

architecture OTHERWARE
XXV INTERNATIONAL UNION OF ARCHITECTS CONGRESS
DURBAN, SOUTH AFRICA, 4-9 AUGUST 2014

**THE NEED FOR THE INCLUSION OF CONSTRUCTION
HEALTH AND SAFETY (H&S) IN ARCHITECTURAL EDUCATION**

**PROF JOHN SMALLWOOD
DEPT. OF CONSTRUCTION MANAGEMENT
NELSON MANDELA METROPOLITAN UNIVERSITY
SOUTH AFRICA**

Introduction (1)

- **International Labour Office (ILO) (1992) states that designers should:**
 - **Receive training in H&S**
 - **Integrate the H&S of construction workers into the design and planning process**
 - **Not include anything in a design which would necessitate the use of dangerous procedures or hazardous materials which could be avoided by design**
 - **Take into account the H&S of workers during subsequent maintenance**
- **Construction Regulations schedule a range of requirements relative to designers**
- **151 / 450 (33.6%) cases of death and disabling of construction workers in the USA, the hazard that contributed to the incident could have been eliminated or reduced if design-for-H&S measures had been implemented (Behm, 2006)**

Introduction (2)

- **To this end a follow up study was conducted to determine:**
 - **Whether architectural programmes address construction H&S**
 - **If so, the form in which it is addressed**
 - **The importance of the inclusion of construction H&S in the tertiary education programmes of built environment disciplines**
 - **The importance of the inclusion of subject areas relative to construction H&S in an architectural programme**
 - **The extent to which actions / activities / aspects impact on construction H&S**
 - **The extent to which design related aspects impact on construction H&S**

Construction Regulations (1)

- **Definition of ‘designer’ – a competent person who:**
 - prepares a design
 - checks and approves a design
 - arranges for a person at work under his / her control to prepare a design including an employee of that person
 - designs temporary work including its components
- **An architect or engineer contributing to, or having overall responsibility for a design**
- **Building services engineer designing details for fixed plant**
- **Surveyor specifying articles or drawing up specifications**
- **Contractor carrying out design work as part of a design and build project**
- **Interior designer, shop-fitter, or landscape architect**

Construction Regulations (2)

Clients required to, among other:

5 (1) (a) Prepare a baseline risk assessment (BRA)

5 (1) (b) Prepare an H&S specification based on the BRA

5 (1) (c) Provide the designer with the H&S specification

5 (1) (d) Ensure that the designer takes the H&S specification into account during design

5 (1) (e) Ensure that the designer carries out the duties in Regulation 6 'Duties of designers'

5 (1) (f) Include the H&S specification (revised after designer report?) in the tender documents

5 (1) (g) Ensure that potential PCs have made provision for the cost of H&S in their tenders

Construction Regulations (3)

Relative to Structures 6 (1) designers of a structure must:

- (a) ensure that the H&S standards incorporated into the regulations are complied with in the design**
- (b) take the H&S specification into consideration**
- (c) include in a report to the client before tender stage:**
 - all relevant H&S information about the design that may affect the pricing of the work**
 - the geotechnical-science aspects**
 - the loading that the structure is designed to withstand**
- (d) inform the client of any known or anticipated dangers or hazards relating to the construction work, and make available all relevant information required for the safe execution of the work upon being designed or when the design is changed**
- (e) modify the design or make use of substitute materials where the design necessitates the use of dangerous procedures or materials hazardous to H&S**

Construction Regulations (4)

- **(f) consider hazards relating to subsequent maintenance of the structure and make provision in the design for that work to be performed to minimize the risk**
- **(g) when mandated by the client conduct inspections to ensure conformance of construction to design. If not mandated then the client's agent is responsible**
- **(h) when mandated by the client stop construction work not in accordance with the design's H&S aspects. If not mandated then the client's agent is responsible**
- **(i) when mandated by the client, during his / her final inspection of the structure include the H&S aspects of the structure, declare the structure safe for use and issue a completion certificate**

Construction Regulations (5)

- **(f) consider hazards relating to subsequent maintenance of the structure and make provision in the design for that work to be performed to minimize the risk**

Motivators for designer contributions

- **Cost of accidents (COA) is estimated to be between 4.3% and 5.4% of the value of completed construction, whereas the cost of implementing H&S is estimated to be between 0.5% and 3% of project costs, clearly H&S is a 'profit centre' (Smallwood, 2004)**
- **Construction Industry Development Board (cidb) (2009) – South African construction:**
 - **Fatality rate: 23.5 / 100 000 (3rd / 23 Industries)**
 - **Disabling injury incidence rate: 0.98 (9th / 23 Industries)**
- **Inadequate or the lack of H&S negatively affects performance relative to the other project parameters i.e. cost, environment, productivity, quality, and time (cidb, 2009)**

Previous research findings (1)

- **The sample stratum consisted of:**
 - 8 (57.1%) Technikon, and
 - 6 (42.9%) University Departments / Schools of Architecture
- **Mailed survey questionnaire**
- **9 Responses:**
 - 5 Technikons (55.6%)
 - 4 Universities (44.4%)
- **Overall response rate of 64.3%**
(Smallwood, 2002)

Previous research findings (2)

- **33.3% Maintained construction H&S is included in the architectural programme / curriculum**
- **Of those that did not: 16.7% intended to include it within the next two years, 16.7% did not intend to ever include it, and 66.7% did not know**
- **Of those that did: 66.7% included it as a component of a subject, and 33.3% as a module of a subject**
- **33.3% regarded construction H&S as ‘important’ to their discipline, 33.3% as ‘fairly important’ and 22.2% as ‘not important’**
- **100% were not aware of the Construction (Design and Management) Regulations in the United Kingdom (Smallwood, 2002)**

Previous research findings (3)

Aspect	Response (%)						MS	Rank
	Don't know	No.....Major						
		1	2	3	4	5		
Design related:								
Method of fixing	11.2	0.0	0.0	11.1	33.3	44.4	4.00	1
Details	11.1	0.0	0.0	11.1	55.6	22.2	3.78	2
Specification	0.0	11.1	11.1	22.2	22.2	33.4	3.56	3
Design (general)	0.0	11.2	22.2	22.2	22.2	22.2	3.22	4=
Content of materials	11.2	0.0	11.1	33.3	33.3	11.1	3.22	4=
Concept design	0.0	25.0	37.5	12.5	25.0	0.0	2.38	6
Size (bulk) of materials	33.3	11.1	11.1	22.2	22.2	0.0	2.22	7
Mass of materials	37.5	12.5	12.5	12.5	25.0	0.0	2.13	8
Texture of materials	22.2	11.2	33.3	33.3	0.0	0.0	2.00	9
Procurement related:								
Form of contract	44.4	11.1	11.1	22.2	11.1	0.0	1.89	10
Procurement system	37.5	0.0	37.5	25.0	0.0	0.0	1.88	11
Contract duration	44.4	16.2	22.2	22.2	0.0	0.0	1.67	12

Table 1: The extent to which various design and procurement related aspects impact on construction H&S according to Architectural Departments / Schools (MS: 1.00 – 5.00) i.e. midpoint is 3.00 (Smallwood, 2002).

Previous research findings (4)

- **55.6% of Respondents had one or more comments in general regarding construction H&S, and construction H&S education:**
 - **“Something that needs more publicity and development.”**
 - **“This aspect is discussed in the construction economics and management department.”**

(Smallwood, 2002)

Research – Sample stratum

- **The sample stratum consisted of Departments of Architecture:**
 - **6 (50%) Universities of Technology**
 - **6 (50%) Universities**
- **E-mailed survey questionnaire (2/x) and follow up phone call**
- **6 Responses:**
 - **4 Universities of Technology (33.3%)**
 - **2 Universities (66.7%)**
- **Overall response rate of 50%**

Research – Findings (1)

Response (%)		
Unsure	Yes	No
0.0	66.7	33.3

Table 1: Extent to which construction H&S is addressed / included in architectural programmes / curricula.

Form	Response (%)		
	Unsure	Yes	No
Separate subject	0.0	0.0	100.0
Issue in design project briefs	0.0	66.7	33.3
Criterion for assessment in design project assessments	0.0	33.3	66.7
Component of a subject	0.0	33.3	66.7
Module in various subjects	0.0	33.3	66.7
On an ad-hoc basis	0.0	33.3	66.7

Table 2: Form in which construction H&S is addressed / included.

Research – Findings (2)

Discipline	Response (%)						MS	Rank
	Unsure	Hardly..... Very						
		1	2	3	4	5		
Construction management	0.0	0.0	0.0	0.0	0.0	100.0	5.00	1
Civil engineering	0.0	0.0	0.0	0.0	25.0	75.0	4.75	2
Electrical engineering	0.0	0.0	0.0	0.0	50.0	50.0	4.50	3
Mechanical engineering	0.0	0.0	0.0	25.0	25.0	50.0	4.25	4
Project management	0.0	0.0	25.0	0.0	0.0	75.0	4.25	5
Landscape architecture	0.0	0.0	20.0	40.0	20.0	20.0	3.40	6
Architecture	0.0	16.7	16.7	16.7	16.7	33.3	3.33	7
Quantity surveying	0.0	0.0	25.0	50.0	0.0	25.0	3.25	8
Interior design	0.0	20.0	20.0	40.0	20.0	0.0	2.60	9

Table 3: The importance of the inclusion of construction H&S in the tertiary education programmes of built environment disciplines (MS: 1.00 – 5.00) i.e. midpoint is 3.00.

Research – Findings (3)

Subject area	Response (%)						MS	Rank
	Unsure	Hardly.....Very						
		1	2	3	4	5		
Occupational health	0.0	0.0	0.0	16.7	50.0	33.3	4.17	1
Occupational safety	0.0	0.0	0.0	16.7	50.0	33.3	4.17	2
OH&S Act & Regulations	0.0	0.0	0.0	33.3	33.3	33.3	4.00	3
H&S plans	0.0	0.0	0.0	33.3	33.3	33.3	4.00	4
H&S specifications	0.0	0.0	0.0	50.0	16.7	33.3	3.83	5
Role of project managers in construction H&S	0.0	0.0	16.7	16.7	33.3	33.3	3.83	6
Role of construction H&S in project performance	0.0	0.0	16.7	0.0	83.3	0.0	3.67	7
Role of designers in construction H&S	0.0	0.0	0.0	66.7	0.0	33.3	3.67	8
Specifying for construction H&S	0.0	0.0	16.7	33.3	33.3	16.7	3.50	9
Need for construction H&S	16.7	0.0	16.7	16.7	50.0	0.0	3.40	10
Designing for construction H&S	0.0	20.0	0.0	20.0	40.0	20.0	3.40	11
Hazard identification and risk assessment	0.0	16.7	16.7	16.7	16.7	33.3	3.33	12
Designing for construction ergonomics	0.0	16.7	16.7	0.0	66.7	0.0	3.17	13
Role of quantity surveyors in construction H&S	0.0	0.0	50.0	0.0	50.0	0.0	3.00	14
Detailing for construction H&S	0.0	16.7	16.7	33.3	33.3	0.0	2.83	15
Role of clients in construction H&S	0.0	0.0	50.0	33.3	16.7	0.0	2.67	16
Environment and construction H&S	0.0	16.7	33.3	16.7	33.3	0.0	2.67	17
Economics of construction H&S	0.0	33.3	33.3	0.0	16.7	16.7	2.50	18
Influence of procurement on construction H&S	16.7	33.3	16.7	16.7	16.7	0.0	2.20	19

Table 4: The importance of the inclusion of subject areas relative to construction H&S in an architectural programme (MS: 1.00 – 5.00) i.e. midpoint is 3.00.

Research – Findings (4)

Action / Activity / Aspect	Response (%)							MS	Rank
	Unsure	Does not	MinorMajor						
			1	2	3	4	5		
H&S pre-qualification of contractors	0.0	0.0	0.0	0.0	0.0	66.7	33.3	4.33	1
Site handover	0.0	0.0	0.0	0.0	33.3	33.3	33.3	4.00	2
Site inspections / discussions	0.0	0.0	0.0	0.0	33.3	50.0	16.7	3.83	3
Detailed design	0.0	0.0	0.0	0.0	50.0	33.3	16.7	3.67	4
Constructability reviews	16.7	0.0	0.0	0.0	33.3	50.0	0.0	3.60	5
Design	0.0	0.0	0.0	0.0	66.7	16.7	16.7	3.50	6
Project duration	0.0	0.0	0.0	16.7	50.0	16.7	16.7	3.33	7
Pre-tender meeting	16.7	0.0	0.0	16.7	33.3	33.3	0.0	3.20	8
Evaluation of tenders	16.7	0.0	0.0	16.7	33.3	33.3	0.0	3.20	9
Site meetings	0.0	16.7	0.0	0.0	60.0	20.0	20.0	3.00	10
Design coordination meetings	0.0	16.7	0.0	0.0	50.0	33.3	0.0	2.83	11
Working drawings	16.7	0.0	0.0	33.3	33.3	16.7	0.0	2.80	12
Project documentation	16.7	0.0	16.7	16.7	50.0	0.0	0.0	2.40	13
Client brief	0.0	16.7	16.7	16.7	33.3	0.0	16.7	2.33	14

Table 5: The extent to which actions / activities / aspects impact on construction H&S (MS: 0.00 – 5.00) i.e. midpoint is 2.50.

Research – Findings (5)

Aspect	Response (%)							MS	Rank
	Unsure	Does not	MinorMajor						
			1	2	3	4	5		
Method of fixing	0.0	0.0	0.0	0.0	16.7	50.0	33.3	4.17	1
Mass of materials	16.7	0.0	0.0	0.0	16.7	50.0	16.7	4.00	2
Edge of materials	0.0	0.0	0.0	0.0	66.7	16.7	16.7	3.50	3
Type of structural frame	0.0	0.0	0.0	16.7	33.3	33.3	16.7	3.50	4
Specification	0.0	0.0	0.0	16.7	33.3	33.3	16.7	3.50	5
Site location	0.0	0.0	16.7	0.0	33.3	33.3	16.7	3.33	6
Content of material	0.0	16.7	0.0	0.0	16.7	50.0	16.7	3.33	7
Design (general)	0.0	0.0	16.7	0.0	33.3	50.0	0.0	3.17	8
Surface area of materials	0.0	16.7	0.0	16.7	16.7	16.7	33.3	3.17	9
Texture of materials	0.0	0.0	16.7	16.7	16.7	50.0	0.0	3.00	10
Position of components	0.0	20.0	0.0	0.0	40.0	20.0	20.0	3.00	11
Details	0.0	0.0	0.0	33.3	50.0	16.7	0.0	2.83	12
Plan layout	0.0	0.0	16.7	33.3	16.7	33.3	0.0	2.67	13
Finishes	0.0	16.7	0.0	33.3	16.7	16.7	16.7	2.67	14
Elevations	0.0	0.0	16.7	33.3	33.3	16.7	0.0	2.50	15
Schedule	0.0	0.0	16.7	50.0	16.7	16.7	0.0	2.33	16

Table 6: The extent to which design related aspects impact on construction H&S (MS: 0.00 – 5.00) i.e. midpoint is 2.50.

Research – Findings (6)

- **“It is probably an area where more practical exposure would benefit the students. If they are able to visit a particularly sensitive site this would assist them in further projects.”**
- **“Please note that H&S issues are currently embedded in the different years of tuition at We are re-curriculating for a new degree (ca 2016), and will focus more specifically in terms of inclusion of H&S in the process of planning this qualification.”**
- **“While the design detailing and the methods of construction can be modified to politely acquire best practices of H&S on file greater training and wage of skilled workers, and practices are essential to safeguard the interests of all concerned.”**

Research – Findings (7)

- **“As architects we rely on the construction managers’ knowledge of H&S. It is an important role which I do think most designers would rather let the knowledgeable person handle it, unless it has an impact on the design. Inclusion of H&S in the curriculum would be determined by the body of knowledge that SACAP prescribes for inclusion. Currently H&S is not in the ‘Purple Book’.”**

A model

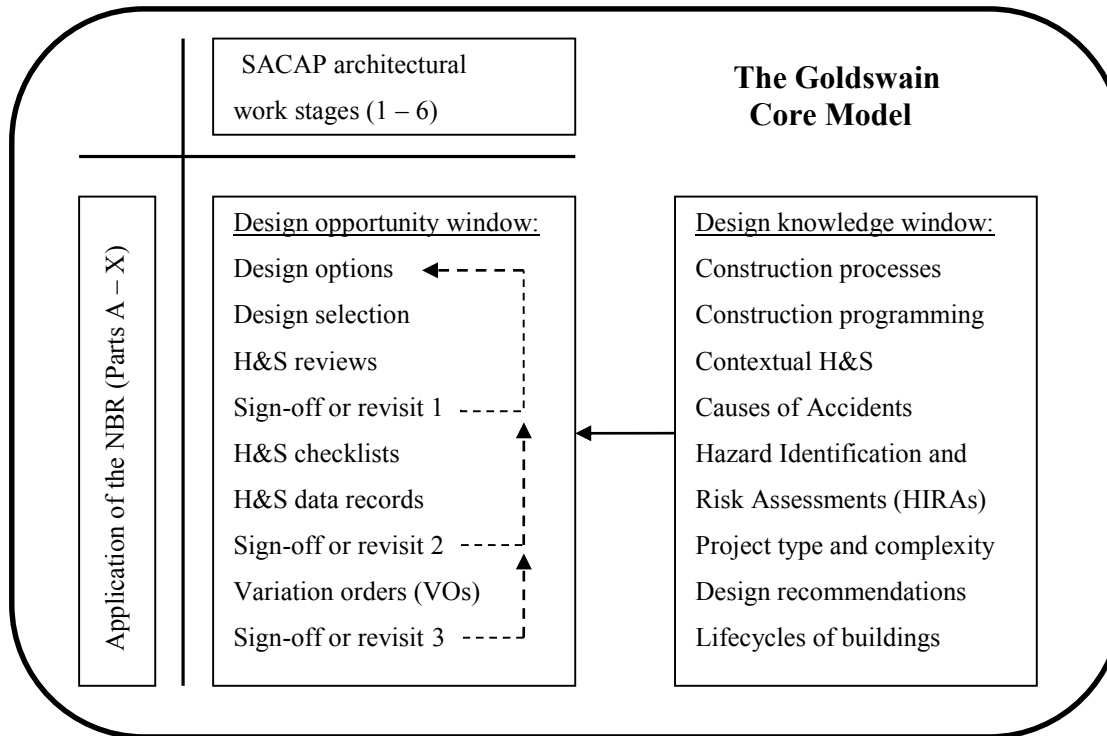


Figure 1: The Goldswain Core Model (Goldswain, 2014).

Conclusions

- **Construction H&S is addressed / included to a degree in architectural programmes:**
 - Not readily easy to determine the extent
 - Component of a subject, module, and ad-hoc basis
- **Appreciation of the importance of the inclusion of construction H&S in the tertiary education programmes of the built environment disciplines, but less so relative to the design disciplines**
- **Degree of appreciation for:**
 - The importance of the inclusion of a range of subject areas relative to construction H&S in an architectural programme
 - The extent to which actions / activities / aspects impact on construction H&S
 - The extent to which design related aspects impact on construction H&S

Recommendations (1)

- **Tertiary education architectural programmes should include appropriate ‘designing for construction H&S’ modules as a component of a subject – probably design**
- **Construction H&S should be included among criteria used for evaluating design projects, working drawings, and details**
- **Construction H&S should be included in continuing professional development (CPD) for architects**
- **The South African Institute of Architects (SAIA) should develop practice notes relative to construction H&S**
- **The South African Council for the Architectural Profession (SACAP) should include construction H&S in their six work stages (IoW)**

Recommendations (2)

- **SAIA and or SACAP accreditation panel visits should interrogate the extent construction H&S is addressed in tertiary architectural programmes**
- **The above should also be addressed in annual reports**

References (1)

- Behm, M. 2006. An Analysis of Construction Accidents from a Design Perspective. Silver Spring: The Center to Protect Workers' Rights.
- Construction Industry Development Board (cidb). 2009. Construction Health & Safety Status & Recommendations. Pretoria: cidb.
- Goldswain, C. 2014. Architectural Design Interventions Toward Improvement of Construction Health, Safety, and Ergonomics in South Africa. Unpublished PhD (Construction Management) Thesis. Port Elizabeth: NMMU.
- International Labour Office (ILO). 1992. Safety and health in construction. Geneva: ILO.

References (2)

- Republic of South Africa. 2014. No. R. 84 Occupational Health and Safety Act, 1993 Construction Regulations 2014. Government Gazette No. 37305. Pretoria.
- Smallwood, J.J. 2002. The need for the inclusion of construction health and safety (H&S) in architectural education. In: S. Rowlinson (ed.) Proceedings 3rd International Conference of CIB Working Commission W99 Implementation of Safety and Health on Construction Sites, Hong Kong, 7-10 May, Hong Kong: The University of Hong Kong, 207-212.

References (3)

- **Smallwood, J.J. 2004. Optimum cost: The role of health and safety (H&S). In: J.J.P. Verster (ed.) Proceedings International Cost Engineering Council 4th World Congress. Cape Town, April 2004. International Cost Engineering Council, 2004: CD-Rom Smallwood-J- Optimum Cost-Health & Safety.pdf**