Safe Design and Communication
RIBA –CDM
October 2009
Stakeholder Groups consulted

‘Helping clients get better value from the construction industry and their procurement’

Consultation with various stakeholder groups including:-

Scott Brownrigg  DIOHAS
Safe Design and Communication Oct 2009
Judith Hackitt CBE (Chair of HSE Board)

“After many years of improvement in health and safety performance our rate of progress has slowed and we need to regain momentum”

“Health and Safety is being used increasingly as a synonym for unnecessary bureaucracy and an excuse for not doing things. It is time for us to regain the value of the brand for genuine health and safety –and not trivia”

“To be truly effective health and safety has to be an everyday process and an integral part of workplace culture”

“Everyone within the Health and safety system has a role but each stakeholder has to understand their role and become better at executing their responsibilities”

“To encourage strong leadership in championing the importance of, and a common sense approach to, health and safety in the workplace”
CDM challenges

…….Niels Torp……..integration of cladding and CDM design essential
Barriers to Improvements to Construction Health and Safety

Lack of knowledge by CDM-C’s and others about what “Designers” really need to know about Health & Safety

Expectations of CDM-C’s and others of Designers’ Health & Safety knowledge requirements is often excessive

Designers can only do so much with regard to Health & Safety - but how much?

How can we improve this state of affairs?
Proposed Solutions

There must be a change of attitude within the industry to accept the shortcomings of the current procedures and look to improvements suggested in CDM 2007.

We cannot keep doing the same things in the same way and expect new outcomes.

Recommendations :-

Recognition and team agreement on what are the “Significant issues” as early in a project as possible. Then concentrate on how to communicate these, as well as any other significant issues that arise.

So how can this be achieved?
The Burg al Arab Hotel, Dubai

........... partly cradle and partly rope accessed
Aims of the Designer/HSE Stakeholder Consultation

1. To highlight the "Significant Issues" that affect CDM decisions by designers on a day to day basis whilst avoiding the "trivial" or issues that should be obvious or within the remit of a competent contractor or specialist subcontractor.

2. To provide examples of "Proportionate responses" to CDM issues by designers without "unnecessary bureaucracy"

3. To highlight "what is" - The right information, to the right people, at the right time?

4. To provide examples of "Notes on Drawings" in a manner that is intelligible and proportionate to the scale and complexity of the H&S issues of the project whilst improving safety.

But what should designers really Do and Not Do!
What do designers really have to do?

HSE’s – Do’s and Don’ts for Designers
There are a lot of misconceptions about CDM:-

CDM does NOT require :-
- designers to stifle their creativity, limit their design freedom or place safety above aesthetics;
- the elimination of attractive features such as atria;
- designers to choose “the safest form of construction”
- designers to have a detailed knowledge of the construction process, or to specify standard construction processes or precautionary measures to the contractor;
- designers to take into account unforeseeable hazards;
- designers to exercise any health and safety management functions over contractors or sub-contract designers (who often have designer duties themselves)

CDM does place certain specific duties directly on designers:
- to eliminate hazards where feasible
- to reduce risks from those hazards that cannot be eliminated
- to provide information on residual risks if they are significant

And in order to discharge these duties a competent designer will need some knowledge and experience of the construction process. For instance:
- to know what the potential hazards will be during the construction, maintenance, cleaning and dismantling of your design.
- to satisfy themselves that there is at least one safe way of constructing their design. (Your client doesn’t want a design that can’t be built or can only be built at disproportionate expense!)
Even such futuristic designs as Zaha Hadid’s can embrace CDM.................!!!!
What are significant & what are trivial risks? CDM 2007 ACOP

SIGNIFICANT RISKS
Project Specific
Not obvious to those who use the design
Not necessarily involving the greatest risks but those including health and safety risks that are:-
Not likely to be obvious to a competent contractor or other designers
Unusual
Likely to be difficult to manage
Information should be brief, clear, precise and in a form suitable for other users.
This can be achieved by :-
Notes on Drawings
Written information provided with the design
Suggested construction sequences

TRIVIAL RISKS – are ordinary Health and Safety design issues or other normal construction risks obvious to a competent contractor

So how can this be done?
**Designer Guidance – Design Risk Assessment Documentation**

**The Problem / Challenge**
In accordance with the CDM Regulations it is preferred to include all significant risk analysis on drawings rather than on written or numerical Design Hazard and Risk Assessment documents. This is to encourage visual analysis and recording of significant construction, maintenance, and demolition issues without unnecessary bureaucracy.

**The risks**
Significant hazards and risks can be hidden in the bureaucracy of a project causing them to be overlooked during design, pricing, construction and maintenance stages of a project.

**The solution**
Project drawings to be annotated in simple graphic manner with key to further detail or references. More complex projects may need special CDM drawings. Hand annotation for design stage issues can suffice.

**The benefits**
All relevant risk information is collated in one place with all the associated complexity visually apparent to all participants in the risk reduction process.

**Key Points**
Designer friendly technique ensures all significant and unusual or specific hidden issues are not missed even during design changes. Important not to confuse drawings with “trivial” or “obvious” risk information which a competent contractor is expected to understand.
Team Guidance – Haskell’s- “Designing for safety” programme

The Problem / Challenge
Traditionally architects were encouraged to stay away from construction safety issues due to potential liability claims. These embedded attitudes need to change.

The risks
This claim conscious attitude inhibits good integration of design and construction safety and potentially causes accidents instead of avoiding them.

The solution
Haskell Design Build (US) are responsible for design and construction and their motto is “one company, one responsibility”. They have corporate liability coverage for all their architects and construction professionals. They use collaborative design-build delivery including a safety alert system using only 8 types of warning symbols on drawings to flag potential hazards.

The benefits
Safety symbols are placed where the hazard is on a drawing, i.e. not in other risk analysis documents or in the margins.

Key Points
Symbols are explained in the margins and in contract documents. Subcontractors are advised that this does not relieve them of their own safety responsibilities.

www.thehaskellco.com

The Problem / Challenge
Providing graphic significant risk data at the point of use on drawings for designers and contractors with an explanatory key if necessary depending upon complexity.

The risks
Designers and supervising/pricing contractors missing the significant risk issues whilst developing designs or cost plans and procurement

The solution
Use of an optimal number of standard industry wide symbols with explanatory key if required

The benefits
Risks are pinpointed on the actual drawn plans rather than lost in the margins or other documents. This prevents the likelihood of risks being missed at key design stages by the entire design and client team and during workshop sessions

Key Points
Discretion of designer and CDM-C needed to decide the significance, amount and complexity of risk information presented

Scott Brownrigg DIOHAS
Safe Design and Communication Oct 2009
Designer Guidance – Symbols and SHE Boxes for Design Drawings

The Problem / Challenge
How to put hazard and risk data on drawings that are relevant to other designers and other relevant construction stakeholders

The risks
Designers could be other team members even of the same discipline and need to see the hazards graphically on drawings, perhaps cross referenced to SHE boxes, so the significant issues are clearly obvious, otherwise they can be missed during the design development process.

The solution
SHE box/key cross referenced with symbols on the drawing eg.

The benefits
Design team and contractor’s supervising and pricing team are aware of the significant issues

Key Points
Avoidance of reference to non-significant, trade or competent contractor risk information is essential to prevent over complication of drawings. Caveats are included to confirm that contractors still have their own responsibilities.

Typical SHE box as used by Olympic Delivery Authority:-

<table>
<thead>
<tr>
<th>SAFETY HEALTH AND ENVIRONMENTAL INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE-WIDE AND GENERAL RISKS</td>
</tr>
<tr>
<td>For details, to be read in conjunction with these notes, see Drg No: ………………………………………………………</td>
</tr>
<tr>
<td>CONSTRUCTION RISKS</td>
</tr>
<tr>
<td>i. Asbestos in existing ceiling void</td>
</tr>
<tr>
<td>ii. Temporary stability of trusses during erection, see design assumptions in document ABC/001</td>
</tr>
<tr>
<td>CLEANING AND MAINTENANCE RISKS</td>
</tr>
<tr>
<td>For information relating to this see the H&amp;S File and drawing nos.</td>
</tr>
<tr>
<td>DISMANTLING / DEMOLITION RISKS (Future)</td>
</tr>
<tr>
<td>i. Cantilevered beams and suspended staircases, see Structural drawing nos.</td>
</tr>
<tr>
<td>ii. Concealed cable runs under main beam A1/A2, see drg XYZ/1234</td>
</tr>
</tbody>
</table>

The design team have highlighted unusual and significant risks only that may not be obvious to a competent contractor. They are to assist with risk reduction only and are not necessarily comprehensive. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement.
Contractor Guidance – Site Drawing Safety Symbols & Signage

The Problem / Challenge
Developing designer drawings to a level of suitability for site operative risk identification. The design team cannot possibly know the contractor’s preferred method of construction or interface issues unless a Design and Build project. Time wasting & abortive risk analysis is to be avoided.

The risks
Too much un-helpful information can be put on drawings by designers which are of no benefit to anyone and diminish the risk reduction process.

The solution
After prices, contracts and construction methodologies are agreed the design stage drawings can be augmented by the contractors team. These can be CAD or simple sticker annotation of drawings and displayed in site huts and at the workface.

The benefits
All operatives irrespective of nationality and education should be able to decipher the relevant information at point of use.

Key Points
Contractors team may include a designer to update the drawings or just use their own safety team resources. Not needed for architectural design drawings. Some possible symbols shown, but others exist.
Contractor Guidance – Workface- Supply Chain Component Signage

The Problem / Challenge
The delivery of relevant site safety information to site operatives at the workface - Trojan Horse Messaging

The risks
The absence of such information can lead to deaths and injuries that are relatively easy to avoid

The solution
Using links with trade associations, component manufacturers and suppliers to provide visually explicit safety information suitable for everyone including foreign workers and other operatives with reading difficulties.

The benefits
Safety information about lifting, handling and fixing provided by the “experts” ie. the people who design and produce the actual components.

Key Points
Trojan Horse messages are eye-catching cartoons which communicate health and safety information to construction site operatives at point of use, i.e. on the actual material or equipment being used. No need for architectural design drawings.

Scott Brownrigg  DIOHAS
Safe Design and Communication Oct 2009
Construction Guidance – The Silent Book

The Problem / Challenge
The provision of health and safety information in a simple, non-verbal format.

The Risks
Misunderstanding by the intended operatives

The solution
NCC formed a working group to develop their own information materials for workers. The group decided to develop a picture book presenting different hazardous work situations - the Silent Book - containing pictures of what not to do and what to do.

The benefits
NCC has received positive staff feedback about the Silent Book. Employees report that it is fun to browse through and that its use stimulates interesting discussions about hazardous work processes and prevention.

Key Points
The Silent Book forms part of NCC’s overall and comprehensive occupational safety and health management system. It is just one part of their activities to train and inform about health and safety, and to motivate and promote good health and safety performance. The Silent Book is an excellent way of providing information to everyone, including those that do not speak the language of the country they live in, and for anyone who cannot read with confidence.

www.ncc.se
Detailed Design - Significant Risks “only” Identified with Symbols

The Problem / Challenge
Producing clear visual information that conveys simple messages to all parties about risk.
Highlighting significant residual risks outside competent contractors’ expectations or of otherwise hidden risks.

The risks
Important information about risk can be easily buried in other project paperwork
Need to allow sufficient time for safety planning.

The solution
Simple identification on the relevant project drawings that can be used at pricing and construction stages.
Standardised set of symbols used to represent common hazards. These can be supplemented by text boxes with further clarification if required.
Symbols could also be used to identify key safety issues for construction workers on site irrespective of language or reading ability.

The benefits
Simple drawing annotation techniques showing key safety issues economically, with minimal bureaucracy

Key Points
Communicate with other designers to agree common significant design safety issues. Provide information that meets all intended purposes on one drawing.
Try to avoid a separate set of H&S drawings but the principal is to make the risk information accessible.

Scott Brownrigg  DIOHAS
Safe Design and Communication Oct 2009
Site Hazard Analysis to facilitate Initial Design & Construction Phase Decisions

**The Problem / Challenge**
To find the best building location on the site, from the site analysis, and the optimum footprint, orientation, size, scale, geometry and sculptural form?

**The risks**
Hazardous local gas installations, railway structures, tracks, viaducts, roads, etc. below ground services, tunnels and foundations, retained structures etc.

**The solution**
Drawings were produced that show proximity to the gasholders and railway viaduct. Shows how close structure, temporary works, scaffolding, hoardings, welfare facilities, etc. can be built to the railway.

**The benefits**
Safe theoretical maximum building envelope was agreed early together with safe site set up principles avoiding later costs and changes eg. Roads, access etc.

**Key Points**
All such hazards require analysis before the footprint and form of the intended structure can be finalised. The Client should provide survey information to clarify all such site issues but analysis drawings needed especially if scheme revised at later stages.

Scott Brownrigg  DIOHAS
Safe Design and Communication Oct 2009
Site Analysis – Underground Services for Initial Design and Construction Phase

The Problem / Challenge
The identification and location of existing underground services prior to the positioning of future structures on site to minimise the need for excavations.

The risks
Electrical services and gas supplies are potentially highly hazardous with the ability to cause death and injury if accidentally struck during the construction phase, and all excavations pose potential risks.

The solution
Designer clearly identified hazardous underground services on the drawings and showed other services such as water, fibre optics and drainage

The benefits
The sub-scan survey costs were significantly outweighed by the benefit of avoiding delays, diversions or bridging. Site safety is enhanced and costs reduced through the elimination of earthworks.

Key Points
Take account of existing and new services when considering the design footprint on the site.
Ask Clients early for adequate survey information.
Service diversions can be planned by the contractor to avoid programme delays.
A competent contractor needs the right information to properly manage the risks on site.
Provide drawings early.
The Problem / Challenge
To avoid exposure to free asbestos fibres of designers (on site visits) surveyors, site operatives, visitors, neighbours, and users by designer intervention.

The risks
Risks of asbestosis or mesothelioma due to inhalation of fibres released during construction activities. This is often due to inadequately detailed surveys and lack of understanding of how to interpret the Asbestos Report.

The solution
Client to instruct appropriate survey analysis of building and site and provision of accurate asbestos survey drawings and report to design team. Key issues are locations of asbestos containing materials (ACM’s) and areas inaccessible to survey which must be assumed to contain asbestos, to be highlighted on drawings. Designer to advise client to remove asbestos but if too expensive or impracticable the designer must avoid it by designing around the areas concerned or by encapsulating the ACM’s and recording its residual presence on site in the H&S Plan and on record drawings.

The benefits
Reduction in likelihood of asbestos exposure before, during and after, and in future construction works.

Key Points
Liaison and communication between client, design team and contractor by interpretation of long reports.
Paying for the appropriate type of survey early in project.
Detail Design - highlighting residual construction risks in the design

The Problem / Challenge
Highlighting significant residual risks hidden or outside of competent contractors’ normal experience.

The risks
If these risks are not identified pre-tender it is possible that the contractor will under-estimate the cost and details of the temporary works solution for safe construction.

The solution
Simple drawing and survey annotation techniques showing existing features, new proposals and possible temporary works solution with commonly recognised symbols.

The benefits
Simple identification on project drawings or surveys that can be used at pricing stages. These can also identify key issues for construction workers on site irrespective of language and educational difficulties.

Key Points
Identification only required with symbols and simple annotation. No need for detailed explanations which can be added to risk register or hazard elimination list if required.

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Safe Design and Communication Oct 2009
Tender / Contract Stage Design – Temporary Fall Protection Issues

The Problem / Challenge
To alert the contractor’s temporary works designers to unprotected slab and roof edges where the designer could insert temporary protection works aides instead of a traditional perimeter scaffolding system.

The risks
Falls from height during construction rather than during future maintenance.

The solution
Designers to highlight typical roof edges and slab edges which need to be considered by contractors whilst pricing for temporary works. Project drawings can be used for site risk identification to all contracting staff irrespective of language and ability to understand drawings.

The benefits
Enables contractor to identify key safety issues that he needs to respond to by traditional methods eg. full scaffolding. Or by means of proprietary edge guarding methods to which designers can contribute eg. sockets in slabs, fixing points in steel, etc.

Key Points
Avoidance of unnecessary bureaucracy and utilisation of contractor’s advice at the appropriate stage of the project

Scott Brownrigg DIOHAS
Safe Design and Communication Oct 2009
The Problem / Challenge
Roof-lights and fragile roofing materials are economic, sustainable and aesthetically desirable features which should not be eliminated from design projects purely for reasons of safety.

The risks
Falls through fragile roofing materials are statistically high and often highly injurious or fatal

The solution
Construction Phase - Important to identify existing and new fragile rooflights and other fragile roofing materials on drawings as a method of informing the contractor to control the risk of falls through these materials during construction. Contractors to recommend methods of temporary protection in tender or construction phase plan proposals to show their response.

In-use - Additional protection measures are required for the longer term in use condition such as metal railings, barriers, wire mesh or non-fragile walk on type rooflights. Avoid in-plane roof-lights or sheeting.

The benefits
Natural daylighting is a human right and engenders healthy and sustainable environments

Key Points
Walk-on rooflights tend to be very expensive so control mitigation measures are necessary. Safe Cleaning methods also need to be considered.
Scheme Design - Plant and Personnel Roof Plant Access Drawings

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Detail Design - Plant and Personnel Roof Access Zonal Details

Fragile roof light residual risk

Danger Risk of falling
Construction Stage - Plant and Personnel Roof Access Details

Fragile roof light residual risk

Scott Brownrigg DIOHAS
Safe Design and Communication Oct 2009
Summary

- Designers significant CDM risk responsibilities need to be clarified and trivia ignored.
- The project significant risks need to be agreed early and allocated to each discipline.
- The designers need to highlight the significant hazards and risks only on their drawings.
- Simple non-text symbols to be used where possible for visual, educational and linguistic clarity.
- Contractors to augment the Designers drawings with specific site safety information symbols.
- Trade associations and specialist suppliers and subcontractors to highlight their own risks.

As Judith Hackett says:-

“From now on, if we all work together with a clear vision and purpose we can recommence improvement and bring about a change for the better”
Safe Design and Communication
Best Practice Case Studies
October 2009
Detailed Design Guidance – Riser Ducts

**The Problem / Challenge**
Maintaining the safety of floor openings before installation of service risers. The programme usually requires the installation of services after the riser holes formed.

**The risks**
This can lead to openings in the floor that the contractor has to manage, creating a potential fall risk or trip hazard.

**The solution**
Alert the contractor to the issues at tender on drawings. By keeping risers adjacent to walls they can be easier to protect. Co-ordination between M & E designers and structural designers can enable the size of riser openings to be reduced. Sleeves or ducts can be cast in ready for services. Alternatively, it may be possible to cast mesh into the floor. The contractor to agree the preferred solution.

**The benefits**
Significantly reduce the reliance on scaffolding or coverings that can be easily moved. Reduce the likelihood of accidents on site.

**Key Points**
Talk to other designers, involve M & E designers as early as possible to minimize risks and size of riser openings. Consider casting in sleeves or mesh to eliminate fall risks. Consider pre-assembly of services, reducing work at height. This is a “competent contractor” issue to manage but the design team can assist to prevent accidents.
Detailed Design Stage – Heavy Element Handling eg. Glass Screens

The Problem / Challenge
To install heavy glass screens that are specifically required by the designer and client and need to be brought into the building and located by other than manual handling methods.

The risks
If these heavy elements are not identified or eliminated early the installation methods may not be adequately planned or costed. Higher risk manual handling may occur. Alternatively expensive additional hoisting methods may have to be added to the contract costs at a late stage.

The solution
The team investigated the feasibility of substituting lighter materials, for instance smaller components that can be demounted and re-assembled on site.

This was not acceptable to the client.

The position of the heavy elements was identified at tender stage and their access route indicating vertical and horizontal transportation routes and methods.

The benefits
This allowed the contractor, client and designer to recognise and react to the key heavy lifting issues. Mechanical aides used to transport the screens.

Key Points
Consider substitution for lighter or smaller elements.

Use drawings to identify areas where heavy components are located by simple symbols.

Look carefully at component access routes.

Consult contractor or specialist lifting and equipment contractors and request proposals at tender.

Think about future replacement access.
Detailed Design – Heavy Masonry Units

The Problem / Challenge
To eliminate musculo-skeletal injuries in the construction industry as a result of repetitive handling of heavy masonry units requiring a fundamental major change in attitudes throughout the industry.

The risks
Lifelong injuries to operatives and loss of skilled workforce.

The solution for designers
NBS Specification Clause 13.2 Design
Apart from general construction hazards, such as working from scaffolding, the main risks associated with brick/ block walling are: • Manual handling:
The Construction Industry Advisory Committee (CONIAC) has concluded that there is a high risk of injury in the singlehanded, repetitive manual lifting of building blocks heavier than 20 kg, and this should be taken into account before specifying heavy units. For detailed CONIAC guidance see HSE Construction sheet number 37.

The solution for contractors
Change in traditional manhandling attitudes to use mechanical aides or less heavy units whilst being competitive in the marketplace.

The benefits
Retaining a skilled workforce long term by showing respect for their health and welfare

Key Points
Increased plant-hire costs can be off-set by faster construction periods but can only be introduced by industry-wide change in attitude to create an even playing field for all.
HSE Designer Guidance – Plasterboard – Musculoskeletal Injuries

The Problem / Challenge
Lack of information about board weights for operatives.
Wide range – from jobbing builders to specialist drylining contractors but mainly sub-contract site operatives injured.
Sites driven by cost – not by considerations of Health and Safety – speed rules! Board handling is part of the project delivery, and to be considered by all stakeholders.

The risks
Operatives are taking excessive risks lifting boards. Operatives treat musculoskeletal injury as a risk that you take and can’t be avoided. Musculoskeletal damage is occurring without being identified. Operatives have a shortened working life.

The solution
Boards to have heavy lifting symbols attached. Progress through working together to find approaches that work. The designer can encourage good working practices and mechanical moving and lifting aides, hoists, goods lifts, in drawings, specifications, and red, amber, green lists, etc.

The benefits
Better plasterboard installations with more motivated operatives, and increased productivity.
Longer working life of operatives and skills retention.
Reduces risk to companies against future injury claims.

Key Points
Work with the stakeholders to jointly develop an approach to reduce the risk of musculoskeletal injury.
Safeguard the health of individuals working with boards by mechanical aides or good lifting practices.
HSE Case Study – Prefabrication and Off-Site Manufacture

The Problem / Challenge
Identification of construction issues involving working at height in difficult climatic or exposed or dangerous conditions to encourage safer working.

The risks
Falls from height and injuries or ill-health due to working in the above conditions.

The solution
Early identification of the issues to the client and contractor to encourage off-site working where possible. Analysis of the access and cranage capabilities of the site are essential to validate the decisions and locations of large modules.

The benefits
Prefabrication reduces work at height and on cold wet sites allowing off-site fabrication in factory conditions but it increases hazardous heavy lifting, access and transportation issues. Prefabrication can be advantageous to CDM but is not always the answer.

Key Points
Review the buildability and access issues with contractor as early as possible. Cost benefits may be possible as well as safety benefits.
HSE Case Study – Small Property Developers- Project Safety Issues

The Problem / Challenge
Small and medium sized contractors to be encouraged to use safe temporary works systems of scaffolding, shoring and propping and construction methods which do not injure operatives.

The risks
Falls from height, structural collapse during construction and personal injuries to operatives due to poor constructional techniques.

The solution
Designers and developer clients to encourage the use of recognised safe constructional practices and procedures whilst also maintaining economic and competitive costings, by use of appropriate or traditional construction techniques for the job. Simplicity of designs, drawings and specifications to be reflected in the simplicity of the constructional processes, highlighting unusual designs, hazards and risks only. Selection of contractors competent for specific projects and tasks is essential.

The benefits
Projects should be constructed quicker and more precisely with appropriate methods and materials. This will improve cost benefits by shorter programmes, less defects and more satisfied customers.

Key Points
Avoid complex unusual designs and constructional techniques without specialist advice.
HSE Designer Guidance – Slips and Trips Avoidance Strategy

**The Problem / Challenge**
Clients and designers like prestigious “shiny” entrance hall floors but many accidents happen as a result of slippery floors whether due to wetness or to these highly polished finishes.

**The risks**
Potentially severe injuries to all users especially in wet weather conditions

**The solution**
Select suitably slip resistant materials and finishes to give compromise of visual finish with slip performance requirements. Management solutions such as mopping and warning signage can further minimise the risk. Provide suitable mat-wells.

**The benefits**
Impressive entrance halls and other areas can still be designed but are safer to use

**Key Points**
Drawings can be annotated early until a suitable finish is found.
Slip resistance values of materials to be checked or tested prior to specification. See HSE Slip assessment tool at sat@hsl.gov.uk

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**Management response**

The pendulum test – with water spray  
Surface roughness meter
Working at Height - Single largest cause of construction accidents - WAH Regulations 2005 (Amended)

Requires designers to......

- avoid WAH where they can
  (impossible in most buildings)

- prevent falls where they cannot avoid WAH
  (we can only assist contractors and users)

where they cannot eliminate falls......minimise the consequences

- How can designers do this?
Initial Design Stage – Early CDM Design Decisions of Mass and Form

**The Problem / Challenge**
Identification of the **key CDM design issues** to consider at the concept stage?

**The risks**
Constructing, maintaining and cleaning the building’s structure and exterior safely. Other detailed CDM issues may be explored at later design stages.

**The solution**
Identify significant CDM Issues affecting the design:
1. What is the Cleaning and Maintenance Strategy of the envelope and any large internal voids such as high spaces, atria or courtyards?
2. Can it be built with reasonably practicable, known or specialist constructional techniques?

**The benefits**
Early consideration of key CDM issues can simplify safety and set the tone for the entire project. Increased costs and project delays may be avoided.

**Key Points**
Liaise with the client and CDM-C in reaching these early decisions.
There are clear advantages to involving a contractor, CDM-C or a CDM experienced designer at the concept stage.
- Early consideration of fundamental safety issues and buildability may avoid wasted effort at later stages
The Problem / Challenge
Cleaning and maintaining glazing to elevations at high level in a safe manner

The risks
Falls from height due to unsuitable systems or inappropriately designed building fabric.
Systems of work that require high levels of supervision for their effectiveness are susceptible to human error.
Falling objects can endanger people

The solution
Early consideration of cleaning options should be made in relation to building form, scale and site constraints.
Careful selection of engineered mechanical systems is needed to ensure that the required cleaning and maintenance tasks can be undertaken.

The benefits
Economic and safe maintenance systems appropriate to the scale, form and type of building.
Provide the client with long-term maintenance strategy and budgetary considerations.
Provide a safe working platform in line with the Work at Height Regulations hierarchy.

Key Points
Review relevant viable options for mechanical systems at an early stage. Mechanically assisted work placement systems require early discussion with specialists. Non-manned robotic systems eliminate work at height but can limit design solutions. Mechanical systems are best suited to large areas with little geometrical complexity. Any access from the ground, including cherry pickers and MEWPs require stable hardstanding and influences landscaping.
Initial Design Stage - Envelope Maintenance Systems - Manually based

The Problem / Challenge
Cleaning glazing to elevations at high level and in difficult locations

The risks
Falls from height due to inappropriate work systems, poorly designed fabric or operative error.

The solution
Early design consideration of cleaning options. Relatively low technology and low cost techniques to be considered, more reliant on manual efforts than mechanical assistance. Ladders, opening windows, long water-fed pole, reach and wash and roped access systems all rely on trained operators and good management control systems for their safety. All are inherently safe in the appropriate situations and when implemented correctly. Limitations of use to be fully understood.

The benefits
Allows economies of scale to be proportionately applied to all building types. Enables quicker and immediate response to cleaning demands. Roped access allows work positioning to difficult undercuts and geometrically intricate areas.

Key Points
Careful consideration of all relevant associated legislation is necessary especially the Working at Height Regulations to determine the most appropriate system or combination of systems for each building design. Large, flat and high elevations are less suited to these systems.
Initial Design – Visually acceptable Roof Edge Protection

The Problem / Challenge
To provide collective roof edge protection all around the new building where regular access to roof plant is required. Visual roof edge details were important to the design team and planners.

The risks
Falls from height by maintenance operatives during roof and plant maintenance operations.

The solution
A built-in 950mm parapet upstand design with integral sun shading brise-soleil feature.

The benefits
No need to assess frequency of access to roof areas.
Edge protection system does not require harness training or rescue arrangements.
No perimeter handrail due to integral parapet.
No need for additional edge guarding

Key Points
Permanent edge protection provides an optimum safety solution and is at the top of the work at height hierarchy.
Co-operation of client and project team required to avoid being “value engineered” out.

Visually hidden edge guarding integrated into cladding

950mm high guarding
View of roof upstand

Scott Brownrigg DIOHAS
Safe Design and Communication Oct 2009
Initial Design - Roof Access - Permanent Fall Prevention Methods

The Problem / Challenge

Roof access fall prevention methods proportionate to the frequency of access requirements for maintenance activities whilst considering the aesthetic and cost considerations.

The risks

Falls from height by plant maintenance operatives or roof workers. Access is unlikely to be entirely eliminated on any roof due to inspections, clearance of rainwater outlets, etc.

The solution

Collective protection measures should be selected in preference to other methods of protection, especially in areas requiring plant maintenance on a frequent basis.

Where other factors prevent the addition of roof edge parapets, balustrading or railings, mansafe type fall restraint systems may be appropriate, set back from roof perimeters.

Fall arrest methods using mansafe systems are the least acceptable option and are only workable if fall recovery and rescue systems are in place. Consider adequate means of safe access to roof level for operatives with tools and kit.

The benefits

Facilities managers, maintenance operatives and inspection staff can make low frequency visits eg. for rainwater outlet clearance if properly planned measures are in place.

Key Points

Early decisions must be made at Initial Design stages considering frequency of access in various roof zones.

Detail of the roof access design may require further development at later stages as plant areas grow.
The Problem / Challenge
The existing globe at the top of the tower of the Coliseum Opera House was no longer illuminated and needed refurbishment. The building is Grade 2* listed so replication of original features was essential.

The risks
Falls from height during refurbishment and future maintenance of the 240 lamps.

The solution
Regular man access was rejected on safety and economic grounds.
A fibre optic design was selected with projectors at lower accessible levels of the tower.
The tower was fully scaffolded during refurbishment, and can be scaffolded for periodic maintenance and cleaning.

The benefits
Risks associated with access to the globe were eliminated. The fibre optic solution allows client an economic method to maintain full lighting to the globe sky sign without risks to maintenance personnel

Key Points
Consultation between the client / FM team and the design and contractor team allowed early decisions to be made. (The early involvement of the client allowed for the increased costs of fibre optics to be accommodated.) Survey drawings were annotated to analyse the risks and communicate the solutions.
The Problem / Challenge
Access to the new glass barrel vaulted roof for cleaning and maintenance purposes. The roof is above refurbished foyers and is designed to recreate the original design.

The risks
Working at height and over fragile glass above high internal and external drops.

The solution
A Building Maintenance Unit (BMU) with an 11metre jib and one man cradle. Planning constraints influenced rejection of other options, eliminating the use of a travelling curved gantry that would be visible at all times from street level. Increased structural works were required to support and conceal the BMU behind the tower at roof level.

The benefits
Both visual and safety priorities were met with some increased complexity and cost. Client has the benefit of increased accessibility provided by a bespoke system

Key Points
The client, the facilities managers and specialist suppliers of cleaning systems were consulted early on. The final solution for this project took account of safety, historic constraints and aesthetic considerations.
Detailed Design – Access to Tower Lighting - Coliseum

The Problem / Challenge
Existing historic freestanding light fittings to be refurbished and replace those missing. These are located on unguarded parapets to the tower and façade. The light fittings vary between 2.5m and 3.5m and cannot be safely reached unaided.

The risks
Falls from unguarded parapets during maintenance access.

The solution
Powered access equipment, and scaffolding were discounted after careful assessment as unsuitable.
A roped access system, allowing safe work positioning and fall restraint, agreed after detailed client, design team negotiations and specialist consultations.
Rope attachment anchors were built into the structural steel and terracotta cladding by design team integration.
Long life lamps were chosen to minimise the frequency of access.

The benefits
Provides safe and economic lamp replacement at short notice using trained theatre maintenance staff.

Key Points
Lighting design drawings were annotated to communicate the risks and solutions to entire team.
The annotated drawings were used by the construction team as the basis of the construction details.
Initial Design – Fragile Domed Roof-light- London Coliseum

The Problem / Challenge
To refurbish the existing stained glass fragile domed rooflight to prevent water ingress and allowing backlit illumination.

The risks
Falls from height during the construction. Falls of people or objects during the maintenance and cleaning of the stained glass panels.

The solution
A glass fibre outer dome was installed by crane for weatherproofing. The inner glass domed roof-light was repaired from a birdcage scaffold within the auditorium. Maintenance walkway installed between the two domes with a high level fall restraint cable fixed to the outer dome. Access to the upper curved areas of glass is via a curved ladder gantry with a slidelock harness attachment. Easily accessed light fittings fitted at low walkway level reflect off the underside of the outer dome to illuminate the rooflight.

The benefits
The client has been able to reinstate a spectacular roof-light feature whilst overcoming the weatherproofing and significant maintenance safety challenges.

Key Points
Specialist design subcontractors consulted early. Communication with the Client and FM team essential in agreeing strategy and budget at early stage by annotation of drawings. A combination of fall prevention methods were carefully selected, each justified in respect of the hierarchy of control measures.
Initial Design- Roped Access- To unusual structures

The Problem / Challenge
Design of landmark or unusual feature structures requiring difficult cleaning and maintenance access to windows and light features and for painting or inspection activities.

The risks
Prevention of falls by methods that respect the Working at Height Regulations hierarchy but provide the necessary and reasonable access requirements whilst facilitating the aesthetic and safety aspirations of the design.

The solution
A roped access work positioning system in accordance with HSE and specialist IRATA installation and operating procedures.

The benefits
Spectacular and essential structures can be designed with the incorporation of safe access enabling features and management systems.

Key Points
Early design team and client agreement that design expectations exceed the more common working at height prioritisation strategy.
Specialist roped access installation advice to inform the integration of rope attachment fittings and features.
Best Practice Case Study – Spinnaker Tower

The Problem / Challenge
Construction and maintenance of an iconic and unusual structure

The risks
Falls from height during future maintenance operations including aircraft light replacement access, observation deck external window cleaning and painting of metal surfaces

The solution
International Rope Access Trade Association member companies IRATA, employed by client to ensure the safe design of attachment points and methodology of access, and their effect upon the structure during design stages. Long life lamps and paints used to minimise access.

The benefits
The structure does not have to be modified for traditional access techniques higher up the hierarchy of working at height regulations.

Key Points
Early recognition of safety issues and consultation with specialists to prevent sub-contractor design at a later stage. The early client appointment of a specialist to assist with the design of the unusual structure requires special coordination of architectural, structural and specialist design skills, and early client funding.
HSE Case Study – Initial Design- Residential Façade Access System

The Problem / Challenge
Landlord controlled window cleaning access to high value flats with balconies to main elevations. Impractical to use a suspended access cradle due to the need to climb out of cradles and over balconies. Access via flats not acceptable to tenants for security reasons. Access from common parts not possible, and balconies not continuous for security reasons.

The risks
Falls from height during window cleaning operations

The solution
Roped access solution for operatives to access each balcony area from which safe cleaning operations can take place.

The benefits
Landlord can ensure all windows cleaned at regular intervals. Operatives clean most windows from safe balconies.

Key Points
IRATA registered company consulted on rope attachment design and details. IRATA trained rope access operatives employed to ensure safe systems of working. Highly specific project details justified a roped access solution, which would need to be equally justified if proposed on other projects.
Scheme and Detailed Design– Fragile Roof-lights- Wigmore Hall

The Problem / Challenge
To refurbish and modify existing fragile roof-lights in a listed concert hall building whilst enhancing the accessibility for cleaning and lighting maintenance access, with no appreciable affect on the hall acoustics or aesthetics.

The risks
Falls from height during construction and maintenance operations.

The solution
The hall was fully “birdcage” scaffolded during construction. This allowed removal of existing cramped crawl-ways and the installation of a new lightweight central spine walkway. This facilitated access to the lights for performances and general hall lighting within the roof space.

The benefits
Significant improvements in accessibility and safety of maintenance operatives
Retention and upgrading of an historic and fragile roof-light feature.

Key Points
Early analysis of the structural limitations of the roof truss and walls. Access requirements for A/C services and lighting requirements understood through discussions with users and consultants.
Buildability issues raised at the beginning of the project through specialist consultation.
**Initial Design – Maintenance Access to Unusual Roofs - Dubai Metro**

**The Problem / Challenge**
To establish an appropriate means of roof surface and glazing cleaning on 40 overground station roofs of iconic structural form in the hot Middle Eastern climate of Dubai.

**The risks**
Falls from height and heat exposure on curved metal roofs and glazed elevations above operational railway and busy 6-lane motorway adjacent.

**The solution**
Variety of roof access options analysed including BMU's, cherry pickers and roped access, with possible use of roof cleaning sprinkler system. All discounted on grounds of impracticability and safety to operatives and road users. Design team and client agreed solution was a purpose designed robotic system.

**The benefits**
Man access to roofs eliminated for general maintenance purposes.

**Key Points**
Details of sun-shading devices critical to allow passage of robot. Roof apex robot attachment system, water supply and mansafe fall restraint harness system to be developed in detailed design with specialist subcontractors.

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Scott Brownrigg  DIOHAS
Safe Design and Communication Oct 2009
HSE Designer Guidance – Unusual Construction Sequences

The Problem / Challenge
Intelligibility of unusual construction sequences

The risks
Collapse during construction due to asymmetric loading and unbalanced cantilevers

The solution
Graphic presentation of the proposed sequence for contractors to understand the structural and constructional design intentions.

The benefits
Information sharing with the construction team at early stages of the project

Key Points
Simple 3-D drawings overlaid in an animated powerpoint, showing the site constraints and proposed significant sequences
**HSE Designer Guidance – Demolition of unusual structures only**

**The Problem / Challenge**
What **demolition information** is required in the **Health and safety file** for future demolition purposes?

Unusual and hidden residual risks such as suspended and cantilevered features, post-tensioned and pre-stressed elements, etc.

**The risks**
Unusual or hidden structural or services related elements can be accidentally damaged or incorrectly cut during future refurbishment or demolition works causing **catastrophic collapse** of the entire or large parts of the structure.

**The solution**
Indicate on drawings where **these issues are hidden** so future designers and contractors can plan appropriately for temporary support or safe demolition.

**The benefits**
Reduced risk of collapse and injuries

**Key Points**
Identify **significant issues only**.

No need to indicate obvious and normal structural and constructional issues which are easily identified by future competent designers and contractors.

Too much irrelevant information will hide the real issues.

Indicate on graphic information where possible.
THANK YOU

QUESTION TIME