HIGHWAYS AGENCY

Safe roads, reliable journeys, informed travellers

The Delivery Hub health, safety and environment Raising the bar 26

Whole life design for safety

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Objective

"Our aim is that as an employer, designer and a leading client, nobody comes to harm as a result of their work for us"
(Source: Highways Agency Aiming for Zero Objective)

Design for safety impacts on the whole life of a scheme; from option selection, specification, construction, hand-over, operation and maintenance as well as in decommissioning / demolition. The key lies in effective communication and collaboration; creating the right culture to drive the behaviours to achieve the shared objective throughout the whole life of a scheme.

Background

Designers make decisions that influence and impact option selection, design, construction, operation, maintenance and decommissioning processes and activities. There are also legal obligations; particularly the CDM Regulations that require this approach. Designers have a leading role to play in the 'whole-life' approach when assessing and mitigating risks that can result in injury or ill health. The most effective way of reducing safety risks is to design them out at source.

Designers have a responsibility to eliminate hazards and reduce the risks identified in each and every part of a scheme's life cycle. (GD04/12 is particularly pertinent in this regard). It is important to recognise that there are often multiple designers involved in projects and that designers are often influenced by many parties who have varying interests in the scheme life cycle.

Leadership

All aspects of design must be driven by maintainability and operability requirements. A holistic approach to the whole life cycle must be encompassed by all parties at every stage.
No party should be allowed to transfer an identified risk or hazard without robustly evidencing how it has been addressed (eliminated or mitigated to the lowest practicable level) and who has the control to eliminate it. Risk transfer should only be by exception.

Key (tier 2+) suppliers should be engaged throughout the design stages to contribute to hazard elimination. The client, CDM-C, contractors and maintainers must be fully involved and relentless in the hazard elimination process as well as being prepared to amend requirements to facilitate.
Safety is at the heart of everything we do and defines how we should operate as a community. This should be based on a culture that embodies a genuine belief that we can become incident and injury free.

Safety leadership is the combined responsibility of the entire project team and requires clear / consistent communication that is cognizant of the needs and expectations of all stakeholders, with early engagement key. Designers must adopt a mind-set that considers occupational and system safety throughout the lifecycle of the asset. Design innovation can be a strong partner of safety as it is likely that many regard safety as something that restricts creativity. We must embrace innovation and technology to improve our safety in design approach. This involves challenging standards and encouraging “thinking outside of the box”.

We must create the environment and define the behaviours that the whole team should ‘exemplify’ in order to achieve the breakthrough in performance in ‘safety in design’ that we are seeking. These can then be translated into the systems and procedures that drive those behaviours. Some ways that designers can show good leadership and improve the hazard elimination process are:

- SFARP undertake pre-design workshops with the operators and maintainers; identify what currently works well, what doesn’t
- Undertake regular workplace inspections of the site (be part of the Highways Agency project manager safety tour party as a minimum).
- Designers must be involved in any high potential / RIDDOR injury investigation to determine if the design could have prevented the injury. Any lessons shall be fed back through all appropriate forums.
- Designers must be an integrated part of the site team; on hand to collaboratively resolve any design issues that arise.

A suggested check-list for every designer to consider is as follows:

1. How do you ensure you understand the safety risks within the scope of the client requirements, particularly those of the operator and maintainers?
2. How do you carry forward lessons learned and innovations from similar projects?
3. Do you ask for feedback from clients, contractors and suppliers from similar projects – what worked and what didn't?
4. Do you think about the specific safety risks that relate to your design rather than the generic?
5. Do you effectively communicate any significant or unusual residual risks?
6. Do you reduce risk through requesting feedback on design issues and encourage constructive challenges?
7. Do you ask yourself 'Would I feel safe constructing, maintaining and operating what I have designed?
8. Do you document lessons learned and feed them back within the project and to wider industry (e.g. Highways Agency knowledge bank)?
9. How do you communicate any residual risk clearly to the end user?
10. What are we designing now that may be unacceptable tomorrow?
11. Do you seek operational and maintainability feedback direct from the local operator and maintainers?
12. Do you undertake post project reviews, with the aim of understanding how well the design has fitted with the expectations of operators and maintainers? How do you ensure lessons are shared?
13. Do you measure design performance at the construction and post construction phases of the project.

Health

National statistical data indicates a higher incidence rate of work related illness in construction, operations and maintenance than across all industries (there is 50 times the number of OH illness related deaths compared to incidents and 3 times the amount of days lost due to OH illness compared to injuries). Occupational health (as well as safety) should be an integral part of the design process.
A designer should:

- Identify prioritise and asses occupational health risks that arise from a design (including vibration (HAVS), noise, MSDs, contact dermatitis, occupational asthma, silicosis etc.).
- Eliminate the hazards so far as is reasonably practicable;
- Adjust designs, where practicable to minimise health risks and
- Provide adequate information about any significant risks associated with the design.

As part of the whole life approach always consider how a structure is to be maintained and subsequently demolished / decommissioned as this often presents significant challenges and risks.

Maintenance Activities

Designers can play a key role in preventing accidents during operation and maintenance activities. Early engagement with the end user and maintainer is essential to secure a safe whole-life outcome in the operation and maintenance of the asset.

Visualisation / BIM

The use of 3D visualisation allows all stakeholders to understand how the design will impact them. The BIM concept enables virtual construction prior to its physical construction, operation or maintenance in order to reduce uncertainty, improve safety, resolve issues, and simulate and analyse potential impacts. Contractors can input critical information into the model before beginning construction to identify opportunities to pre-fabricate or pre-assemble some systems off-site and can consult maintainers and operators on the impact of the solutions.The Government, through the published construction strategy has targeted all public departments will adopt, as a minimum, collaborative Level 2 BIM by 2016 so adoption of a BIM solution will allow the Highways Agency to achieve this target.

Designing for safety (safety excellence wheel and matrix):

The Highways Agency safety excellence wheel is a continuous improvement assessment tool which design for safety forms one part.
This raising the bar guidance document suggests both minimum and desirable performance indicators for each aspect of the design for safety section of the safety excellence wheel as shown below:

The use of the safety excellence wheel by all parties needs to be consistently adopted in order that it is an important performance driver and measure for safer designs and safer sites.

	Performance Level 1	Performance Level 2	Performance Level 3	Performance Level 4	Performance Level 5
	Minimum Requirement	Minimum Requirement	Minimum Requirement	Desirable Standard	Desirable Standard
R1 - Relentless Hazard Elimination through Design	Construction, design and management regulations with Construction, design and management - C fully involved in design review process.	Hazard Identification and elimination starts at preferred route selection	Client and maintainer fully involved in hazard elimination process and prepared to amend requirements to eliminate hazards	Key tier 2+ suppliers engaged and utilised at preliminary design stage to eliminate hazards	Hazard elimination integrated within design as a continuous full team-embracing process from preferred route selection onwards.
Performance indicator	Construction, design and management-C appointed to scheme and demonstrably involved with the designer / design process. Demonstrable and evidenced engagement within and across construction, design and management-C community as well as between construction, design and management-Cs and Highways Agency project managers and designers	Evidenced through regular and meaningful liaison throughout the design process. Application of the 'standard' smart motorways hazard elimination schedule as a template to schemes. All Pre Construction Information passed to principal contractor.	Design team meetings – should include: designer, construction, design and management-C, DP (when appointed) / maintainer / client representative. OSM TAG – monthly standing Construction, design and management agenda item. Provide transparency through use of the supply chain portal OSM TAG group. Evidence of peer review of design solutions Evidence of audits to verify level / scope and extent of involvement.	Demonstrate tier 2+ supplier involvement at preliminary design stage. Evidence of tier 2+ involvement in hazard elimination and mitigation. Develop 'standard' smart motorways hazard elimination schedule to give transparency across whole scheme lifecycle – separately consider preliminary design, detailed design, construction, operation and maintenance and de-commissioning of scheme. Include the need to seek feedback from the current operators and maintainers – via questionnaire / workshop/ focus group etc?	Evidence that residual hazard information is included within the pre-construction health and safety plan and includes detailed mitigation plans with agreed owners responsible for actions - at 'no cost' to the operation of the scheme. Demonstrate that lessons learned forums based on designer/ contractor reviews (and peer reviews) are conducted – driving improvements in design to make construction safer and more efficient. Evidence to demonstrate effective communication of risk between all the designers and stakeholders and the use of interdisciplinary design checks.

	Performance Level 1	Performance Level 2	Performance Level 3	Performance Level 4	Performance Level 5
	Minimum Requirement	Minimum Requirement	Minimum Requirement	Desirable Standard	Desirable Standard
R2 - Residual Construction and Maintenance Hazards Identified	Identified on Safety, Health and Environmental (SHE), box on drawings or in maintenance manual and maintenance philosophy prepared	Client and maintainer fully engaged in identified and mitigating residual risks.	Contractor fully engaged in identifying and mitigating residual risk	Key tier 2+ suppliers engaged and utilised at preliminary design stage to identify and mitigate residual hazards	Achieve a more comprehensive link and cross reference between Hazard Elimination schedule and (design) Residual Risk register.
Performance indicator	Demonstrate that notes on drawings are appropriately transcribed into the scheme hazard elimination schedule – and evidence that they are disseminated within and between design organisations. Residual risk information should point to where relevant information resides. Construction phase plan – evidence that contractors have shared with one Another (and designers) across the programme – to disseminate best practice And lessons learnt.	Evidence awareness of CIVILS and OSM TAG within the HUB and their activities – (monthly standing agenda item for construction, design and management) and information repository on supply chain portal.. Evidence supply of appropriate and sufficient pre-construction information as well as gaps, where they are identified. Evidence client (including operator) and maintainer involvement in the hazard identification, mitigation and elimination process. Evidence that the construction phase plan assessment criteria have been shared across the programme	Evidence regular, collaborative engagement (Contractor / designer / maintainer) in the identification, mitigation and hazard elimination process. Evidence that the balance between construction, operation and maintenance risks is recognised, understood and that appropriate decisions (in accordance with GD/04) are made. Undertake regular workplace inspections of the site (be part of Highways Agency project manager safety tour party as a minimum).	Designers to evidence identification of tier 2+ suppliers and that liaison has commenced with them to identify and mitigate residual hazards Designers should be involved in any high potential / RIDDOR injury investigation to determine if the design could have prevented the injury. Any lessons shall be fed back through all appropriate forums. Evidence that relevant information in the scheme MRSS is adequately and comprehensively translated across to the scheme residual risk register. Evidence of an integrated team and co-location.	Evidence collaborative engagement in the hazard elimination and residual risk identification and mitigation process. Evidence a holistic 'whole life' approach to Design for Safety – to include design, construction, operation, maintenance and decommissioning. Demonstrate review of related residual risk registers from completed schemes and other relevant experience. Strong evidence that the transfer of residual risk only takes place by exception.

	Performance Level 1	Performance Level 2	Performance Level 3	Performance Level 4	Performance Level 5
	Minimum Requirement	Minimum Requirement	Minimum Requirement	Desirable Standard	Desirable Standard
R3 - Planning and Designing for Safe Construction, Operation and Maintenance	Base Highways Agency Industry standards utilised and communicated through AIPs and design input statements.	Highways Agency and maintainer review planning and design to deliver operational and maintenance (health and) safety	Contractor and key suppliers review planning and design to deliver construction (health and) safety.	Planning and design of temporary and permanent works delivered by integrated planning, design and construction scheme.	Safety drives planning construction sequence and design
Performance indicator	Construction, design and management-c appointed to scheme and demonstrably involved with the designer / design process. The health and safety file is a key construction, design and management co-ordinator duty - construction, design and management co-ordinators should manage and produce the health and safety file(s). Designers should be able to evidence that information requirements are understood, agreed and that an agreed schedule / programme of information handover activities has commenced. Evidence that the scheme construction, design and management-C has undertaken awareness / induction of the ha pm. Evidence that designers and contractors understand and respect the role of the construction, design and management- C and the benefits that the construction, design and management-C (who is welcomed and actively engaged as a member of the design and construction team) can bring to the project. Demonstrate sharing and dissemination of ideas, best practice and lessons learnt – through taking items and issues to appropriate technical and knowledge share groups	Evidence that once elements have been designed (as far as is reasonably practicable) to eliminate, initially, and then, reduce, risks that these remaining risks should be transparently transferred to those constructing/ maintaining a structure with appropriate information. Evidence level of engagement, liaison and interaction with the relevant maintainers.e	Evidence of co-located ('multi-disciplinary') teams. Designers should be an integrated part of the site team and be on hand to collaboratively resolve any design issues that arise on site. Demonstrate consistency in respect of staff (cross-learning) working across stages of a scheme – to help the embedment of lessons learnt and the understanding and experience of the reasons behind decision making.	Evidence consideration of whether the permanent design also be utilised as the temporary works solution Evidence that designers have integrated their thinking with contractors' practical methodologies? Evidence a holistic 'whole life' approach to design for safety – to include design, construction, operation, maintenance and decommissioning.	Evidence appropriate and comprehensive interaction between design and construction planning teams Evidence designers approach to design solutions and organisational culture that drives safe thinking and solutions Achieve zero post project health and safety asset defects up to 12 months following handover No post handover monies required to make good the asset following the identification of foreseeable health and safety issues

	Performance Level 1	Performance Level 2	Performance Level 3	Performance Level 4	Performance Level 5
	Minimum Requirement	Minimum Requirement	Minimum Requirement	Desirable Standard	Desirable Standard
R4 Appropriate Standards Selected and Clearly Communicated	Compliance with construction, design and management regulations with construction, design and management-C fully involved in design review process.	Risks to Workers in deviating from standards identified, eliminated if possible and mitigated.	Risks to Workers in deviating from standards identified, eliminated if possible and mitigated.	Changes to HIghways Agency / Industry standards which affect worker safety performance monitored and results fed back to HIghways Agency / Industry and toolkit	Holistic decisions made in challenging standards to deliver improved worker and road user safety for less cost.
Performance indicator	Catalogue basic (minimum) sources of information for best practise in design – that all designers would be expected to have familiarity with and awareness of: • CIRA 662 • CIRA 663 – workplace design • APS practice notes 2/13 • HSE website • Managing Health and Safety in Construction – CDM ACoP • Highways Agency knowledge bank • vdesignforconstructionsafety.org • www.structural-safety.org • www.safetyindesign.org/ • IAN 69/03 Asbestos Management • IAN 105/08 • IAN 69/05 Designing for Maintenance • IAN 166/13 • IAN 165/12 • IAN 149/11 existing motorway minimum requirements • IAN 115/08 Requirements and Guidance for works on the Hard Shoulder and Road Side Verges on High Speed Dual Carriageways. • GD/04 Standard for Safety Risk Assessment on the Strategic Road Network. Evidence awareness and use of own and other corporate Design for Safety initiative across the supply chain and beyond. (eg: Network Rail - Safe by Design initiative)	Evidence engagement with and use of the HUB departures tracker – evidence active review of Department for Transport from a road worker risk perspective. (Note also the introduction of ICert for Type A and Type B departures). Evidence use and application of the road worker safety assessment tool in the development, design and deployment of mitigations.	Evidence of awareness of and contributions to RoWSAF and AfZ. Evidence of Client attendance / engagement at review meetings. Promote awareness and use of the road worker safety assessment tool. Evidence cognisance with and practical application and understanding of GD-04 techniques.	Evidence existence of an appropriate review and monitoring strategy pertaining to road worker safety - in collaboration with designer / contractor and maintainer. Evidence feedback process employed and provide examples (knowledge dissemination) of best AND bad practice.	Evidence existence of an appropriate review and monitoring strategy pertaining to road worker safety - in collaboration with designer / contractor and maintainer. Evidence local, Highways Agency and national contributions made to the challenging of standards and development of the design concept.

	Performance Level 1	Performance Level 2	Performance Level 3	Performance Level 4	Performance Level 5
	Minimum Requirement	Minimum Requirement	Minimum Requirement	Desirable Standard	Desirable Standard
Buildability reviews (designer/ contractor/CDM Co-ordinator)	Buildability reviews involving designer, contractor and CDM Coordinator carried out	Clear evidence that Buildability reviews have resulted in design changes which improve health and safety	Client and Contractor fully involved in buildability reviews to ensure base client requirements challenged and amended to improve buildability.	Key Tier 2+ suppliers engaged with buildability at preliminary design stage	Buildability reviews integrated within design process to ensure review of all key design decisions from preferred route selection onwards.
Performance indicator	Demonstrate through meeting minutes at every stage of design development.	Evidence that buildability reviews are carried out as part of the design process. Demonstrate active and regular (integrated team) contact and collaborative working - including dissemination of 'results' into knowledge sharing communities	Evidence buildability and peer reviews and, where appropriate, challenge the base requirements. Demonstrate interaction with the operators who experience 'bad' design rather than designers who are perhaps constrained by standards.	All tier 2 suppliers identified and contacts engaged. Share accident Investigation (outcome) reports – identify where design was root cause. Demonstrate regular review of accidents / incidents and embedment of lessons learnt into the design and planning process.	Consider shadow – audit on Highways Agency process etc by related industry experts – to share knowledge.

Legislation

Construction (Design and Management) Regulations 2007
(CDM) Approved Code of Practice.

Additional Information

Highways Agency Safety Excellence wheel
Highways Agency Raising the Bar Guidance Documents
GD04/12
Designing For Maintenance IAN 69/05
Highways Agency Aiming For Zero Strategy

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