

D⁴h – Influences on Designing for Health

K.A.Horne (1) A.G.F. Gibb (2) T.C. Pavitt (3) R.A. Haslam (4)

(1) K.A.Horne@lboro.ac.uk

(2) A.G.Gibb@lboro.ac.uk

(3) T.C.Pavitt@lboro.ac.uk

ApaChE, Department of Civil and Building Engineering, Loughborough University,
Sir Frank Gibb Annex, Loughborough, Leicestershire, LE11 3TU

(4) R.A.Haslam@lboro.ac.uk

Health and Safety Ergonomics Unit, Department of Human Sciences, Loughborough
University, Loughborough, Leicestershire, LE11 3TU

Abstract

D⁴h is a two-year UK Government-funded research project developing a strategy for best practice in designing construction projects to account for the occupational health of construction workers. For many years, health has been the 'poor relative' of safety in 'health and safety' considerations. This is an important issue where little in-depth work exists although it is rapidly becoming a key issue for many European countries. The European Temporary and Mobile Construction Sites Directive, leading to CDM in the UK, has stimulated a change in design culture in many states with designers being expected to explicitly acknowledge health and safety in their designs and seek to reduce or remove risk to construction workers.

However, all the concentration so far has been on safety, to the exclusion of occupational health, except for issues surrounding hazardous substances. This paper presents the preliminary findings from the first phase of the D⁴h project, namely semi-structured interviews of experienced design practitioners and managers regarding design phase provision for occupational health of construction workers. The intention of this paper will be to raise the principal issues regarding design influences and provide a platform for further debate.

Keywords: European TMCS Directive, CDM, Healthy Design, Risk Assessment

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1 Introduction

The Construction (Design and Management) Regulations (CDM) was introduced in the UK in March 1995, derived from the European Directive on Temporary and Mobile Construction Sites (92/57/EEC). This directive has been dealt with at length in as can be seen in the CIB conference proceedings, Safety Co-ordination and Quality in Construction (1999), which contains reports from throughout Europe on implementation of the Directive. Smallwood et al (2000) stress that 'design precedes construction and consequently designers have the greatest potential in terms of contributing to the minimising and/or eliminating of the risk posed by hazardous chemical substances'. Duff & Suraji (2000) also explain that the design role is 'not only associated with providing better design outputs but also minimising negative effects of the design process and maximising the value of their design skills and project knowledge'.

Experts and non-experts often use health and safety alike to represent only safety. Most health and safety managers, supervisors or inspectors have little more than a very rudimentary knowledge of occupational health issues' (Gibb, 2002). The authors argue that this is also true of designers. Every year many thousands of construction workers suffer from work-related ill health. In 1995, the UK's self-reported work-related illness survey found an estimated 134,000 construction-related workers report a health problem caused by their work, resulting in an estimated 1.2 million days lost in a workforce of 1.5 million (Gibb 2002). In particular there were 96,000 musculoskeletal disorder cases; 15,000 respiratory disease cases; 6,000 cases of skin disease and 5,000 noise induced hearing loss cases. Hand arm vibration syndrome (HAVS) has also been identified as a health hazard as shown by recent research (Gibb 2002).

The European Construction Institute (ECI) produced a guide to managing health in construction (ECI 1999). It includes strategies to manage health throughout the construction process and gives information on regulations for health issues in European countries. This manual is mainly targeted at construction managers, so the D⁴h project is applying some of this previous work and develop practical guides for designers. The overall strategy of D⁴h is to identify and build on current 'best practice' where it exists for healthy design, particularly issues relating to the construction process. Currently, little exists which can be used as a benchmark and there is little specific guidance for healthy design.

2 Methodology

This paper presents the preliminary findings from the first phase of D⁴h, namely interviews of experienced design practitioners and managers regarding design phase provision for occupational health of construction workers. A 19 question semi-structured interview was developed and piloted. In addition to some closed questions to gather comparative data, many of the questions were open-ended to allow discussion to evolve and it is these questions that form the basis of this paper. Individuals were asked to give their own opinion, not just that of company policy. Interviewees were designers selected from individuals linked to the project steering group, the ECI and other design experts employed in the construction sector. 14 individuals were interviewed, from various construction sectors including petrochemical, architectural, and design contractors. The interviewees are described in Table 1.

Table 1. Background data on interviewees

Interviewee Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Specialist Area															
Architect	X				X			X	X						Data unavailable
Structural Engineer		X													
H&S/CDM Manager			X				X								
Civil Group Manager				X											
Design/Technical Manager						X				X	X		X		
Head of Support												X			
Years Experience															
0-10		X													Data unavailable
11-15			X					X					X		
16 - 20				X						X	X				
21-25						X	X								
26-30	X								X			X			
30+					X										
Gender															
Male	X			X	X	X	X	X	X	X	X	X	X	X	
Female		X	X												
Project Types															
Petrochemical/Power				X											Data unavailable
Residential			X				X	X	X		X				
Civil	X		X							X		X	X		
Commercial	X	X	X			X	X	X	X						
Retail	X	X	X			X	X	X							
Educational	X		X				X	X							
Recreational	X		X			X	X	X	X						
Light Industrial	X	X	X		X	X	X	X	X						
Pharmaceutical				X	X							X			
Airports											X				

3 Results and Discussion

3.1 Healthy Design Procedures

The basis of the procedures used for designing for healthy construction varied significantly across the interviewee's organisations. It was difficult in most of the interviews to separate out occupational health issues from the overall health and safety issues. Several of the companies had extensive documents outlining guidance for designers that incorporated CDM requirements. Figure 1 illustrates the influences on design to take account of the occupational health of construction workers.

The majority of health design procedures followed were driven by Risk Assessments (RA). Formal Quality Assurance (QA) procedure drivers as part of a Quality Management System (QMS) were cited by a few and these included checklists and Risk Assessments. Others relied on British Standards, the Building Regulations or COSHH (Control of Substances Hazardous to Health) regulations, all of which mainly cover the performance of the completed building.

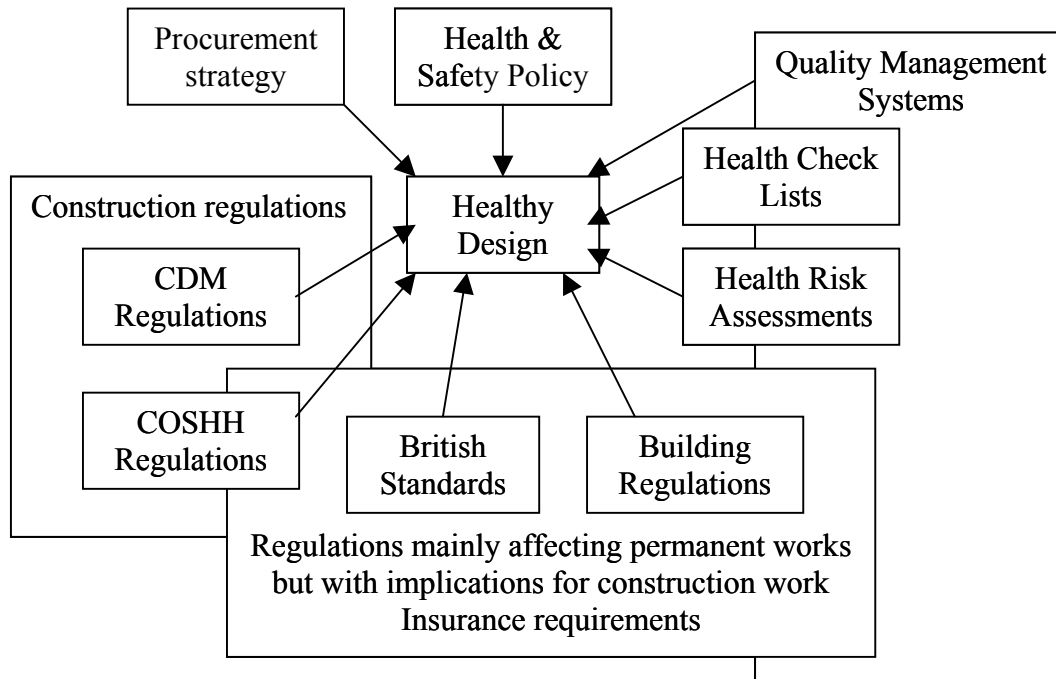


Figure 1: Influences on healthy design

One interviewee noted that they carry out designs to the standards set by the insurers. Insurers requirements are often more stringent than those of the British Standards and the Building Regulations. If the requirements are not met and an incident occurs then a claim cannot be made, which could lead to a major financial loss on a project. It is now an increasing trend that designers look at the insurance requirements for a design rather than that of the Building Regulations and British Standards.

Most of the interviewees stated that everyone in the company is responsible for healthy design. Designers tended to report to project engineers or specific CDM managers, design directors or principal architects who then report to a board of directors and ultimately to the Managing Director. Therefore it was seen as important to keep everyone 'in the loop'. Checks were done through internal and external audits.

3.2 Legal Requirements

The majority of interviewees said that achieving more healthy designs was influenced by both legal requirements and the company health and safety policy. 3 interviewees said it was mainly legally driven and 3 interviewees said it was mostly company policy driven. No-one stated that it was totally legal requirements or totally company policy that led to improved design.

3.3 Construction (Design and Management) Regulations (CDM)

One of the questions directly addressed the regulations, asking if CDM had altered the way that they did their design. Figure 2 illustrates their answers.

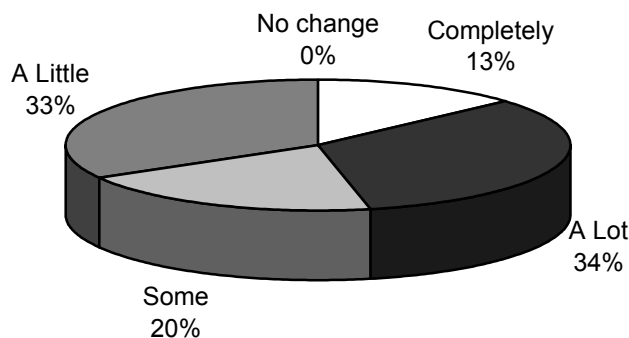


Figure 2: Has CDM altered the way you carry out your design?

CDM has improved designs related to health in projects as it has made designers more aware of health issues, specifically material used in buildings. At least two people said it had not affected the way they designed to a great extent as they worked to similar standards before CDM was introduced with CDM simply encompassing the whole process. The majority saw a marginal improvement and suggested it had not had as big an impact as it might have done.

Two designers thought it had had little effect because health was difficult to include in design whereas safety was much easier to consider and often subsumed health problems. At least two interviewees claimed that CDM was not good at addressing problems for materials in terms of occupants of the building or on occupational health issues, as there was more emphasis on safety. This supports Gibb's argument (2002) that 'safety is often seen to overshadow health.

Although the interviewees mentioned that CDM had made designers more aware of health issues it was unclear to what extent they were still classing health as synonymous with safety. One interviewee mentioned that a substantial amount of money had been spent on CDM and achieved nothing. However, holistically, financial risk can be significantly reduced in the event of a claim, as there would be an audit trail that designers had carried out their duty of care under CDM. Companies in the petrochemical industry stated that they felt that they had most of the CDM procedures in place already because they worked in such a hazardous industry and that they needed to have such a high health and safety standard as any accident could prove to be catastrophic.

Most interviewees felt that CDM was addressing the main areas. However, some considered that there was not enough emphasis placed on the practical issues and how to resolve them which can lead to an ineffective process – an increase in paperwork. Also identified was the disparity between domestic clients and developers, where the same project for two different clients can result in one being covered by CDM and one not. There seemed to be a lack of co-ordination between the whole construction team with the client being unaware of their legal duties under the regulations.

Another problem identified was that the early notification procedure to the Health and Safety Executive (HSE – The UK Government body responsible for H&S regulation and enforcement) was an anomaly as it was not practical to notify them for every project at this early stage, especially for speculative enquiries as only a small proportion of these are taken to concept and detailed design. It was also claimed that planning supervisors (who are responsible under CDM for coordinating H&S issues mainly during design) should be appointed earlier so they are included

in design process earlier, not just halfway through when it is often too late to have an effect.

The issue of high-turnover maintenance schemes is one that needs to be improved upon under CDM, as there appears to be uncertainty as to whether the projects are covered by CDM. However CDM states that any project that lasts over 2 years is covered by the regulations so this type of project should be included. Furthermore there needs to be greater understanding of the legal requirements CDM has placed upon the design team.

Another issue raised was that of client influence. Under CDM the client is responsible and can have a significant influence on the design – but they need to be more aware of their role. For example, the client has the responsibility to appoint a planning supervisor at the start of the project. When it was mentioned by one of the interviewees that planning supervisors are not appointed early enough it suggests that maybe the clients are not fulfilling their full responsibilities. Some felt that clients should be included in CDM training programmes and should be required to do a health and safety audit trail similar to that of designers.

3.4 Quality Management Systems

There has been an ongoing debate about the pros and cons of incorporating health and safety within a Quality Management System (QMS) as far back as the early cib w99 conferences (eg cib w99, Lisbon, Portugal, September 1996 – Proceedings edited by Alves Dias & Coble). The D⁴h interviewees were divided on whether relying on an overall project Quality Management System (QMS) to identify problem areas, was more effective than using specific health-related checklists or the health and safety policy. Some company's QMS incorporated checklists and health and safety policies. Others mentioned that health and safety policies do not tend to be read, just left on a shelf therefore the QMS itself was used as it could provide specific information for audits. Some identified that health and safety was not discussed as part of the QMS review and instead used checklists and RAs to identify problems.

One interviewee mentioned that QMS and health and safety policies tend to merge but the QMS could not replace the health and safety policy. Some companies had a QA manager to ensure policy implementation. One interviewee stated that QMS did not fulfil the CDM obligations, because the QMS can do as much or as little as the company likes as long as it complies with the 'Standards', which could result in the QMS being very 'slack' or very 'tight'. The QMS was seen as being more project-specific with the H&S checklist being a higher standard, as it was more 'hands-on'. Another interviewee mentioned that the QMS encompassed everything as it is part of a system so it can improve health and safety issues. It does need to be a live document that is constantly updated, as the design team will respect it more if it is kept up to date. Another interviewee stated the quality department deals only with procedures and is only concerned at getting designs completed.

The QMS seems still to be an area of controversy. Some integrate H&S into their QMS as a matter of course as it works well within their company structure whereas others are more sceptical of it and feel happier using other methods. It appeared to be dependent on the type of company. Many companies are comfortable using a QMS, claiming it achieves a better quality of product and also ensures that health issues are included in the design. Nevertheless, some companies argued that were unable to use QMS but that they already had systems in place that allowed them to audit health input to the design process.

3.5 Health Risk Assessments (RA)

Most RAs were carried out throughout the design process, especially at pre-tender stage, so that they could be included in the tender. Most used the high, medium and low probability of risk model, if the RA identifies a significant risk, then they would look at designing-out the activity. One interviewee stated that they did not use the risk probability method as they felt it was very subjective and therefore dependent on the person who carried out the assessment. One interviewee stated that they would like more explanation from the HSE on how to carry out RAs.

RAs should be used to identify residual risks including things such as site conditions. Some only carried out RAs if the checklists identified a particular problem. It was admitted that many RAs were carried out 'after the event' as individuals were afraid that they might get audited! Furthermore Ash (2000) stated that it was common to assess risk too late in the process to have any beneficial effects. It is imperative that RAs are used to actually identify risks and the importance of completing them properly is instilled into designers from the beginning. Changes in the attitude of the individual and, to some extent the company, need to be implemented to ensure that healthy design is automatically included, not something that is an after thought. Interviewees claimed that this will lead to improved design, ultimately making the company more competitive.

Interviewees acknowledged that the RA document needs to become a live document, constantly updated throughout all design phases from inception through to handover. It must constantly evolve and be project-specific, as it will not address specific details if only in generic form. One company started RAs on the first day of the project by setting up a risk register, which focused on site-specific issues ensuring a 'live' document was created and kept updated throughout the project. If the designers had input into the design of the RA form, they were more likely to use it, as they would value the RA more. The RA outcome was usually then indicated on the drawings.

3.6 Health Checklists

Most interviewees had used checklists either on their own or as part of the QMS, RA or Health and Safety Policy. Interviewees commented that checklists could be dangerous, as there could be a temptation to tick the box without carrying out the actual assessment itself – 'doing a risk assessment' rather than 'assessing the risk'. There is also a worry that they can be filled in after the design has been completed as a post rationalisation and to cover potential future audits (This was a worrying aspect that was brought up several times by a number of the interviewees). Benefits were found if the checklists were project-specific. Some interviewees preferred to use checklists as a starting reference point to overcome the problems.

The majority of the interviewees thought checklists should be used in both in concept and detailed design stage. Five interviewees thought they were best used in concept design whereas only one thought they were better in detailed design. Furthermore, they appear to be useful at concept design stage as prompts for designers due to time constraints. At the detailed design stage, designs are committed so there is a limit to what can be changed and cost implications to any changes. However, in detailed design there are more possibilities to look at maintenance issues and focus on the materials.

One suggestion was to have standard checklists with specific sections depending on the project, and then include user notes to ensure that the design team are aware of the issues. The overall opinion was that it would be useful to have checklists

relating to specific design briefs such as cladding or pre-stressed concrete, especially if the designer did not have much expertise in that particular area. Then they could relate it to a stage in the design. It would be useful to have a quick checklist as long as it was implemented properly within the company guidelines and was not too over complicated. One interviewee mentioned that information relating to the demolition should also be included, as there are likely to be health issues that need to be considered.

Most interviewees thought that prompt cards as 'cards in a box' would not be useful or may get lost but were more positive about computerised checklists, as an on-line approach would have a higher user rate. Two companies already has web based best practice sheets that included simple information such as 'best way to build' and photographs. This appears to work well, as there was a visual reference for many different scenarios and a quick retrieval of the information with 'pop up' prompts on screen to act as a reminder. Another company had site employees using hand held devices checking for asbestos with a warning to remind them of the danger.

In general checklists were considered as being a useful tool. The main issue is to make sure that they are project specific and develop through the project so that the design team actually have to think when completing them instead of simply ticking boxes. It appears to be a battle between having the answers available so they 'switch off' and do not think about the issues and leaving it too open where there may be a possibility that something is overlooked.

3.7 Project Procurement

The interviewees were split over which was the best and worst procurement route for healthy design. Two interviewees stated that no one method was worse than another - the problem was the way the contracts were structured. The more favoured routes were where the contractor was appointed early enough to have design input or had some kind of partnering involvement. These methods included Partnering; the Private Finance Initiative (PFI); Alliancing; Design-Build-Finance-Operate; construction management; and management contracting. The traditional, lump-sum, design-then-build route was favoured by some as it allowed time for drawings to be completed.

Conversely, design and build was disliked by these interviewees because of the perceived lack of scope for planning and failure to consider lifecycle issues in a drive to reduce capital cost. The designers felt they were often 'bulldozed' into using low cost options attempting to save the contractor money. Designers also considered they had a lack of control but retained the responsibility and liability for the design, which was not eventually built to the original specification. The view was that drawings were often not of a good standard as they are frequently 'rushed'. In addition, incomplete inquiries or tenders tend to be fast-tracked and may not be properly thought through.

Generally, designers favoured procurement routes that allowed designs to be completed and consider all aspects from conception to demolition as they had most control over them. Great value was seen when the contractor and designer worked together as knowledge sharing could occur which would lead to a design that not only incorporated health and safety aspects but ultimately culminated in a superior project. Projects where contractors 'shut-out' designers after the initial design were considered the worst as the designers may still be liable for the design but have no control over it.

The majority of the interviewees considered that designers should not specify work methods, as they do not have enough experience. It would be useful, however, to specify certain special consideration areas by making notes on drawings as they are usually the only item the installer on site actually sees. Designers should specify a healthy design. They should be able to justify that they have considered a healthy method of constructing their design and that they are satisfied with it. Interviewees mentioned that it should be a team effort with the designer and contractor interacting over the design and construction phase but this was seen to be dependent on company structure and procurement route.

3.8 Training to design-out health problems

Most of the interviewees had been trained at University or College prior to the introduction of the CDM regulations. Figure 3 shows that most had very little H&S training.

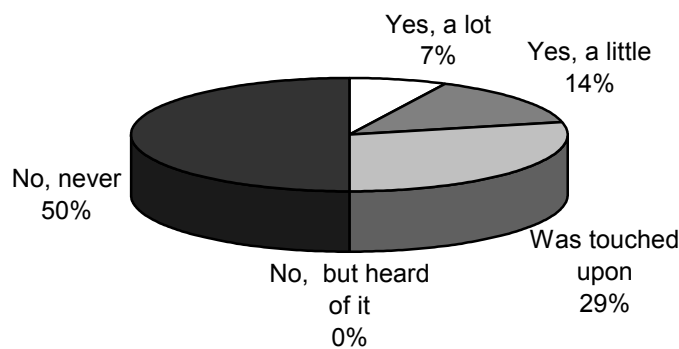


Figure 3: Were you taught about designing-out health problems whilst training to become a designer?

Today it appears that there has been only a small change in the way universities and colleges include health and safety issues. A few have integrated H&S throughout the course or even occasionally as a core module. Under CDM it is the designer's duty to keep up to date with new legislation. When asked about training on current health regulations, most interviewees had CDM training when CDM first came in but have not had any health and safety training for at least 1-2 years.

Furthermore, it appeared to be difficult to find a good CDM course, as they were often too repetitive and rarely geared towards designers. Many considered that the courses merely went over the CDM regulations and they did not actually teach them anything new. They would prefer to have discussions and practical examples of how to overcome the problems through case studies examples. Many of the designers did their own research with materials, often sourced from the web or updates from HSE.

Some claimed that because their company was multi-disciplinary they could use expert advice within the company when it was needed. Some had structured training courses whereas others carried out training on an ad hoc basis, particularly for new starters. One interviewee admitted that he was very sceptical about training, as often the participants tend to switch off during the course. In addition it was better to have hands-on experience and find better ways to implement training. One company had a partnering arrangement with a professional health and safety consultancy that did all their training.

Continuing Professional Development (CPD) was suggested as a way companies can keep up to date on new developments. In house seminars, industry specific courses, day or lunchtime courses were suggested as other ways of implementing training. Time role reversal was also suggested i.e. architects considering the problems engineers face and vice versa to raise inter-discipline awareness.

On-site training was seen to be one of the best methods of promoting training yet many designers spend minimal time on site and have no idea of the problems that can occur. A site when dry could be a completely different scenario when it is muddy and wet. It is issues like this that designers need to be aware of and consider how different environmental conditions may alter the process.

4 Conclusions

These preliminary findings indicate that healthy design is influenced by a number of aspects. The construction regulations (e.g. CDM & COSHH) have a direct bearing, but so, to a certain extent, do regulations covering the end-product building or facility. Quality Management Systems, incorporating risk assessments and checklists are considered effective, although some interviewees would prefer to use these tools outside of a formal QMS. The overall health and safety policy was also considered to be a significant influencer, although these were often too generic to be of much use.

Procurement routes were considered to be important, with those that facilitated collaboration between designer and constructor being favoured. Traditional 'design-then-build' was considered to be preferable to contractor-led 'design-and-build' as it was seen that the contractor often ignored the original design principals in amending the design but still required the original designer to retain H&S responsibility. Training to incorporate health considerations for construction workers was sparse and poorly organised. This remains as an important barrier to healthier design.

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