

# D<sup>4</sup>h

## Healthy Design for Construction Knowledge Transfer of Effective Health Issues during Design

### CD Development Report

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The D4h project is partly funded by the European Construction Institute (ECI) and partly by the Department of Trade and Industry (DTI). The project has 5 confirmed project partners, ECI, Loughborough University, ECI's Safety, Health and Environment (SHE) Task Force, Health and Safety Executive (HSE) and Rethinking Construction and has additional collaboration from many other construction-related organisations.

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# Milestone 4 Report

## Contents

- 1.0 Initial Background Research
- 2.0 CD Development
- 3.0 Continuing work
- 4.0 Appendices

### 1.0 Initial Background Research

Initial background research for the project involved a review of health and safety policies from various organisations. Health and safety documents were received from the following project steering group companies and one of their contacts (Bluestone):

- CTRL
- ALSTEC Group
- BNFL
- Foster and Partners
- Stone and Webster
- Jacobs Engineering Group Inc.
- Bluestone

This was carried out in July/August of 2002 as part of Milestone 1. The main conclusions from this report highlighted that Health and Safety tended to be lumped together and treated as one entity with health often overshadowed by safety problems.

From the findings of the initial milestone 1 report, a 19 question semi-structured interview and a three page questionnaire were developed and piloted. 23 designers from industry completed the interview and questionnaire. The designers were known to the steering group and the D4h research team. A focus group was also held at Bond Bryan architects where the same questions were asked to a group of designers which also allowed further discussion and brainstorming between the group. The data was collated and presented in a report to the steering group.

Meetings to publicise the project were also conducted at:

- **IOSH Construction Specialist Group**, Leicester, May 2003
- **Institute of Civil Engineers (ICE)**: Evening lecture, London, April 2003

## 2.0 CD Development

The D4h team used the interview findings of milestone 1 to establish the key health areas which the CD needed to cover such as HAVS, dermatitis etc. The steering group were asked to comment on these areas. The steering group were also asked to identify key construction areas and identify the processes and sub-processes within these. The 3 construction areas agreed by the steering group were:

- Major Building
- Civil Engineering
- Engineering Construction

Within these 3 main sections various sub-component sections were identified such as Substructure, Superstructure, Façade, Roof, M&E and Internals in the Major Building section. Work on these areas had previously been undertaken by the APaChE HASPREST project so the information was used as a basis and adapted for the D4h project accordingly. The tables were also adapted from previously existing Vauxhall design tables. The first draft of the tables split construction elements (i.e. steelwork) into Concept, Detailed and Scheme design stages and looked at how problems could be eliminated in each of these sections (see appendix 1). After consultation with the steering group this was adapted into a simpler format with the elements being split into sub-activities (e.g. cast in holding down bolts, install columns, install beams etc for steelwork) (see appendix 2). This simpler format allowed the health problems for a specific sub-activity to be looked at in detail which the first tables did not allow for. Other columns were added to allow for designer action information, whether the problem can be avoided or reduced, comments and examples (appendix 2).

The sub-activities and health hazards were completed by the D4h team. Members of the steering group took part in several one-on-one meetings with the D4h team and provided information to fill in the missing sections of the tables. They also provided a lot of time and advice on individual CD sections such as the building strategy page, flow charts, information on concrete and the steel frame construction sections etc.

One of the main aims of the CD was to establish innovative construction methods and products that had been developed and were currently being used in the UK construction industry. The D4h team encountered many problems trying to find evidence of these products. An article was written for the trade press asking for examples of innovative products but received no replies to our request. The D4h team asked members of the steering group to pass on information of any innovative products that they had used in their company. External contacts from the research team were also contacted for information such as Vauxhall Motors and Taylor Woodrow.

The D4h team also carried out research into products on the internet and a number of companies were contacted directly for permission to use their products and get permission to use photographs on the CD. Searching 'blind'

on the internet proved to be difficult and did not return many results. Many of the photos used in the CD were photos that had been taken by the D4h team for past projects. These were anonymised where necessary.

Key individuals from government departments were contacted for advice on new or upcoming legislation and provided documents.

A steering group working meeting was held on the 13<sup>th</sup> of March 2003. This meeting allowed the steering group to go through the information that the D4h team had amassed and identify and expand on areas that were missing.

The first draft of the CD was sent to Rosemary Alexander of Bond Bryan and Stuart Barlow of Reid Architecture to comment on. Their comments were taken on board and the necessary changes were made. On July 3<sup>rd</sup> the second draft version of the CD was presented to the steering group for them to comment on. The group was then split into two so missing designer action could be discussed and hazard examples established. The changes discussed were made to the CD.

On the 28<sup>th</sup> of October 2003 the steering group received an update of the CD (version 2). Lawrence McKay (APaCHe) developed the Civil Engineering sections with close collaboration from Andrew Coultate of CTRL. The steering group went through the CD and suggested changes where appropriate and supplied information.

In the 1<sup>st</sup> week of November the third version of the CD was presented to:

- Jack Cotterill, Tweeds Project Services
- Stuart Barlow, Reid Architects
- Rosemary Alexander, Bond Bryan
- Graeme White, HBG

These designers then filled in a CD evaluation form and any changes suggested were made to the CD. The designers were also asked for names of people they thought would be interested in helping with the implementation of the CD.

### **3.0 Continuing Work**

Work is progressing well towards the completion of the D4h CD deliverable. The CD is expected to be available by the end of January 2004 and a web version is now being considered for future development.

Implementation trials are underway and will be covered in a future report for D4h milestone 6. Dissemination activities are also progressing and these too will be covered in the Milestone 6 report.

## Appendix 1

Considerations and Issues		Steelwork	
why use steelwork? Scope in work, element sizes, piece weights, manoeuvrability, equipment, site environment, programme, carnage, working area, sub assemblies, movement joints, temporary loads, interface connections, sequencing of work, connection types, bolt types, temporary conditions, pre-assembly, lining and levelling, tolerances, painting, testing.	Concept Design	Exploit the facility to quickly erect and achieve stability: a safe working platform offers specific safety advantages. Determine how the steel frame can provide working platforms for subsequent work and other trades. Assess methods for delivery, storage, pre-assembly and erection of steelwork to safeguard construction workers. Metal decking for composite slabs offers significant safety advantages during construction (e.g. stabilised the structure, provides safe working platform). Because the highest incidence of accident and injuries arise from 'falls from height' this must be a special consideration when considering ways to allow safe work on partially-erected steel frames. Consider prefabrication options	
	Scheme Design	Show how structure might be built to anticipate and eliminate (if possible) hazards. Consider how temporary/erection loads can be accommodated without the need for additional members or framing. Explore how pre-assembly off and on site can enhance health. Consider installing staircases earlier to provide safe access. Ensure adequate bracing is provided as the frame is erected. Can the steel frame erection be conceived as inherently stable sub assemblies. If welding is involved, consider HSFG or bolts in bearing offer any particular health and safety benefits e.g. by providing temporary moment capacity. Assess structure to see if areas can be rapidly developed to act as stable work platforms. Design so that stairways can be installed ahead of frame erection for safer access. Establish a method of pre-assembly and erection is established to ensure the contractor can be advised of a way in which it can be built safely.	
	Detail Design	Consider advantages of repetition (e.g. One size, fully-threaded bolts) to reduce complexity of hazards at work. Specify lifting points. Chases or holes should be detailed to be cast into the unit and not cut or drilled later. Ensure that connections are dimensionally tolerant to avoid need for remedial works at height. De-burr holes and grind arises to make connections safer to handle. Eliminate/reduce need for work on site at height by ensuring an adequate base is prepared to allow safe working of mechanical lifting plant. Avoid complex connections, consider putting guidance cleats in position to help line up girders easily. For ease of erection, look to use one size of bolt throughout. Can elements in tension also be designed to accept temporary compression loads (to provide enhanced stability). Ensure that structural mechanism assumed for method of construction is communicated to all who might need to know. Include temporary working platforms and/or harness attachments.	
Hazards	Specific Health problem		
Musculoskeletal	Noise and Vibration: Pneumatic and manual wrenches and hammers, bolting, drilling, reaming	Avoid: Design to avoid identified hazards but beware of introducing others	Consider pre assembly on the ground. Use electric drills to reduce vibration.
		Reduce: Design to reduce identified hazards but beware of increasing others	Specify one size, fully-threaded free running bolt to simplify work at height
		Control: Design to provide acceptable safeguards for all remaining hazards	Allow for use of hydraulic platform for jointing at height
Respiratory	Weigh, Manual Handling	Avoid: Design to avoid identified hazards but beware of introducing others	Place steel work straight from lorry. Specify lifting points. Design in contact points so lifts can be made easily. Consider methods of remote release crane hooks. Consider pre assembly on ground.
		Reduce: Design to reduce identified hazards but beware of increasing others	Establish adequate lay down areas near to where steel work is needed but not in direct route of other site traffic if possible
		Control: Design to provide acceptable safeguards for all remaining hazards	Use guys and timbers to support steelwork until placed in position
Dermatitis	Cutting/welding, descaling, greases	Avoid: Design to avoid identified hazards but beware of introducing others	Consider using bolted connections. Can application be done in a factory
		Reduce: Design to reduce identified hazards but beware of increasing others	Make sure area is well ventilated
		Control: Design to provide acceptable safeguards for all remaining hazards	

## Appendix 2

### Steel Frame

Major Health Hazard	Typical sub-activities	Architect/Engineer Designer Action (Avoid, Reduce, Control)	Other Designer Action	A/R	Comments	Example
Dermatitis	Cast in holding down bolts	See substructure				
Manual handling (MH)	Bring steelwork to site, off load and store	Reduce manual handling-Consider just in time principle to reduce manual handling- Lorry to installation	Design lifting points for all steelwork to facilitate off-loading and erection	R	Consult structural engineer	
MH  HAVS (bolts)	Install columns	Consider lifting points	Reduce manual handling of columns onto the holding down bolts by designing a hole at the top of the column web.  Use electric drills instead of pneumatic to reduce effects of HAVS on tightening holding down bolts	R  A	Consult structural engineer	<a href="X:\D4H\Building\Superstructure\New format 16-6 superstructure\Finished Pictures\ 21 Vauxhall cols">X:\D4H\Building\Superstructure\New format 16-6 superstructure\Finished Pictures\ 21 Vauxhall cols</a>
MH  MSDS	Install beams  <a href="X:\D4H\Building\Superstructure\New format 16-6 superstructure\Finished Pictures\22A installing beams">X:\D4H\Building\Superstructure\New format 16-6 superstructure\Finished Pictures\22A installing beams</a>	Consider lifting points	Consider pre assembly on the ground.  Design lifting points on the beams to reduce manual handling which enables safer lifting practice (consult LORER Regs).	R	Consult structural engineer	
Dermatitis	Grout column bases <a href="X:\D4H\Building\Superstructure\New format 16-6 superstructure\Finished Pictures\23a Concrete column bases">X:\D4H\Building\Superstructure\New format 16-6 superstructure\Finished Pictures\23a Concrete column bases</a>	Avoid grouts with toxins or chromide <sup>vi</sup>	Material selection is critical-consult COSHH	A	Consult specialist suppliers	<b>Link to ground beam 'T' connection for column bases.</b> <a href="X:\D4H\D4H Publish\HUB\Building_process\B_strategy\_frame_case\frame_case.html">X:\D4H\D4H Publish\HUB\Building_process\B_strategy\_frame_case\frame_case.html</a>
M H	Install floors  <a href="#">Link goes to flooring systems (in already)</a>	Consider off-site prefabrication	Reduce manual handling by using precast hollow core or equivalent	R	Consider lead in times	
Respiratory	Paint frames	Avoid paints with toxins & solvents	Use water based or solvent free paints. Reduce working at height and confined spaces- paint frames wherever possible at ground level before installation	A	Consult specialist suppliers	
Respiratory	Fire protection	Avoid non-sprayed fire protection	Consider using board finish fire protection	A	Consult specialist suppliers	