share demand data to maximise opportunities • Record & track cost reductions • Implement innovations on trial schemes and scale up opportunities once proven • Embed best practice & lessons learnt to ensure successfully proven opportunities become standard approach	Start Q3/Q4 2021 (Please note dependent on SDF timeframe)
Corrosion Protection (Cathodic)		Competition - out for tender in the current SDF lots	• Set up Supplier Community Groups • Develop opportunities within the community to capture efficiencies and innovations • Share demand data to maximise opportunities • Record & track cost reductions • Implement innovations on trial schemes and scale up opportunities once proven • Embed best practice & lessons learnt to ensure successfully proven opportunities become standard approach	Start Q3/Q4 2021 (Please note dependent on SDF timeframe)
Waterproofing, Expansion Joints & Bridge Bearings		Competition - out for tender in the current SDF lots	• Set up Supplier Community Groups • Develop opportunities within the community to capture efficiencies and innovations • Share demand data to maximise opportunities • Record & track cost reductions • Implement innovations on trial schemes and scale up opportunities once proven • Embed best practice & lessons learnt to ensure successfully proven opportunities become standard approach	Start Q3/Q4 2021 (Please note dependent on SDF timeframe)
Brickwork, Blockwork & Stonework		Current frameworks and Tier 1 contracts	Due to the value and opportunities in the other sub-categories this sub-category will not have any proactive Category Management until others are embedded and realising efficiencies	TBD

Opportunities Summarised

	**Standardisation** – the purpose of which is to reduce complexity and variants (which can impact time, cost and safety), and unlock opportunities for new supply chain entrants. Better value in eliminating re-design which obviously effects the overall programme and improving on site installation time. Working with the investment programmes, Innovation Reapplied and Supply Chain to develop more standardised solutions and capturing them in the Digital Product Catalogue for schemes to access. Quality, full life impact (lower maintenance).	MP
	**Carbon** – needs to form the basis of decision making from design through to maintenance. Working with SES, Supply Chain and investment programmes to identify, qualify and embed carbon reduction opportunities. These are explored through new design (standardisation), supply chain communities and industry understanding & research. Maintenance has a role in developing lower carbon approaches and technology, harnessing preventative maintenance and inputting learning and best practice back through to the design to positively influence the next generation of build.	OD & MP
	**Supply Chain Performance** – measure, manage and optimise performance across a wider breadth of our supply chain. Drive aspirational performance to increase quality, safety & efficiencies and recognise positive behaviours in tackling productivity, value and the carbon agenda. Performance not only plays a part in delivering schemes better but also how we learn lessons to improve in the next Roads Period.	OD & MP
	**Innovation** – utilising supplier communities (existing and new supply chains), the wider industry and trade bodies to incubate ideas and innovations around new technologies, products and techniques. Develop all of these aspects to contribute to, and help deliver, safer methods of working, lower carbon investment programmes, and on time to meet our customers expectations.	OD & MP
	**Market Opportunities** – working with improved data, unlocking supply chain innovation and a cross functional approach we will consider the best approach to purchasing (the five Rs). Modulisation, offsite manufacture, aggregated purchase and agile strategies to recognise opportunities, risks and appropriate mitigation.	OD & MP
	**Smart Demand Planning** – to unlock the benefits of all of the above, improved data is the key. Working with what we have, working with our supply chain (who instinctively have to plan) and looking to what else is possible to unlock good data. Understanding what we need and when we need it better opens up opportunities, makes us an informed customer and helps deliver better value.	MP

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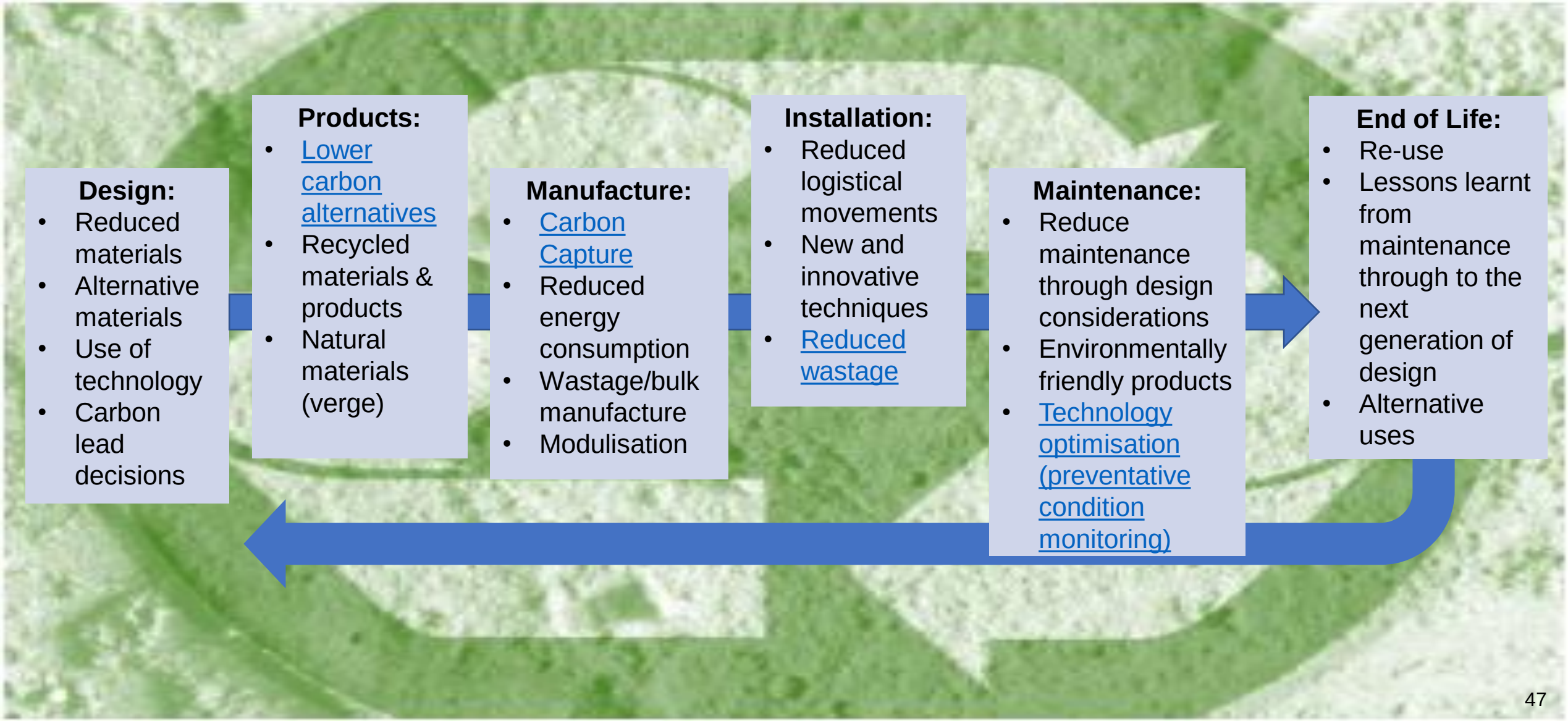
Achieving Net Zero – Concrete Structures



Opportunity – Retaining Walls

Link to the Deep Dive paper can be found here:
http://share/share/llisapi.dll/properties/92392425

3 Develop Strategy/Plan
Create the strategy that will deliver the statement of need

Low Height Retaining Walls S10.RP2.2020.v1

Asset Efficiency Group

OVERVIEW

There is increasing need for low height retaining walls across the Strategic Road Network (SRN) – particularly within the Smart Motorway Programme (SMP). The retaining wall options include sheet piles, king post walls, gabion, L shaped walls, modular walls and crib walls (see Figure 1).

The key to an efficient design is the consideration of direct cost, production output and maintenance. Option selection should consider the activity as a whole as opposed to only the installation phase. Key aspects to consider include temporary works (planning and approvals), resource and plant optimisation, production outputs, impact of earthwork and backfill time and possible procurement delays. Experience from the SMP would suggest that the preferred solutions are often but not exclusively:

- <500mm Slab on edge
- 500-1500mm Crib wall
- 1500-3000mm King Sheet Piles (KSP*) & traditional sheet piling
- >3000mm Bored piled wall

The final choice will depend on capital cost, programme considerations, environmental issues and need for any substantial temporary works such as piling platforms. Production wise sheet piling would generally out perform all other types of wall but will not necessarily have the lowest capital cost. Above all, eliminating the need for a retaining wall should be considered first.

KSP is a patented product and is likely to have advantages over standard piling, where feasible, due to the significant material cost saving and quicker installation

KEY FACTORS FOR IMPLEMENTATION

- Better verge optimisation to remove or reduce retained heights. Moving infrastructure can reduce or eliminate need for walls. Consider an earthworks solution instead of a wall – avoid over engineered solutions
- Right first time through topographical surveys, timely availability of Ground Investigation information and early Supply Chain involvement
- Better risk management. Non programme critical walls can quickly move onto the critical path because of changes and delays. Avoid pressures to reduce product lead times, often leads to problems
- Utilise other similar schemes; greater visibility and accurate cost data, and potential for cross-project productisation for similar solutions.
- Design for unplanned excavation (500mm min) or for the depth of the proposed services (could be 1m+).
- Site specific factors must be carefully considered during selection of the most appropriate solution. Verify all assumptions at start of works

Figure 1: Typical Retaining wall solutions

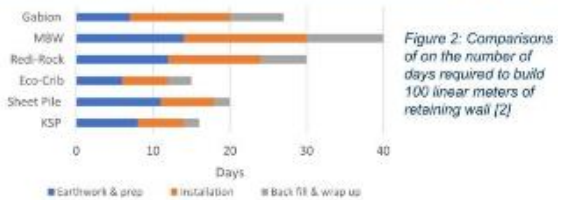


Figure 2: Comparisons of on the number of days required to build 100 linear meters of retaining wall [2]

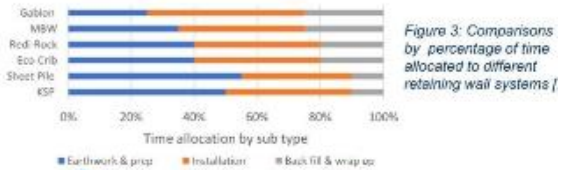


Figure 3: Comparisons by percentage of time allocated to different retaining wall systems [

STAKEHOLDERS

RESPONSIBLE:	Supply Chain
ACCOUNTABLE:	Supply Chain and Project Managers
CONSULTED:	Project Managers and the Designers
INFORMED:	Highways Central Efficiency Group (CEG)

POTENTIAL EFFICIENCY SAVINGS

- *SMA opportunity for savings of £29.6M, coming from productivity savings of £12.4M and product selection savings of £17.2m. [2]*
- *Balfour Beatty logged £10M saving on M25 widening by using KSP [5]*
- *Balfour Beatty saved £2.7M for client on A421 [5]*

TECHNOLOGY READINESS LEVEL

9 *This technology has specific provision within the Design Manual for Roads and Bridges and or the specification. Therefore, it can be used without a Departure from Standard (DfS).*

SPECIFICATION AND STANDARDS

- *Structural certification for walls >1.5m and Approval In Principal (AIP) for walls >2.5m*
- *Standards vary depending on wall type*

BENEFITS / SUCCESS CRITERIA

Benefits

- Clearer understanding of actual costs and greater transparency for all.
- Standardisation and products across range of heights.
- Earlier involvement and incentivisation of the Tier 2 suppliers.
- Less re-design during construction.
- 10-20% cost savings through correct choice and improvements in production output.
- Solution chosen with clear understanding of cost, programme and temp works.

Success of this efficiency will be evaluated based upon:

- An increase in the appropriate technique/technology.
- Delivering within a post efficient budget, supported by an entry on the efficiency register and sufficient evidence to allow validation.

References:
[1] Modular Block Retaining Walls M23 J8 – 10 Smart Motorway Programme.
[2] SMP Business Improvement; Change and Efficiency - Retaining Wall Deep Dive
[3] Geotechnical considerations for widening highway earthworks, HA Report 43
[4] Geotechnical Retaining and Widening Systems, Annex E3.04
[5] Balfour Beatty, Sustainable Innovation, KSP used on M25 and other projects

Note: This Knowledge Transfer Pack (KTP) has been produced to share best practice and raise awareness of potential efficiencies. It may not be applicable for all schemes and it should therefore be reviewed on a case-by-case basis. When evaluating and implementing these efficiencies, Highways England's processes and governance must be followed – which may require a Departure from Standard (DfS). Highways England's Safety,

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Conclusion: Standardising Retaining Solutions will deliver cost benefits estimated at £29.6m thought productivity and design savings.

Anecdotal evidence suggests 50% of Retaining solutions are re-designed at a later stage. This is costly and inefficient in productivity. It also has a programme risk issue which effects cost and the customer as schemes are delayed.

It will also open up opportunities to go the supply market for specific products, economies of scale, surety of supply and other more stretching opportunities in looking at production in quiet periods.

By consolidating materials and giving better demand forecast it could also help material producers to invest in facilities, learning and other social value factors

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Opportunity – Modular Solutions

3
Develop Strategy/Plan
Create the strategy that will deliver the statement of need

Modular Off-Site Construction MP6.RP2.2020.v1

Cost Reduction Toolkit

OVERVIEW

The Construction Industry under performs in areas of productivity, certainty of delivery, skills shortage and data transparency. Off-site manufacture and greater use of technology has the potential to improve the industry. Included under this umbrella is prefabrication, standardisation, modularisation and productisation of assets within a controlled factory environment.

There are a number of different terms used to describe this including DfMA (Design for Manufacture and Assembly), ABC (Accelerated Bridge Construction), PPMOF (Prefabrication, Preassembly, Modularisation and Off-site Fabrication, Smart construction). TIES (Transport Infrastructure Efficiency Strategy) adopts the broad title of MMC (Modern Methods of Construction) to cover the whole life of the asset.

Off-site manufacturing has potential to cover a large number of assets e.g. modular standardised bridges, different components of bridges, gantries, retaining walls and the significant number of minor structures on SMP schemes.

KEY FACTORS FOR IMPLEMENTATION

- Transparency of costs and more emphasis on whole life asset cost.
- Success of the new Alliances and Partnerships (RDP/DIPs) and SMP/SMA) are needed to drive this efficiency.
- Application across a portfolio of project; 'Develop once, use many'.
- Greater certainty in work to encourage early Supplier engagement, investment and commitment to off site manufacturing.
- Design for 'off site' manufacture from the start:
  - Understanding constraints caused by site, project and Suppliers.
  - There will be limitations on the weight, length, width and height of modular units that can be delivered to site.
  - Understanding manufacturing capacity, and incorporating offsite manufacturers into the planning process.
  - Close collaboration is required between the permanent works designers, the temporary works designers and Suppliers to ensure that the element's needs are considered throughout all stages of their lifecycle, from manufacturer to placing on site.
  - Well planned and durable interface/connections of modular units is critical. Solutions to show improvement on traditional methods.
- Develop solutions to benefit the asset during its life cycle through simple asset replacement or enhancement of modular units.

Figure 1: Modular construction on Stafford Area Improvements Project (Laing O'Rourke)

Figure 2: The pre-cast yard used for the A14 Improvement Scheme

STAKEHOLDERS

RESPONSIBLE:	Highways England and Supply Chain
ACCOUNTABLE:	Supply Chain and Project Managers (PM's)
CONSULTED:	SES, PM's, Contractors and Designers.
INFORMED:	Highways Central Efficiency Group (CEG)

POTENTIAL EFFICIENCY SAVINGS

Efficiency savings will vary significantly from site to site. Despite additional costs associated with one off site construction, projects will still realise savings from shorter construction periods. More significant savings will result from economies of scale across a portfolio of projects.

TECHNOLOGY READINESS LEVEL

8

The technology is undergoing active commissioning within Highways England having undergone network trials. These specifics should be taken into consideration during application for use within a Departure from Standard (DfS). Early consultation with Safety, Engineering and Standards (SES) is recommended to support this process.

SPECIFICATION AND STANDARDS

Design Manual for Roads and Bridges (DMRB), CD 350 The design of highway structures (formerly BD 100/16, BA 57/01, BD 57/01, IAN 124/11)

BENEFITS / SUCCESS CRITERIA

- Safety: By removing construction activities from the site and placing them in a controlled factory environment, there is a significant positive impact on safety. This also benefits remaining site activities by having less interaction between trades.
- Accelerated construction: Opportunity to significantly reduce construction programme through the use of prefabricated elements and products.
- Increased reliability: Greater certainty of delivery and less defects from off-site manufacture.
- Lower whole life costs: By improving quality and reducing the number of unique parts, modularisation and productisation can provide lower whole life costs.
- Increased productivity: Productivity of a workforce in factory environments typically reaches approximately 80%, compared with 40% for a typical construction site. Assembly time is shortened and the transition between design to production phases is smoother.
- Higher quality: A highly automated approach can enhance quality and efficiency at each stage.
- More sustainable: There is less waste generated because pre-fabrication makes it possible to optimise material purchase and reduce vehicle movements transporting materials to site.

Success of this efficiency will be evaluated based upon industry wide adoption and a significant shift in construction practices.

References:
[1] Smart Motorway Programme Design Guide
[2] From Construction to Production: Enablers, Barriers and Opportunities for the Highways Supply Chain
[3] https://www.designingbuildings.co.uk/wiki/Design_for_Manufacture_and_Assembly_(DfMA)
[4] https://www.builtoffsite.com/publicationsguidance/bim-dfma/
[5] https://www.ice.org.uk/knowledge-and-resources/case-studies/dfma-a453-road-widening-new-approach-bridge

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Conclusion: Modulisation needs further exploration along with modulisation to understand potential cost, programme, safety and carbon benefits

Proof of concept along with a pilot scheme would solidify a case study for wider use of these methods as standard HE practice.

Laing O'Rourke have presented their technology offering and Sanksa and actively looking to use this technique on the A428 investment scheme

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Opportunity – Offsite Manufacture

3
Develop Strategy/Plan
Create the strategy that will deliver the statement of need

Off-Site Manufacturing (OSM) S5.RP2.2020.v1

Asset Efficiency Group

OVERVIEW

The construction industry under performs in areas of productivity, certainty of delivery, skills shortage and data transparency. Off site manufacture/construction and greater use of technology has the potential to improve the industry. Included under this umbrella is prefabrication, standardisation, modularisation and productisation of assets within a controlled factory environment.

Off Site Manufacturing (OSM) using Modern Methods of Construction (MMC) has the potential to cover a large number of assets e.g. modular standardised bridges, different standard components of bridges, gantries, retaining walls and the significant number of minor structures on Smart Motorway schemes.

The take up of OSM has been slow for a number of reasons, namely: 1) construction is an 'on site' focused industry, 2) cost benefits of OSM are not proven or transparent enough and 3) procurement is not aligned in a way to exploit OSM.

To achieve the full benefits of OSM an integrated design process from an earlier stage with all key Stakeholders engaged and committed to a transformational change is required.

The key benefit is likely to be reduce construction time and disruption, whilst the biggest challenge will be ensuring the long term durability of joints that an integral part of OSM. The customer is predominantly interested in minimal network disruption.

For bridges the best opportunity for modular construction is likely to be within cantilever edge beam and parapets, deck slabs, wingwalls and piers.

KEY FACTORS FOR IMPLEMENTATION

- Accurate and substantive evidence of the benefits and risks is needed to drive a transformational change in the industry.
- Greater transparency of the construction costs and a greater emphasis on the whole life cost of assets.
- Greater understanding of the risks associated with the durability of joints within modular construction.
- Greater certainty in work load and more incentivisation to encourage Supplier investment in OSM.
- Application across many projects using the 'develop once, use many' mantra.
- Greater standardisation across structures and their components.
- Design for OSM from the start:
  - Understanding constraints, caused by site, project and supply chain factors.
  - Close collaboration is required between the permanent works designers, the temporary works designers and suppliers to ensure that the elements are adequate throughout all stages of their lifecycle from manufacturer, to transportation, lifting and placing and incorporation in the works.
  - Well planned and durable interface/connections of modular units is critical. Solutions need to show an improvement on traditional methods of working
- Exploit new and developing digital technology through the design and construction phases of OSM
- Develop solutions that benefit the asset during its life cycle by allowing for simple asset replacement or enhancement of modular units

References
[1] Smart Construction, KPMG
[2] From Construction to Production: Enablers, Barriers and Opportunities for the Highways Supply Chain
[3]https://www.designingbuildings.co.uk/wiki/Design_for_Manufacture_and_Assembly_(DfMA)
[4] https://www.buildoffsite.com/publicationsguidance/bim-dfma/
[5] https://www.ice.org.uk/knowledge-and-resources/case-studies/dfma-a453-road-widening-new-approach-bridge

Figure 1: Modular construction on Stafford Area Improvements Project (Laing O'Rouke)

Figure 2: The pre-cast yard used for the A14 Improvement Scheme

Figure 3: A modularisation approach (blue) achieves 6 month saving over traditional construction (red) over a 3 year period [5]

STAKEHOLDERS

RESPONSIBLE:	Designers, Contractors and Supply Chain
ACCOUNTABLE:	Supply Chain and Project Managers (PM's)
CONSULTED:	SES, PM's, Contractors and Designers.
INFORMED:	Highways Central Efficiency Group (CEG)

POTENTIAL EFFICIENCY SAVINGS

Efficiency savings will vary significantly from site to site. More significant savings will result from economies of scale across a portfolio of projects or through greater standardisation. Reduced construction times will also realise significant savings where structures are on the critical path

TECHNOLOGY READINESS LEVEL

8 *Off-Site Manufacturing can be adopted now. The extent of adoption and success will vary depending on the asset and ability to standardise across a programme of works.*

SPECIFICATION AND STANDARDS

Design Manual for Roads and Bridges (DMRB), CD 350 The design of highway structures (formerly BD 100/16, BA 57/01, BD 57/01, IAN 124/11)

BENEFITS / SUCCESS CRITERIA

- **Safety:** By removing construction activities from the site and placing them in a controlled factory environment there is a significant positive impact on safety. This also benefits remaining site activities by having less interaction between trades.
- **Accelerated construction:** Opportunity to significantly reduce construction programme through the use of prefabricated elements and products
- **Increased reliability:** Greater certainty of delivery and less defects from off site manufacture.
- **Lower whole life costs:** By improving quality and reducing the number of unique parts, modularisation and productisation has the opportunity to reduce whole life costs
- **Increased productivity:** Productivity of a workforce in factory environments typically reaches approximately 80 per cent, compared with 40 per cent for typical construction sites. Assembly time is shortened and transition between design to production phase is smoother.
- **Higher quality:** A highly automated approach can enhance quality and efficiency at each stage subject to careful and durable detailing of connections
- **More sustainable:** This has the potential to generate less waste because pre-fabrication makes it possible to optimise material purchase and reduce vehicle movements transporting materials to site.
- **Risks.** OSM is not risk free. There is still real concern about the long term performance of the connections in such an aggressive environment. The workforce and construction techniques also need to be able to efficiently deal with the more stringent geometric tolerances required.

Success of this efficiency will be evaluated based upon:

- An increase in the appropriate technique/technology.
- Delivering within a post efficient budget, supported by an entry on the efficiency register and sufficient evidence to allow validation.

Note: This Knowledge Transfer Pack (KTP) has been produced to share best practice and raise awareness of potential efficiencies. It may not be applicable for all schemes and it should therefore be reviewed on a case-by-case basis. When evaluating and implementing these efficiencies, Highways England's processes and governance must be followed – which may require a Departure from Standard (DfS). Highways England's Safety, Engineering and Standards (SES) team and the Asset Efficiency Group (AEG) are available to advise and support where required

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Conclusion: Off Site manufacture needs further exploration along with modulisation to understand potential cost, programme, safety and carbon benefits

Proof of concept along with a pilot scheme would solidify a case study for wider use of these methods as standard HE practice.

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Opportunity – Offsite Manufacture (continued)

3
Develop Strategy/Plan
Create the strategy that will deliver the statement of need

Off-Site Manufacturing; Precast Deck Elements S6.RP2.2020.v1

Asset Efficiency Group

OVERVIEW

Off-Site Manufacturing (OSM) has brought great benefits to other sectors and has the potential to improve the quality, speed of construction and safety of bridge construction. The use of precast deck slab elements on steel or concrete beams is an example of OSM that has been used successfully on a number of projects in the UK. However, it is important to realise that use of precast deck slabs is not without its difficulties, in particular there is concern about the long term durability of the in-situ connections, problems of rebar clashes at joints and increased skill and attention needed to achieve the tighter construction tolerances essential to successful installations.

The assessment of whether to use precast slabs needs to demonstrate that they will provide something at least as durable as an in-situ concrete deck that can provide a joint free, homogeneous slab with proven long term durability. Highways England have concerns with the numerous construction joints that will be created in the deck. In particular, they have reservations about the joints in the edge cantilevers and plinths where full waterproofing protection cannot be provided.

Although there are many forms of precast elements including full-depth and partial-depth units (which require an in situ concrete topping) and the use of permanent formwork systems the real change would come from the greater use of full depth units. The use of these units in Europe, especially Scandinavia, the Far East and the USA is extensive.

KEY FACTORS FOR IMPLEMENTATION

- Clear understanding of the reasons for, and the risks associated with the use of precast deck slabs.
- Design for OSM from the start, avoid trying to retro-fit to existing designs.
- Need for reduced construction programme.
- Design for transport to site, potential storage and assembly on site.
- Design for maintenance and replacement.
- Early engagement of supply chain is essential.
- Repetition/standardisation across a number of structures or on long viaducts will normally be necessary to be economic.
- Simple geometry to reduce the number of bespoke units.
- Narrow structures (<20m) could allow full width deck slabs with weights less than 25t.
- Requires either suitable staging / storage area for components, or proximity to casting-yard.
- On larger schemes on site manufacturing of the precast units can demonstrate savings (e.g. A14) through reduced transport costs.
- Greater appreciation of construction tolerances. Accurate and detailed setting-out of the reinforcement and studs to avoid clashes etc. are particularly critical.
- Demonstratable evidence that proposed joints are durable for the life of the bridge (120yrs). Joint details in documents like the SCI P316 guide are not necessarily approved details by HE.
- Further research into design of in-situ concrete joints and the opportunities from the use of UHPC would promote greater use of PC slabs and potentially allay fears over the long term durability.

References:

1. Composite bridges with prefabricated decks (ELEM) European commission
2. Precast composite decks for composite bridges (P316) SCI 2004

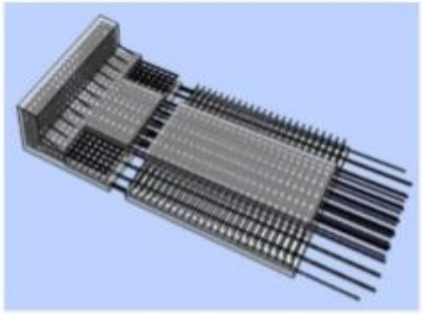

Figure 1: 3D view of typical edge unit, showing "stitching" details

Figure 2: Deck part-plan showing typical layout of pre-cast and in-situ elements (New Wear Crossing, Moore Concrete ltd)

STAKEHOLDERS

RESPONSIBLE:	Supply Chain
ACCOUNTABLE:	Supply Chain and Project Managers
CONSULTED:	Project Managers and the Designers
INFORMED:	Highways Central Efficiency Group (CEG)

POTENTIAL EFFICIENCY SAVINGS

On the A14 the use of PC slab units on the Rover Ouse Viaduct (17 spans over 750m) resulted in a £4m cost saving and 2 month programme reduction. The scale of this bridge was key to realising these savings.

TECHNOLOGY READINESS LEVEL

7 or lower

Precast techniques are well proven but further research/examples into the long term performance of in-situ stitch joints is needed. Highways England have concerns with the numerous construction joints created in the deck.

SPECIFICATION AND STANDARDS

- *Specifications and standards are not specifically developed for precast deck elements.*

BENEFITS / SUCCESS CRITERIA

Benefits:

- Potential programme savings through speed of installation.
- Direct cost saving with more standardisation is possible.
- Improved quality of finish due to factory conditions.
- Potentially less waste.
- Less trades on site and potential for improvements in safety.
- More incentive to seek standardisation across a programme of works for greater savings.
- Up skilling of site teams as the amount of OSM and productisation increases.
- Greater Supply chain investment in the principles of OSM.

Risks/Issues:

- In-situ joints and connections may not be as durable as a joint free in-situ slabs.
- The lifting operation can be difficult and there is a risk of significant delay.
- Panels can be difficult to accurately locate into position.
- Panels can be easily damaged during installation.
- Much greater tolerances need to be introduced for girder profiles.
- Multiple or long structures are generally required for precast panels to be economic.

Projects:

- New Wear Bridge in Sunderland.
- A14 between Cambridge and Huntingdon New River Ouse Viaduct.
- Multiple projects in the US and Europe.

Success of this efficiency will be evaluated based upon:

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Retaining Walls - Relationship to Strategic Value Chain Opportunities

Strategic Value Chain Opportunities

Wireless Communications | Automated Plant | Data Strategy/AI | Risk Management | Drones | TTM

Surveys | **Digital Construction**

Retaining walls design will potentially be affected by new developments in Automated Design, BIM & Surveys

End to End Asset Lifecycle

Automated asset monitoring technology could affect the design, installation and maintenance of retaining walls

Logistics

More efficient retaining walls solutions can be enabled by optimised logistical arrangements

Modularisation

The modularisation opportunity aims to deliver modularised solutions for Highways England assets including retaining walls

Product or Service Level Value Chain Analysis

Retaining Walls Value Chain Analysis

Key

- Direct Relationship
- Indirect Relationship
- Unclear or no Relationship

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