Interim Advice Note 69/05

DESIGNING FOR MAINTENANCE

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Interim Advice Note 69/05 - "Designing For Maintenance"

Summary

The Highways Agency (HA) is committed to reducing the risks and casualties to those that have to work on our roads. Up to now the main focus has been on improving operating practices and procedures, however this work has highlighted the important role of designers and the way they fulfil their duties under the Construction (Design and Management) Regulations 1994 (CDM); specifically the attention given to the whole-life management of health and safety risk.

Key messages for designers are:

- The design of a highway scheme is an intelligent iterative process requiring designers to treat each set of unique circumstances on their merits. Standard details and design guidance within the HA's published documents are provided to assist the work of designers. As far as it is reasonably practicable to do so, the CDM regulations require designers to eliminate or reduce hazards that could arise at anytime during the lifetime of a highway scheme as a consequence of their design. This process must, therefore, consider how the highway scheme is to be maintained in the future.

- Consideration of how a highway scheme is to be maintained is good practice and not just a requirement to satisfy the law. There are strong business arguments for giving careful consideration to maintenance requirements at the design stage. HA spends in the region of £900M per annum on maintenance and can also be vulnerable to civil claims if roads are poorly maintained. In addition, it should be noted that failure to comply with health and safety legislation may, in some circumstances, lead to criminal prosecution. Any worker safety improvement or cost saving that can be achieved through better design and the structured assessment of risk, is worth pursuing.

- The management of health and safety must be considered at the time of developing scheme options, including fundamental issues surrounding route choice and purpose. Designers must inform the HA at an early stage in the process about their assumptions on how maintenance will be carried out and the likely effects on network availability and safety issues for road users and operatives. This will be achieved via the '**Maintenance and Repair Strategy Statement'** that this advice note introduces. **This is a new requirement and more information on this document is given later.**

- Organisations responsible for future maintenance must be consulted at the earliest opportunity and then at regular intervals throughout the process.

- In terms of maintenance, there are two main threads to the strategy that can be adopted to reduce future risk to operatives:
  - Design a road so that future maintenance interventions where road workers are at risk are minimised
  - Design the road so that when maintenance is required it can be carried out safely

- This Interim Advice Note provides some generic conceptual ideas to stimulate designers who must tackle this important issue on a scheme-by-scheme basis.

1 Introduction

A key objective for the Highways Agency is to reduce the casualties and risks faced by those that work on our roads. Designers also have a statutory duty through the Construction (Design and Management) Regulations (CDM) 1994, as amended, to reduce health, safety and welfare risks for, amongst other things, the maintenance of completed highway schemes. The CDM Regulations require the identification of hazards and, where reasonably practicable, their elimination. Maintenance work, especially alongside traffic, presents significant hazards to operatives and also to road users.

Research has concluded that within the UK construction industry:

- The cause of a significant percentage of accidents can in part be attributed to decisions made by designers
- There is a 1:300 chance of somebody working a lifetime in construction being killed, and a far greater chance of being seriously injured

These findings illustrate why designers must give very careful thought to the issues associated with future maintenance and to effectively manage the likely risks presented to those who have to carry it out.

This Interim Advice Note (IAN) provides guidance to assist designers in discharging their duties.

2. Background

The CDM Regulations are accompanied by a combined Approved Code of Practice and Guidance document entitled *Managing Health and Safety in Construction*, which provides practical advice on how to comply with the law.

Designers can rightfully place a high degree of reliance on HA standards as a starting point and as a design tool, but their applicability to a project's individual circumstances must be considered in all cases. CDM requires the application of foresight to consider what hazards exist and to ensure, so far, as is reasonably practicable, that these are either eliminated or managed effectively through the process of risk assessment. This IAN relates particularly to the requirement to ensure that what we build, we can also maintain both safely and economically.

The HA's intention is to update design standards on a rolling programme. Work is also is also being done to include risk-based methodologies within the Design Manual for Roads and Bridges (DMRB). However there is an immediate need to provide guidance to designers and Project Leaders on the important aspect of designing with maintenance in mind.

3. Outcomes

The expected outcomes of implementation of this IAN will be:

i. Reduced exposure to risk by operatives
ii. Reduced level of site accident rates and ill-health arising from maintenance activities
iii. More efficient and cost effective maintenance
iv. Reduced congestion and delay

4. Implementation and Timing

This IAN applies to new roads, and also to improvement schemes on existing roads.

Improvements to the safety and efficiency of maintenance operations can be introduced at any stage, but with varying degrees of potential impact and cost. However it is a requirement within every HA project, including those that may have been designed some time ago but not yet built, to include the management of health and safety risk to others at every stage of the process.

The greatest scope for safety improvements is at the earliest stages of scheme preparation; particularly before land requirements have been fixed.

Designers should not fall into the trap of only considering hazards at the end of the design process. This leads to additional mitigation being needed often at additional cost, or reworking previous designs. Team brain-storming sessions at the start of the design process (and throughout as necessary) will allow some significant hazards to be eliminated and the number of remaining hazards to be mitigated, at minimum cost and disruption to the design.

The use of gateways at key stages of design is an appropriate means of ensuring that progress is made in this respect, and monitored throughout the design phase.

5. Actions Required of Designers.

General
Designers[1] are widely defined under CDM. They include the conventional 'designers' e.g. civil engineer, bridge engineer, landscape architect, M&E engineers, but may also include others such as those in management roles if they take decisions which have a significant impact upon the health or safety risk to others. Designers do not just belong to 'design consultancies'; they may be found in contracting organisations, or specialist suppliers or indeed within the HA.

Generation of Ideas
The HA has generated a list of design suggestions at Annex A. This has been compiled using the knowledge and experience of HA staff and a number of service providers working on demonstration projects. Designers should consider this non-exhaustive list in relation to their individual scheme requirements at an early stage to identify appropriate measures. Considering the list at Annex A in isolation is unlikely to result in optimum scheme designs.

All schemes should be subject to Value Engineering (VE) or Value Management (VM) or Risk workshops and it will be essential to include a session on maintainability. All VE/VM discussions need to consider the implication to the health and safety of others arising from the proposals.

Maintenance and Repair Strategy Statement
A key element in this Interim Advice Note is the new requirement for a *'Maintenance and Repair Strategy Statement'* and it is recommended that this procedure is followed. This is a way of formalising procedures that designers should already following and parallels the philosophy outlined in CIRIA Report C611 "Safe Access for Maintenance and Repair"

This proposes the production of '*maintenance philosophy sheets*' combining together to form a '*Maintenance and Repair Strategy Statement*'. Designers will have to liaise with the HA as

[1] HA engage 'suppliers' as a generic term, some of whom will be designers

client and those responsible for eventual maintenance in order to complete these statements. All parties in the process need to be aware of and signed up to the strategy. The use of such integrated teams is a way to ensure that those who have experience of maintenance and repair are on hand to advise on appropriate, safe and cost-effective solutions throughout the design process. Further details in respect of the *maintenance philosophy statements* can be found in Annex B. It is worth re-iterating that as the HA is closely involved in the design process by both providing standards and guidance and participating in detailed discussions on scheme requirements, relevant HA staff can be to some extent, designers under CDM and need to be fully aware of the implications of decisions taken.

It is not only essential that consideration is given by designers to the maintenance methodology, but also that any operational assumptions are conveyed to the HA, and those responsible for maintenance, at an early stage in the design process. This will then ensure there are no surprises or concerns when, on completion, the project is handed over.

Maintenance is now a sophisticated activity. Designers need to ensure they are in tune with current thinking; this is commented on further in the following section.

This approach is not designed to set down the obvious or the trivial. A judgement is needed as to the subjects included and the level of detail.

Liaison
Individual projects create unique circumstances and it is important that designers consult widely with the relevant stakeholders for each project.

It is essential that designers understand how maintenance of a particular completed project fits into maintenance regimes for a route or section of the HA's network or a local authority's wider network. Suitability of diversion routes and the techniques and plant utilised by a particular maintenance contractor may affect the initial project design.

For these reasons designers should consult with local authorities, maintaining organisations and others as early as possible in the design process to identify their ideas and concerns. Regular contact must be maintained and the relevant maintaining organisations shall be consulted on proposed designs. Where significant advice is received that may change with the party involved e.g. maintaining agent, this should be commented upon in the *Maintenance Strategy Statement* and raised with the HA.

6. Costs to Individual Projects

Delivery of these desired outcomes might have cost implications. However, these should be considered on a 'whole-life basis'. In many cases this may be cost neutral or even cost beneficial.

This process will involve the use of the HA's economic models eg QUADRO 4 in order to test the implication of some proposals.

Where Designers, Agents or Contractors identify proposals that would appear to meet the required outcomes of this IAN, they should discuss the implications with Project Leaders and Route Managers before including features within designs. The subsequent decision making process should be recorded, including consideration of any disbenefits.

7. Possible Disbenefits

Ideas generated by stakeholders that may improve the health and safety of operatives and road users have to be weighed against potential disbenefits. A risk assessment process should be used to reach balanced decisions. Examples of potential disbenefits include:

- Visual impact and loss of habitat by introducing engineering solutions e.g. hardened areas beyond the hard shoulder.
- Reductions in one type of maintenance may introduce greater problems for other types of maintenance. For example:
  - Flapped signs may reduce manual handling and carriageway crossings but may become a maintenance liability themselves
- Hardstandings for maintenance vehicles may create road safety risks for the travelling public unless carefully designed and signed.
- Good access (e.g. fixed ladders) may prove to be an attraction for vandals or terrorists and could require security measures
- Initial capital costs may be too high

On all these and other examples, a judgement has to be made as to an appropriate overall solution.

8. Departures From Standards

Any design that varies mandatory requirements of the Design Manual for Road and Bridgeworks (DMRB) or the Manual of Contract Documents For Highway Works (MCHW) will require approval from the Highways Agency as a Departure From Standard. The process of seeking departures includes a requirement to consider future maintenance as identified through the *Maintenance and Repair Strategy Statement*.

9. Methods of Hazard Elimination and Reduction.

The approach required by the CDM regulations to improve the design in respect of its affect on the health and safety of others should follow the hierarchy of control, which is known by the acronym **ERIC**:

Action	**Example**
Eliminate the hazard	Avoid maintenance activity through better or alternative design Choose another technique/approach etc
Reduce the hazard	Change detail, proximity, material, use latest technology, design to reduce time of exposure etc Improve access, provide identification e.g. marker posts, ensure appropriate management systems are in place,
Information	Inform others of residual hazards and assumptions after actions above. • Assumed diversion routes • Traffic management scheme, • Access to works • Drainage access issues (confined space, traffic proximity) etc Provide Maintenance and Repair Strategy Statement
Control	Having done the above, the responsibility for producing a 'safe method of work' to ensure it is safe, falls to those in charge of the work itself.

All actions are 'so far as reasonably practicable'

10. Further Information.

Further information on requirements for Health and Safety Files is contained in SD 11 [MCHW Volume 6.1.2] respectively.

Further information may also be obtained by contacting Mike Greenhalgh (mike.greenhalgh@highways.gsi.gov.uk, telephone GTN 5173 6482). The Highways Agency is keen to generate further ideas and these may also be emailed to this address. Following a suitable time period and further nationwide consultation with interested parties this IAN may be re-issued with updated guidance.

Annex A: Suggestions for reducing risk

Notes:
1. This table must be read in conjunction with the Interim Advice Note, which contains advice on the consideration of any disbenefits of adoption of these suggestions.
2. Adoption of some of these ideas may require approval as Departures from Standards

	Type A: Eliminate the need for maintenance		
	General Method	**Typical Example**	**Comment**
A1	Relocation of features	i. Move sign positions away from trees or vice versa, either longitudinally or transversely ii. Consider placing lighting columns in verge to facilitate bulb changes. iii. Provide access to bridge interiors such that operatives can avoid live carriageways (i.e. no access manholes in carriageways)	
A2	Consider alternative drainage designs	i. Reed beds rather than interceptors ii. Cross carriageway drains can be difficult to maintain and repair and consideration should be given to provide ducting and/or larger pipe diameters or parallel "spare" pipes. iii. Avoid offside gullies iv. Provide proprietary semi-bound filter drain material to reduce stone scatter problems v. Avoid manhole covers within live lanes and hard shoulders/hardstrip	
A3	Eliminate need for any ongoing work	i. Stainless steel features e.g. lighting columns ii. Low maintenance materials fencing panel materials	
A4	Edge line road studs placed on non-trafficked side of lines.		HCD already allows some flexibility where studs are rigid.
A5	Increase design life of assets	i. Increase pavement design life ii. Use rigid safety barriers (e.g. concrete) iii. Higher specification luminaires	
A6	Structures – design for durability / maintainability	Make decks continuous and integral where possible – eliminate joints and bearings	

	Type B: Reduced effort		
	General Method	**Typical Example**	**Comment**
B1	Reduce amount of grass cutting	i. Harden verges locally close to signs and safety fences to reduce grass cutting, or possibly use Astroturf substitute ii. Harden central reserves to reduce grass cutting and litter picking iii. Use low growth species or retarders	Hardening could be simply around posts of signs and safety fences to reduce time at difficult and time-consuming cutting / strimming sites, or could be over larger areas e.g. in front of signs where a "swathe" is regularly cut to assist visibility of sign face. This also reduces the risk of damage to posts. Hardening for the full width available in front of safety fences would allow the safety fence to protect any grass cutting operation behind it.
B2	Reduce time exposure	Simplify tasks and methods e.g. design of gullies compatible with common plant used to clean and empty gullies	
B3	Provide sign bins	Stock with commonly needed signs	Removes need for delivery and unloading
B4	Reduce manual handling effort	i. Use extruded or short concrete kerb lengths. ii. Fixed location of flapped TM signs. iii. Reduce weight of access covers where non-trafficable, also allow flat area to place lifted covers. iv. Lightweight fence panels v. Lightweight paving slabs	
B5	Reduce need for crash repair	i. At vulnerable sites (splitter islands, noses and laybys etc.) consider frangible type sign posts without safety fence. ii. Use socketed posts for signs or safety fences that are likely to be damaged often or could be difficult to access to repair e.g. where safety fences are founded in concrete or driven through hardened surfaces, a sleeve may assist speed of repair. Repair databases would assist identification of high risk locations	i. Restrictions on use of these posts apply e.g. not to be used near footways (draft Advice Note refers). ii. Note that rigs to drive safety fences can be large and may require traffic management for long periods. Therefore this concept has most merit where lane closures would be difficult
B6	Co-locate features at locations where maintenance is safe and convenient	Weather stations, control and power cabinets	This may also rationalise the amount of safety fence on the network
B7	Increase life of assets	i. Consider increase in specified design life ii. Lift metal objects from ground using plinths/platforms (if no driver hazard created) iii. Dew resistant sign faces	

B8	Provide permanent crossover locations	i. Consider constructing crossovers on new roads for future use. ii. If no crossover to be provided at outset, consider instead providing minimal equipment in central reserve to minimise future work	TA 92/03 generally advises against this idea because typically the future needs cannot be so accurately predicted. However, some schemes e.g. long viaducts, it may be beneficial where a regular need for crossovers at obvious locations exist. Need also to liaise with contingency planning teams who may be developing plans for emergency diversions.
B9	Reduce drainage blockages	i. Minimise use of combined kerb/drainage units ii. Litter traps/netting at culverts iii. Plant trees away from drainage pipes to reduce damage by roots iv. Consider the minimum acceptable size of culvert if access will be required in future.	
B10	Ease erection, placement and subsequent maintenance of temporary signs	Provide sockets to locate posts	
B11	Structures	i. Consider use of weathering steel to avoid future painting ii. Consider the use of stainless steel rebar to eliminate future corrosion / spalling	
	Type C: Use alternative techniques/technology		
	General Method	**Typical Example**	**Comment**
C1	Reduce use of hand held tools	i. Provide regular shapes to allow grass cutting by mower ii. Rebar detailing may reduce need for drilling e.g. use couplers	
C2	CCTV and other remote monitoring to reduce inspections	Bridge stress detectors using remote data logging.	
C3	Use sensors to trigger alarms	Could indicate water levels in culverts or interceptors using flashing beacons or similar linked to sensors	
C4	Reduce risk of electrocution	Increase use of solar powered signs or microprismatic signs	
C5	Reduce carriageway crossings to erect or change temporary signs	Use remotely operated signs	
	Type D: Reduce proximity of operatives to hazards		
	General Method	**Typical Example**	**Comment**
D1	Move work remote from traffic	Cabinets near highway boundary	
D2	Avoid high risk locations when siting design features	Avoid locating a phone, cabinet or sign at end of merge tapers or at narrow hard shoulders	
D3	Increase space	Increase verge and central reserve widths (including modest increase to safety fence setbacks and clearances)	

	Type E: Improve access		
	General Method	**Typical Example**	**Comment**
E1	Redesign of access	i. Hatches positioned such that operatives face oncoming traffic e.g. lighting columns ii. Deep manholes configuration of ladders such that traffic faced on entry/egress	
E2	Provide alternative routes of access	i. Use of parallel tracks rather than hard shoulder ii. Locked gates in highway boundary iii. Provide space between drainage ditches and steep slopes to allow plant access	Likely to require easements, but consider purpose built sole-use tracks within existing or modified highway boundary.
E3	Provide safer places to stop	i. Hardstandings adjacent to hardstrips or hard shoulders, particularly for frequently maintained features e.g. signal controllers at junctions ii. Small "works units" accessed via gates from public laybys iii. Drop kerbs at roundabouts plus hardstanding.	Generic advice is in TD27/05
E4	Better access to "at height" working	Walkways and ladders at structures	
E5	Improve operative or vehicular access to central reserve	Use tunnels or ramps from junction or overbridges	
E6	Reduce risk of falls from height	Relocate gantry operating equipment to ground level	
E7	Provide cut-throughs at interchanges	Small lengths of gated access road	
E8	Improve access to consumables	e.g. bearings, joints, pumps	This may include significant designed-in features e.g. to allow in-situ jacking
E9	Increase bridge headrooms	Allow painting scaffold without road/lane closure, but consider risk to operatives of over-height vehicles.	Subject to VFM (to be considered by TAA)
E10	Minimise features in central reserves and other difficult sites	i. Consider merits of superspan gantries that avoid central support ii. Consider lighting from verges iii. Avoid access chambers in hard shoulders and central reserves iv. Increase distance from feature to traffic (e.g. landscape planting)	iv. min distances are contained in DMRB Volume10 HA56
	Type F: Improve management systems		
	General Method	**Typical Example**	**Comment**
F1	Co-ordinated "mass" maintenance	Consider road closure to blitz several items at once	Requires careful handling of timing and media. May justify permanently signed (flapped) diversion routes
F2	Reduce survey needs	i. Aerial surveys may be sufficient for feasibility stages of improvements ii. Improve asset management to reduce site visits e.g. full data on safety fence types, lengths, bolts etc	

F3	Liaison designer/maintainer	Consider methods and plant available and rules of the route for maintenance	
	Type G: Provide safe and convenient diversion routes		
	General Method	**Typical Example**	**Comment**
G1	"Build in" diversion routes	i. For bypasses ensure old road remains useable for future diversion, possibly by remaining trunk. ii. For wide corridors consider use of collector distributor roads	
G2	Increase road widths	Increase width of connector roads to allow maintenance without closing OR to allow sufficient width to run traffic whilst mainline is closed.	
G3	Improved signing	i. Include symbols on traffic signs that cater for expected diversions ii. Provide permanent flapped direction signs (not dated) for known common tourist events e.g. large race meetings and flower shows	
	Type H: Provide identifiers		
	General Method	**Typical Example**	**Comment**
H1	Improve identity of features	Make finding features easier to reduce time exposure e.g. provide "asset numbers" and/or markers particularly where features (e.g. manhole covers) could be hidden in grass.	
H2	Name junctions and bridges	Eases task of keeping accurate records and identifying network defects	
H3	Provide marker posts on APTRs	Makes finding features easier, reducing time-exposure	
Type I: Traffic Management sub-Group Proposals[2]			
	General Method	**Typical Example**	**Comment**
I1	Safe pull-off areas	Make provision on roads without any existing hard shoulder or designed pull-off area	See TD 27
I2	Safer taper positions		This is aimed at identifying locations where Chapter 8 tapers may be safely installed, and deriving a TM policy around this.
I3	Site specific TM layouts		Derivation of site specific TM layouts where application of standard Chapter 8 layouts is difficult
I4	Central reserve construction	i. Harden centre reserve ii. Discourage use of Type 1 material or topsoil and seed iii. Use remote controlled signs iv. Consider access ladders from gantries to centre reserve area	Consider safe reserve within the central reserve by surfacing, access, storage or widening
I5	Wider hard shoulders	Consider wider hard shoulders to incorporate a 1.2m hatched separation strip.	

[2] See 'Design for Maintenance' Highways Agency-Maintenance Community

Type J: Anti theft/vandalism			
	General Method	**Typical Example**	**Comment**
J1	Theft	i. Use materials less attractive to thieves where theft is likely to be a problem e.g. plastic signs and doors/cabinets instead of aluminium ii. Use specific anti-theft devices e.g. shaped bolts not operable by normal spanners	
J2	Vandalism	Consider the use of anti graffiti coatings	

Annex B: Maintenance and Repair Strategy Statements

Based on CIRIA C611 'Safe access for maintenance and repair'

Maintenance Strategies

Designers should record their assumptions and requirements regarding maintenance activities via *maintenance philosophy statements*, which should then be collated into an overall *Maintenance and Repair Strategy Statement.*

The intent is not to schedule matters which are obvious and of low risk. It is to identify the key features relating to maintenance activities which:

- Must be undertaken in a particular manner,
- Do not have an obvious approach
- Are hazardous to those undertaking the work or others who may be affected by it.
- Require a disciplined approach

Designers should, in conjunction with others as required, be satisfied that a safe method exists and set this down in sufficient detail to inform those undertaking the work. This does not preclude the maintenance contractor doing it differently if, at the time, they can demonstrate a safe method of work, and have the necessary authority to make such a change.

A typical *maintenance philosophy statement* might detail:

- The anticipated tasks and their frequencies
- The assumed means of safe access to the workplace
- The TM measures required
- The assumed safe method of work
- Assumptions regarding provision and location of welfare facilities
- Any specific safety measures
- Specific risks