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PREVENTION THROUGH DESIGN

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Outline

- The presentation has been extracted from a number of modules
- Sections:
  - Role of designers in construction H&S
  - Reduction of risk through design
  - Design HIRAs
  - Designer report
  - Design and construction method statements

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Introduction

- Design occurs upstream of construction
- Designers are a construction industry stakeholder
- Designers advise clients
- Architectural designers often set the parameters for civil, electrical, interior, landscape, mechanical, and structural designers
- Designers have a legal and moral responsibility

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Role of designers in construction H&S

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Designing for ergonomics and H&S (1)

Precast concrete stair flights, Port Elizabeth (Smallwood)

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Designing for ergonomics and H&S (2)

Precast concrete stair flights, Port Elizabeth (Smallwood)

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Designing and ergonomics and OH

‘Bush-hammered’ concrete, Port Elizabeth (Smallwood)

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Designing for ergonomics and OH

Thermal Lance, Mount Road Police Station, Port Elizabeth (Smallwood, 1987)

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Designing for ergonomics and H&S (1)

Crow's-nest, Mt Isa, Australia (Mount Isa Mines Limited and National Safety Council of Australia, 1992)

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Designing for ergonomics and H&S (2)

Crow's-nest, Mt Isa, Australia (Mount Isa Mines Limited and National Safety Council of Australia, 1992)

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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

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Construction Regulations (2)

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**

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Construction Regulations (3)

- (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

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Construction Regulations (4)

Designers of temporary works must ensure that:

- **they are adequately designed to support all vertical and lateral loads**
- **the designs are done with close reference to the structural design drawings and if uncertain, consult the contractor**
- **all drawings and calculations pertaining to the design of temporary works are kept at their office and are available for review by inspectors**
- **the loads caused by the temporary works and any imposed loads are clearly indicated in the design**

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Construction Regulations (5)

Clients required to:

- **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 in the tender documents**

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Construction Regulations (7)

- 5 (1) (r) When changes are made to the design or construction work provide sufficient H&S information and resources available to the PC
- 5 (1) (s) Ensure that the H&S file is kept and maintained by the PC

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Influence of designers (1)

- Directly:
  - Concept design
  - General design
  - Choice of structural frame
  - Details
  - Provision for services (construction ergonomics)
  - Specification of materials, finishes and processes
  - Consideration of H&S:
    - During design coordination
    - During constructability reviews
  - Reference to H&S:
    - During pre-tender site visit
    - Upon site handover
    - During site visits / inspections
    - During site visits / meetings

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Influence of designers (2)

- Indirectly:
  - Selection of / advice regarding type of procurement system
  - Selection of / advice regarding preparation of contract documentation
  - Decision regarding / advice with respect to project duration
  - Status of design upon commencement of construction (contractor pre-planning)
  - H&S prequalification of contractors
  - Site location e.g. exposure to elements, power lines etc.
  - Site coverage e.g. availability for storage

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General design (1)

- Shape of structure i.e. irregular plan shape
- Pitch of roof i.e. high pitch
- Over sailing sections (access to soffit / working overhead)
- External work and finishes (elevated work to facades)
- Position of ablutions relative to municipal services (depth of excavations)
- Pre-fabrication, pre-assembly and pre-casting:
  - Reduces elevated in-situ work
  - Reduces manual handling
  - Engenders mechanisation

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General design (2)

Bahia Temple, Delhi, India (Smallwood, 2005)

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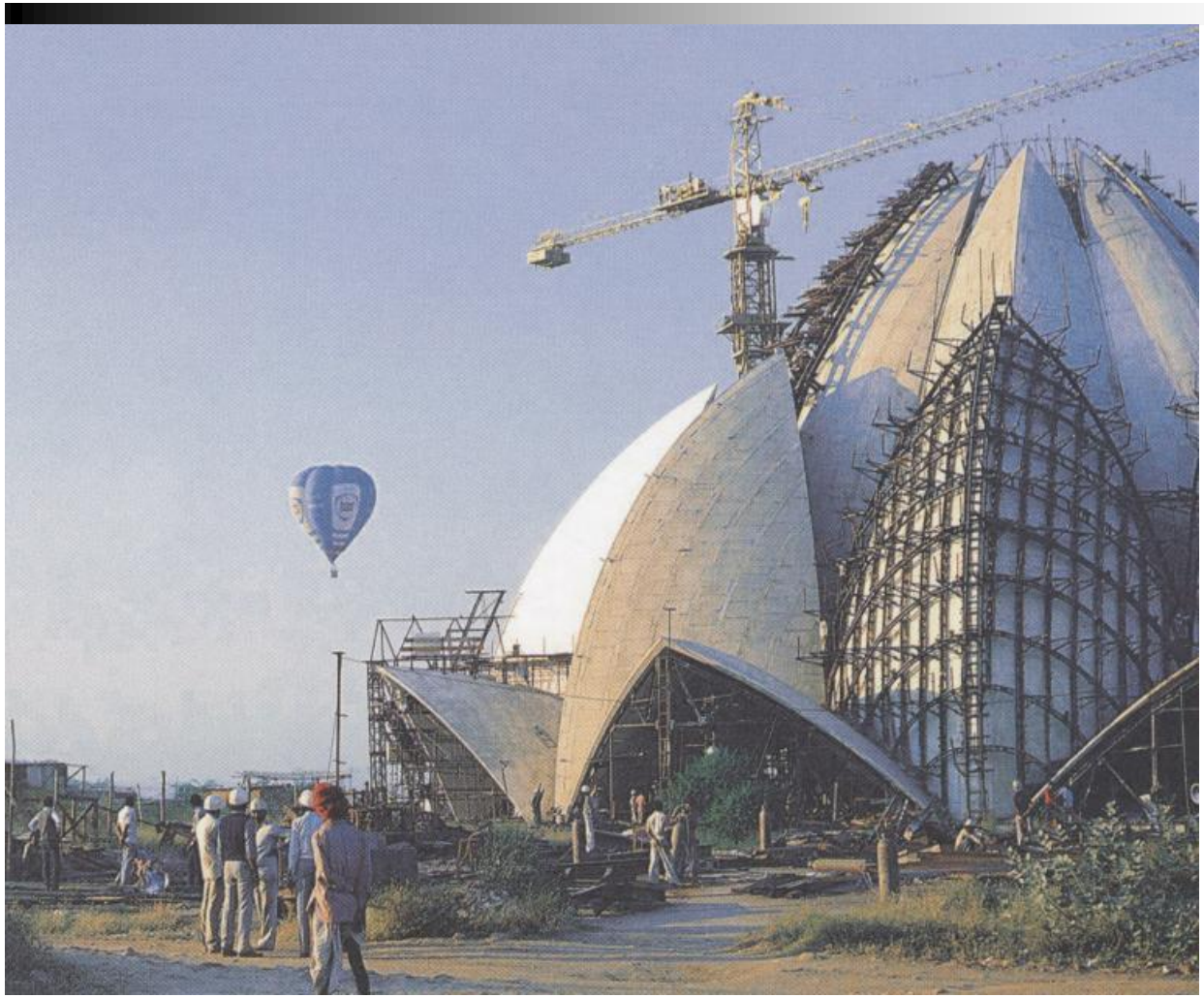
General design (3)



Bahia Temple, Delhi, India (The National Spiritual Assembly of the Bahia'is of India, 2002)

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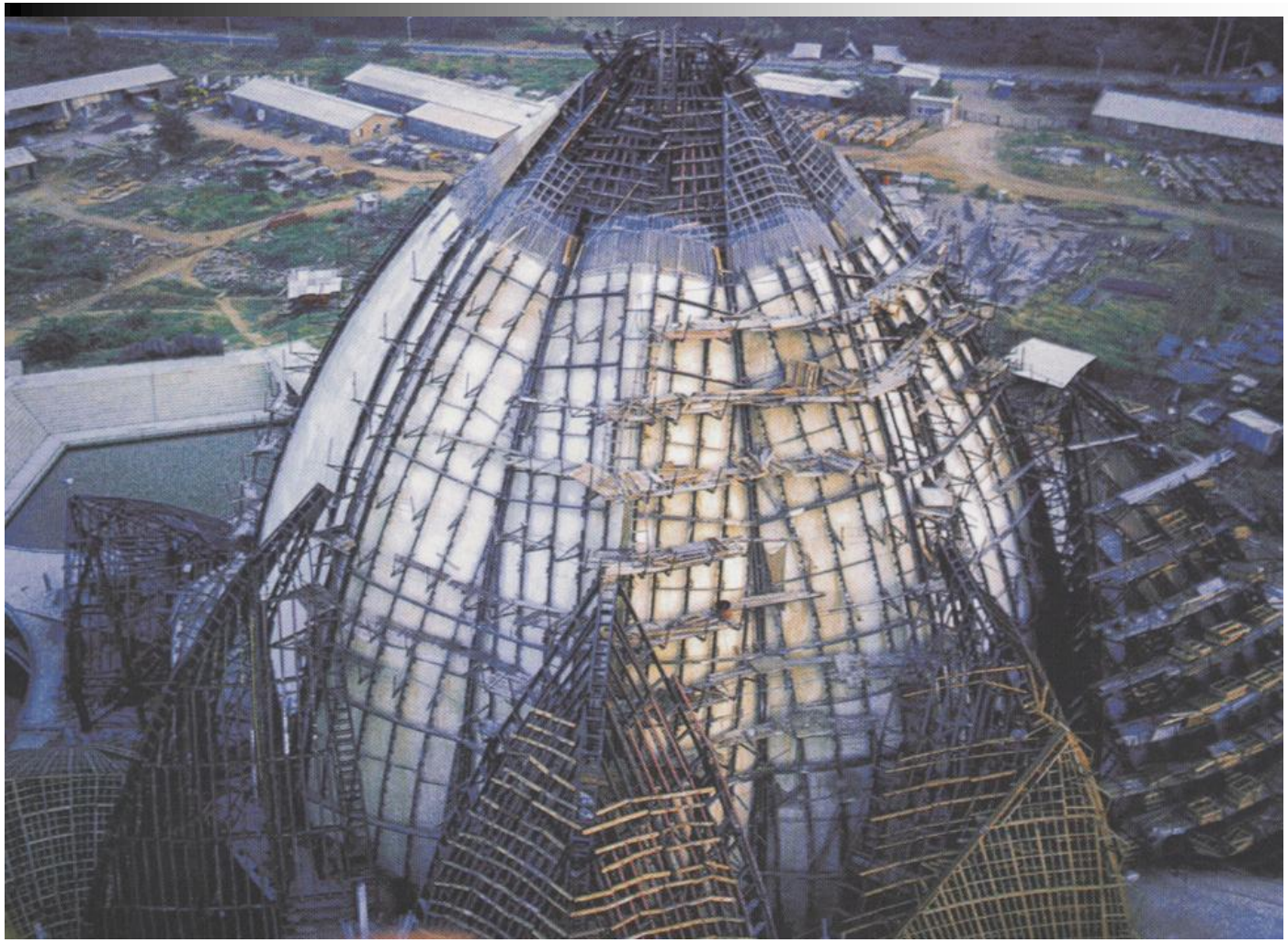
General design (4)



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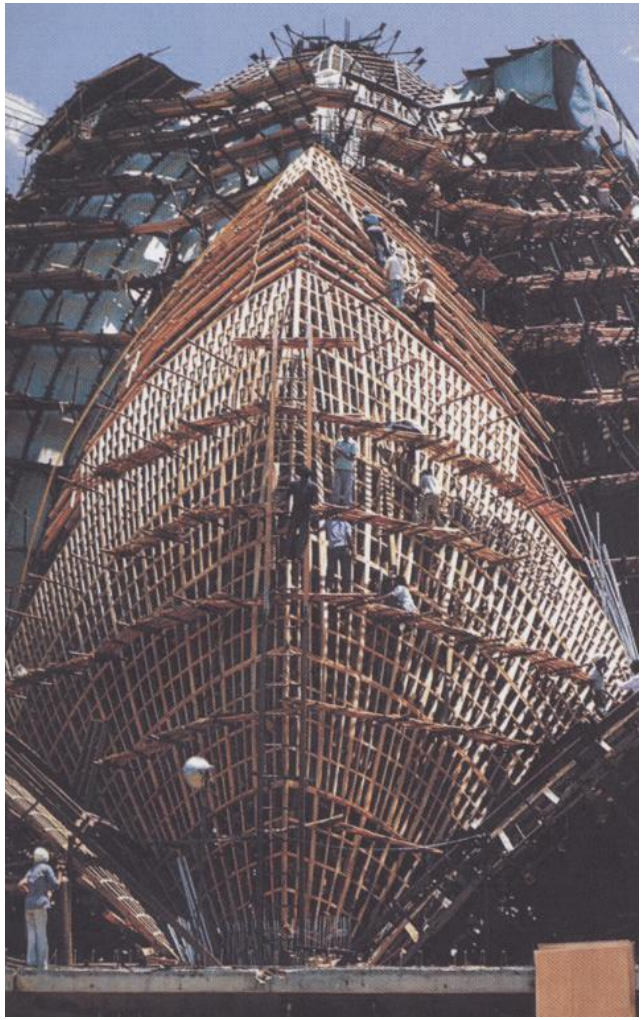
General design (5)



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General design (6)

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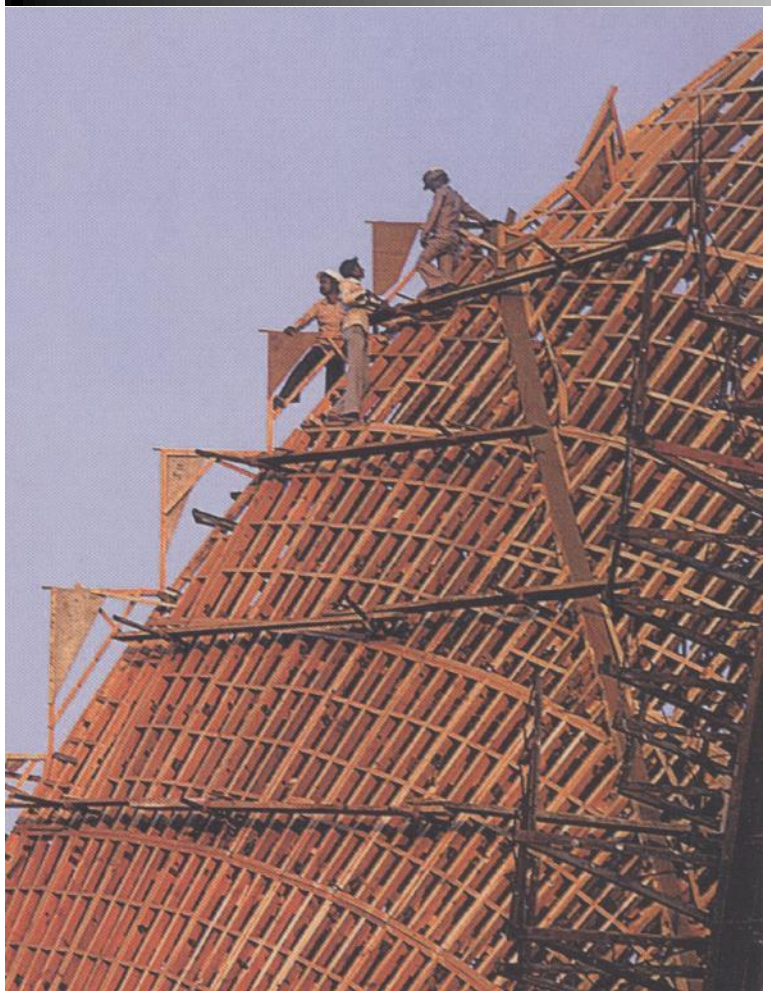
General design (7)



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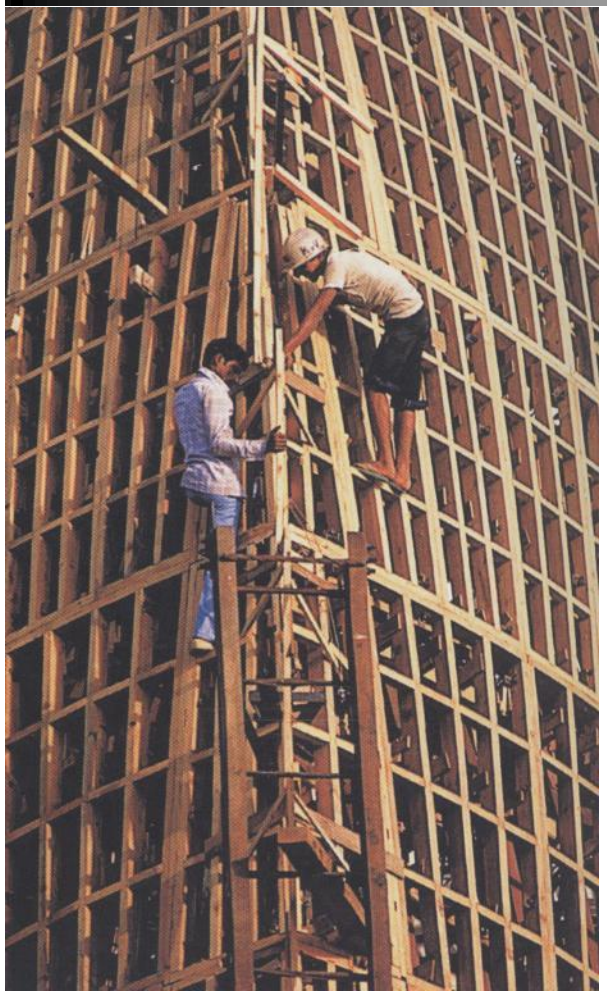
General design (8)



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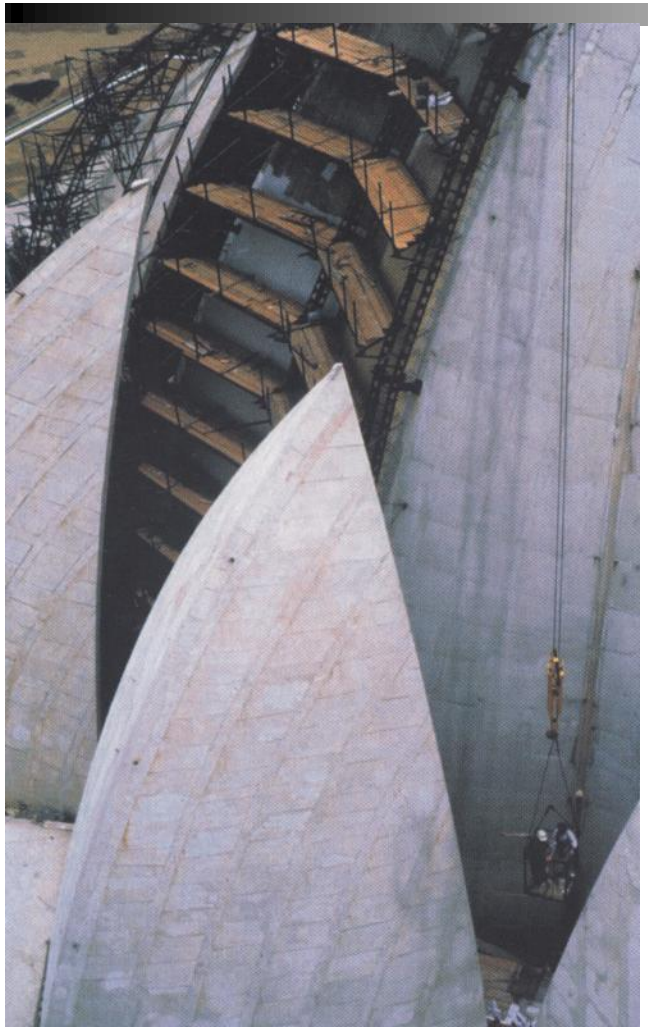
General design (9)



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General design (10)

Good Hope Centre, Cape Town (Deacon, 1997)

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General design (11)

Investec Office Complex scaffolding collapse, Sandton, August, 1997 (Prinsloo, 1997)

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General design (12)

Precast wall panels, Dublin (Smallwood, 2004)

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General design (13)

Precast floor panels, Dublin (Smallwood, 2004)

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Choice of structural frame (1)

- Load bearing masonry:
  - Mass of materials
  - Manual handling / Bending and twisting
  - On-site storage (housekeeping!)
- Timber frame:
  - Pre-fabrication
  - Light weight
  - Less on-site storage = enhanced housekeeping
  - Less manual handling
  - Engenders mechanization
- Structural steel:
  - Less on-site storage = enhanced housekeeping
  - Pre-assembly
  - Less manual handling
  - Very challenging elevated work

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Choice of structural frame (2)

- **Reinforced concrete:**
  - On-site storage (housekeeping!)
  - Manual handling / Bending and twisting / Use of body force
  - Challenging elevated work

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Details (1)

- Affect constructability
- Affect work method
- Affect work postures
- Affect required plant and equipment
- May require ‘special’ access

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Details (2)

Externally installed full fenestration, Dublin (Smallwood, 2004)

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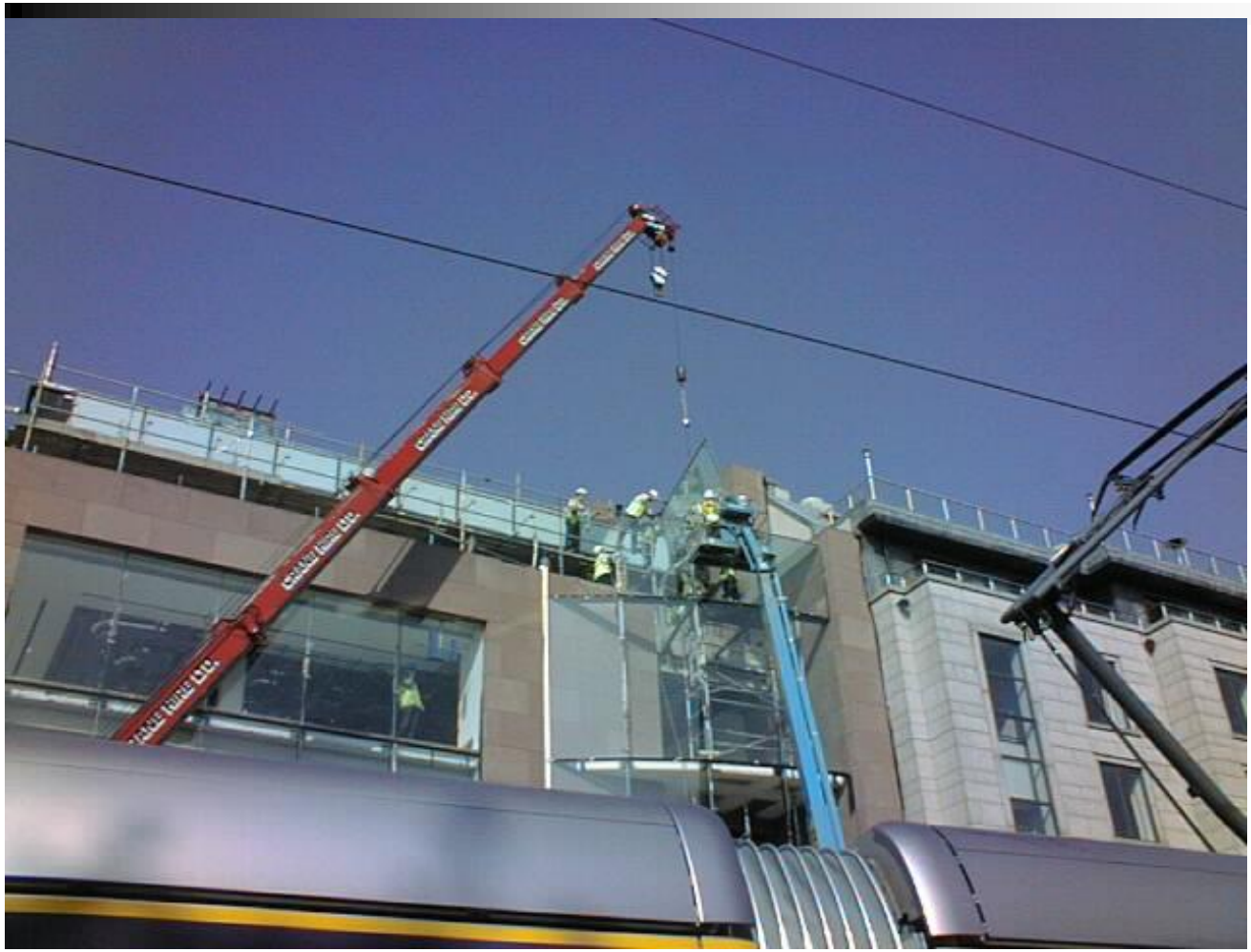
Details (3)



Externally installed full fenestration, Dublin (Smallwood, 2004)

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Provision for services (1)

- Affects construction ergonomics:
  - No. of services e.g. in ceiling
  - Layering (horizontal plane)
  - Space for working and fixing e.g. in vertical ducts
  - Method of fixing
- Therefore, optimum:
  - Coordination
  - Layering
  - Sectional area (vertical ducts)

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Provision for services (2)

Congested ceiling space, Cape Town (Smallwood, 2004)

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Provision for services (3)

Congested ceiling space, Cape Town (Smallwood, 2004)

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Position of fittings (1)

Porte Cochere, Nelspruit Airport (Smallwood, 2004)

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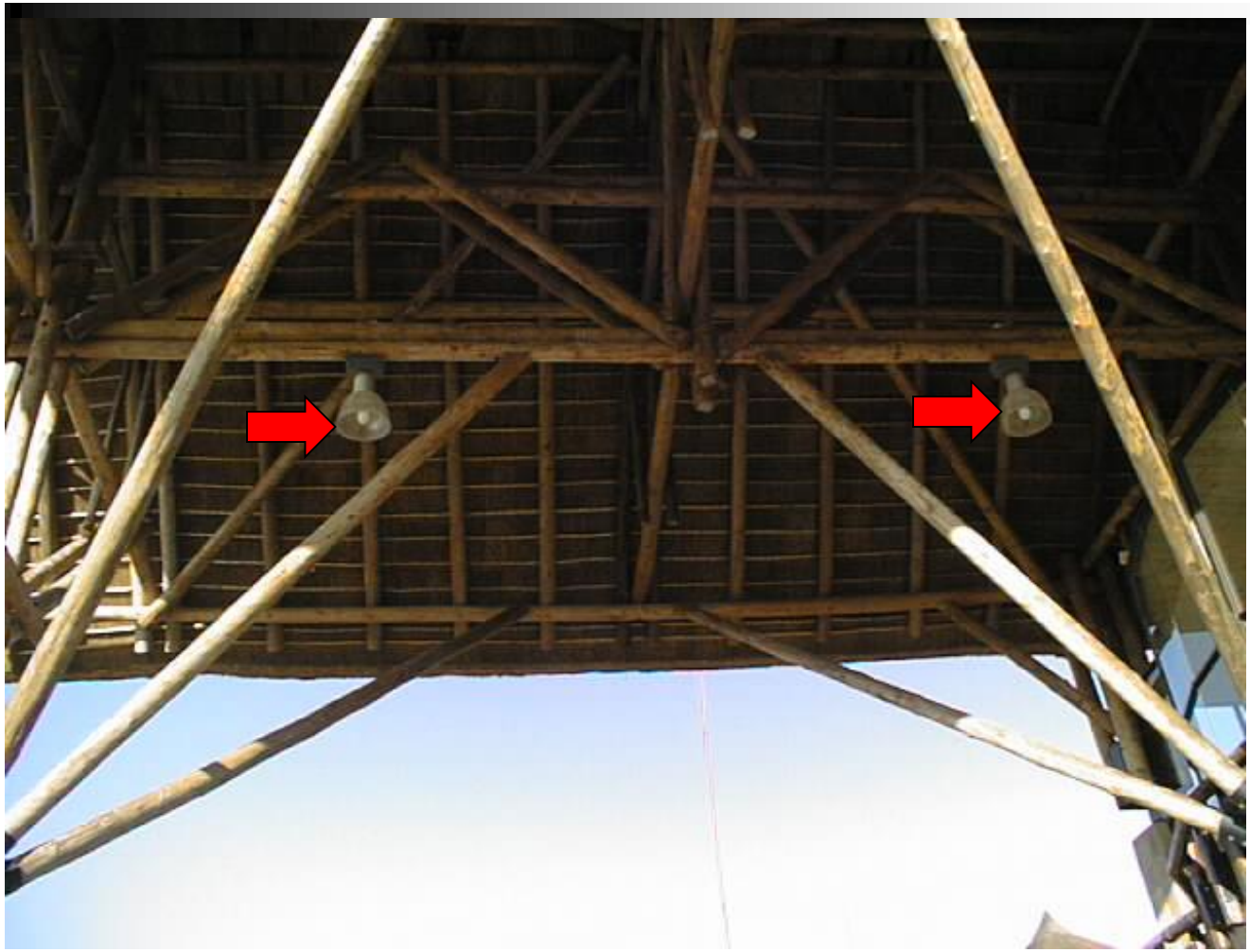
Position of fittings (2)



Light fittings, Porte Cochere, Nelspruit Airport (Smallwood, 2004)

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Materials (1)

May be / have:

- Heavy - mass per unit / m / m^2 / m^3
- Rough surface
- Sharp edges
- Toxic
- Large e.g. ceiling / drywall panels and glass shop fronts

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Materials (2)

‘Melting’ mastic asphalt, Canal Walk, Cape Town (Smallwood, 2000)

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Impact of design(ers) (1)

Occasion	Response (%)						MS	Rank
	Don't know	Never	Rarely	Some-times	Often	Always		
Site inspections/ discussions	0.0	3.0	17.2	23.2	26.3	30.3	3.64	1
Site meetings	0.0	3.1	17.3	23.5	32.7	23.5	3.56	2
Site handover	1.0	9.1	18.2	19.2	19.2	33.3	3.50	3
Preparing project documentation	1.0	7.1	26.3	24.2	18.2	23.2	3.24	4
Pre-tender meeting	1.0	11.2	24.5	20.4	20.4	22.4	3.19	5
Working drawings	1.0	11.2	25.5	20.4	18.4	23.5	3.18	6
Evaluating tenders	2.0	15.0	23.0	19.0	16.0	25.0	3.13	7
Detailed design	1.0	11.2	26.5	20.4	20.4	20.4	3.12	8
Pre-qualifying contractors	1.0	10.1	25.3	28.3	17.2	18.2	3.08	9
Constructability reviews	4.1	12.2	24.5	22.4	19.4	17.3	3.05	10
Design coordination meetings	1.0	10.3	34.0	24.7	15.5	14.4	2.90	11
Client meetings	2.0	11.1	30.3	29.3	14.1	13.1	2.88	12
Concept (design)	1.0	19.2	27.3	21.2	15.2	16.2	2.82	13
Deliberating project duration	4.2	15.8	29.5	23.2	15.8	11.6	2.77	14

Table 1: Frequency at which Architectural practices consider / refer to H&S on various occasions (MS: 1.00 – 5.00) (Smallwood, 2000)

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Impact of design(ers) (2)

Occasion	Response (%)						MS	Rank
	Unsure	Never	Rarely	Some-times	Often	Always		
Site meetings	0.0	0.0	2.1	12.4	35.1	50.5	4.34	1
Site inspections / discussions	0.0	1.0	1.0	13.4	41.2	43.3	4.25	2
Site handover	1.0	1.0	6.3	12.5	28.1	51.0	4.20	3
Preparing project documentation	0.0	1.0	4.1	18.6	33.0	43.3	4.13	4
Detailed design	0.0	2.1	13.5	24.0	31.3	29.2	3.72	5
Working drawings	1.0	1.0	18.6	22.7	33.0	23.7	3.58	6
Pre-tender meeting	1.0	4.2	20.8	18.8	30.2	25.0	3.49	7
Constructability reviews	2.1	2.1	17.5	24.7	37.1	16.5	3.44	8
Concept (design)	0.0	4.1	14.4	35.1	28.9	17.5	3.41	9
Client meetings	0.0	4.1	12.4	41.2	32.0	10.3	3.32	10
Design coordination meetings	0.0	3.1	17.5	41.2	25.8	12.4	3.27	11
Evaluating tenders	0.0	9.4	29.2	22.9	25.0	13.5	3.04	12
Deliberating project duration	4.1	9.3	25.8	29.9	26.8	4.1	2.82	13
Pre-qualifying contractors	3.2	13.7	28.4	20.0	26.3	8.4	2.81	14

Table 2: Frequency at which Engineering practices consider / refer to H&S on various occasions (MS: 1.00 – 5.00) (Smallwood, 2004).

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Impact of design(ers) (3)

Aspect	Response (%)						MS	Rank
	Don't know	Never	Rarely	Some-times	Often	Always		
Specification	2.0	6.1	17.3	20.4	25.5	28.6	3.54	1
Method of fixing	1.0	6.1	16.2	19.2	34.3	23.2	3.53	2
Position of components	4.0	8.1	15.2	21.2	33.3	18.2	3.40	3
Edge of materials	4.0	11.1	20.2	15.2	22.2	27.3	3.36	4
Content of materials	2.0	8.1	20.2	22.2	25.3	22.2	3.34	5
Details	3.1	12.2	15.3	22.4	24.5	22.4	3.31	6
Finishes	4.1	9.2	21.4	20.4	23.5	21.4	3.28	7
Type of structural frame	4.0	9.1	22.2	19.2	25.3	20.2	3.26	8
Plan layout	5.1	12.2	19.4	21.4	19.4	22.4	3.22	9
Texture of materials	3.0	13.1	18.2	26.3	20.2	19.2	3.15	10
Design (general)	1.0	11.2	23.5	28.6	18.4	17.3	3.07	11
Schedule	6.2	14.4	20.6	21.6	21.6	15.5	3.03	12
Surface area of materials	6.1	17.3	18.4	19.4	21.4	17.3	3.03	13
Elevations	5.1	15.3	23.5	22.4	15.3	18.4	2.98	14
Site location	3.0	18.0	26.0	20.0	14.0	19.0	2.90	15
Mass of materials	5.1	13.3	26.5	26.5	16.3	12.2	2.87	16

Table 3: Frequency of which Architectural practices consider / refer to H&S relative to various design related aspects (MS: 1.00 – 5.00) (Smallwood, 2000)

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Impact of design(ers) (4)

Aspect	Response (%)						MS	Rank
	Unsure	Never	Rarely	Some-times	Often	Always		
Specification	1.0	3.1	8.2	8.2	35.1	44.3	4.07	1
Method of fixing	3.1	3.1	6.2	14.4	34.0	39.2	3.94	2
Design (general)	1.0	0.0	10.4	21.9	38.5	28.1	3.82	3
Details	1.0	4.2	14.6	19.8	33.3	27.1	3.63	4
Type of structural frame	10.4	8.3	8.3	15.6	19.8	37.5	3.49	5
Position of components	5.2	7.2	13.4	18.6	36.1	19.6	3.37	6
Content of material	5.2	7.2	9.3	32.0	25.8	20.6	3.33	7
Plan layout	6.2	7.2	11.3	22.7	35.1	17.5	3.32	8
Site location	4.1	9.3	17.5	18.6	27.8	22.7	3.29	9
Schedule	4.1	10.3	13.4	28.9	28.9	14.4	3.15	10
Elevations	7.2	9.3	18.6	19.6	28.9	16.5	3.10	11
Mass of materials	8.3	7.3	18.8	24.0	24.0	17.7	3.09	12
Edge of materials	8.2	8.2	15.5	32.0	22.7	13.4	3.01	13
Finishes	4.1	11.3	18.6	33.0	23.7	9.3	2.93	14
Surface area of materials	8.3	12.5	22.9	29.2	16.7	10.4	2.73	15
Texture of materials	9.3	11.3	25.8	29.9	14.4	9.3	2.66	16

Table 4: Frequency at which Engineering practices consider / refer to H&S relative to various design related aspects (MS: 1.00 – 5.00) (Smallwood, 2004).

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Engendering H&S by designers

- Consideration of H&S throughout all stages of design: brief; concept; detailed design, and working drawings
- Pre-fabrication, pre-assembly, and pre-casting
- Minimal work at elevated heights
- Self-finished materials
- Engendering of mechanisation
- Appropriate procurement systems
- Reference to H&S in contract documentation
- Facilitate financial provision for H&S in contract documentation
- Reference to H&S during pre-tender, pre-contract and contract phases of construction, and during commissioning and maintenance phases of projects (and recycling and de-construction)

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Reduction of risk through design

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Implications of the Construction Regulations (1)

- To meet the client and designer requirements of the Construction Regulations requires clients and designers (including CPMs and QSs) to:
  - Identify hazards and assess the risk
  - Mitigate or eliminate the hazards and risks
  - Record the residual risk, if any (Designer Report and 'revised' H&S Specification)
  - Document the BRA and design HIRA processes
- All project stages: project initiation and briefing; concept and feasibility; design development; tender documentation and procurement; construction documentation and management, and project close out
- Required following any redesign during construction phase

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Implications of the Construction Regulations (2)

- Ergonomic related hazards require analysis, evaluation and to be addressed in the risk assessment

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Steps

- Collect up-to-date information
- Carry out the risk assessment - engage outside experts (if necessary)
- Identify priorities – quantify the risk
- Address ‘raw’ risk and ‘residual’ risk

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Collect up-to-date information

- Known H&S hazards for construction activities and specified aspects
- Relevant legislation, regulations, standards, and rules e.g. OH&S Act, Construction Regulations, and SANS
- Material safety data sheets (MSDSs)
- Client / Project manager / Other designers / QS / H&S consultants
- Effective protective / control measures / responses likely to be used or required

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Identification of hazards (Categories)

- **Falls from height:**
  - Structural erection
  - Window cleaning
  - Cladding
  - Roof work
- **Harmful substances:**
  - Contaminated land
  - Paint application
  - Stone cutting
- **Manual handling:**
  - Building blocks
  - Long roof sheets
  - Kerb stones
  - Paving slabs

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Identify priorities (1)

- Determine priorities based on risk
- Risk depends on two elements:
  - Likely severity of harm or ill health (consequence / impact)
  - Likelihood that the harm or ill health will occur (probability)
- Estimate the likely severity, likelihood of occurrence, number of people affected and the time necessary to take preventative measures
- Likely severity (consequence / impact):
  - Three categories – high, medium, and low
  - High – fatality, major injury or illness causing long-term disability
  - Medium – injury or illness causing short-term disability
  - Low – other injury or illness

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Identify priorities (2)

- Likelihood of occurrence (probability):
  - Three categories – high, medium, and low
  - High – certain or near certain to occur
  - Medium – reasonably likely to occur
  - Low – very seldom or never occurs

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Identify priorities (3)

Alternative approach (5-point scale) – more logical:

- **Likely severity:**
  - 5 – fatality
  - 4 – permanent disablement
  - 3 – temporary disablement
  - 2 – medical aid injury
  - 1 – first aid
- **Likelihood of occurrence:**
  - 5 – certain
  - 4 – near certain
  - 3 – reasonably likely
  - 2 – very seldom
  - 1 – never

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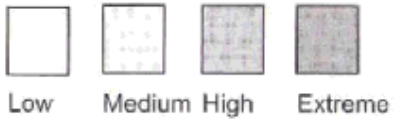
Risk quantification

- Need to quantify the likelihood of the risk occurring (probability) and the likely severity (consequence / impact)
- Evolve a probability and consequence / impact matrix:



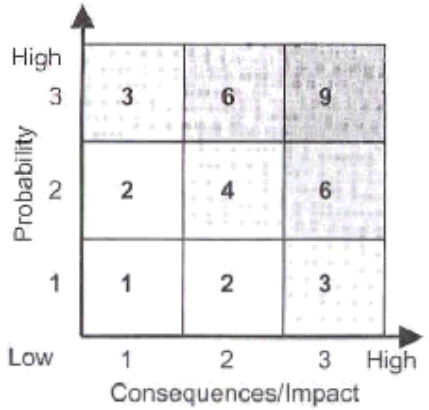


Figure 1: Probability / Impact matrix (Burke, 2003)

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Documentation

- Name(s) and function(s) of the assessor(s) / team
- Date of risk assessment
- Work breakdown structure (WBS) / Elements / Finishes / Activities
- H&S hazards and risk / the above
- Response
- H&S report / specification reference
- Details of subsequent monitoring arrangements e.g. construction and requirements for further risk assessments

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Reduction of risk through design and specification (1)

- Optimum approach – prevent hazard arising and avoid risk:
  - Are there alternatives?
  - If not reasonably practicable - then combat at source
  - If not reasonably practicable - then priority for measures to control risk that provide communal protection
- Specification of PPE to control risk is a last resort

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Reduction of risk through design and specification (2) (Groundwork) (1)

- Collapse:
  - Avoid / Combat at source: Effect of excavations on adjacent structures
  - Communal protection: Temporary support versus temporary instability
- Hazardous substances:
  - Avoid: Locate structures, pipe runs to avoid contaminated areas
- Noise and vibration:
  - Avoid: Quieter methods e.g. bored versus hammer driven piling

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Reduction of risk through design and specification (3) (Groundwork) (2)

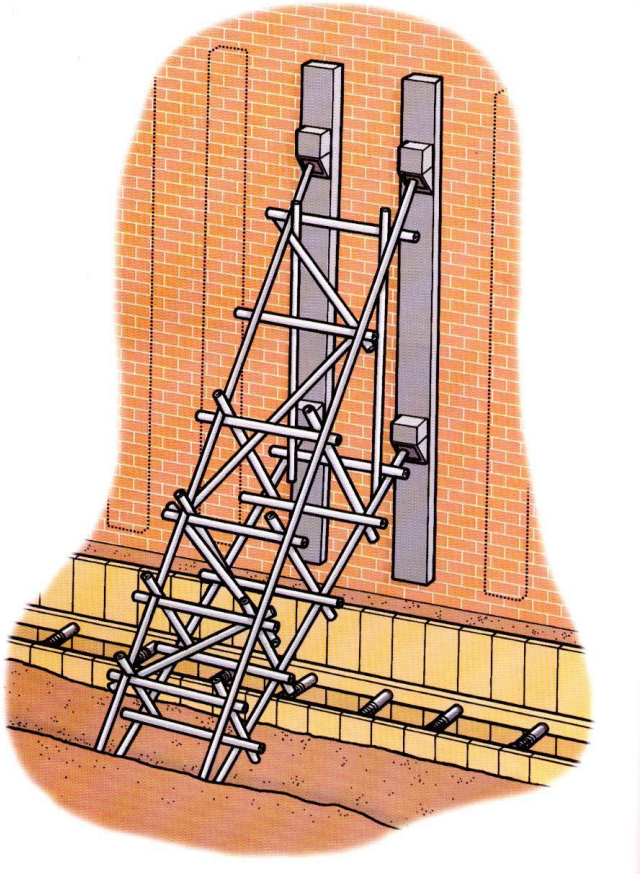

Figure 2: Shoring of building with excavation at base of building (HSE, 1999)

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Reduction of risk through design and specification (4) (Erecting structures) (1)

- Falls from height:
  - Avoid: Connections at height – pre-assembly
  - Communal protection:
    - Erect stairways and floors as the frame is erected
    - Incorporate guardrails into the design
  - Personal protection: Design steelwork to accommodate static lines

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Reduction of risk through design and specification (5) (Erecting structures) (2)

(Steel Construction, 2004)

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Reduction of risk through design and specification (6) (Erecting structures) (3)

(Steel Construction, 2004)

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Reduction of risk through design and specification (7) (Erecting structures) (4)

(Steel Construction, 2004)

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Design HIRAs

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Design HIRA practices (1)

What they should do (Smallwood, 2016):

- Document the design HIRA process
- Review the client H&S specification
- Maintain a register of project hazards and risk
- Gather H&S information relative to projects
- Assemble H&S expertise e.g. consult an H&S Agent
- Identify hazards
- Avoid / Eliminate hazards
- Amend designs
- Amend details
- Substitute materials
- Identify residual hazards
- Identify risks from residual hazards
- Assess / Prioritise / Investigate selected risks

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Design HIRA practices (2)

- Focus on significant / Unusual / Difficult risks
- Prepare design and construction method statements
- Provide information on residual risks e.g. on drawings
- Prepare a ‘designer report’ (H&S) for clients
- Provide H&S information for tender documentation
- Prepare a ‘design loop’ for temporary works
- Review the construction phase H&S plan
- Monitor construction activities relative to design HIRAs
- Conduct site risk assessments and actions / directions
- Revisit the process if the design changes at any point
- Consider H&S during maintenance
- Contribute to the H&S file
- Compile a project H&S ‘lessons learnt’ report
- Maintain a practice register of hazards and risk

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Designer report

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Designer 'Report' - Significant design and construction hazards

- Design assumptions and control measures e.g. design and construction method statements – composite slabs, and structural steel i.e. temporary support
- Arrangements for co-ordination of on-going design work and handling design changes e.g. nominated subcontractors' shop drawings
- Information on significant hazards identified during design e.g. bush-hammered concrete
- Removal of spalling concrete and exposure of corroded reinforcing steel
- Materials requiring particular precautions e.g. heavy blocks, paving slabs, and precast concrete kerbs

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Designer 'Report' - Visual examples (1)

Precast planks / ribs and blocks to composite slab, Plettenberg Bay (Hamp-Adams, 1994)

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Designer ‘Report’ - Visual examples (2)

Precast planks / ribs and blocks to composite slab, Plettenberg Bay (Hamp-Adams, 1994)

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Designer ‘Report’ - Visual examples (3)

Bush-hammered concrete, UPE (Smallwood, 1994)

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Designer ‘Report’ - Visual examples (4)

Exposing of corroded steel to piers beneath Dar Es Salaam Quay (Deacon, 2005)

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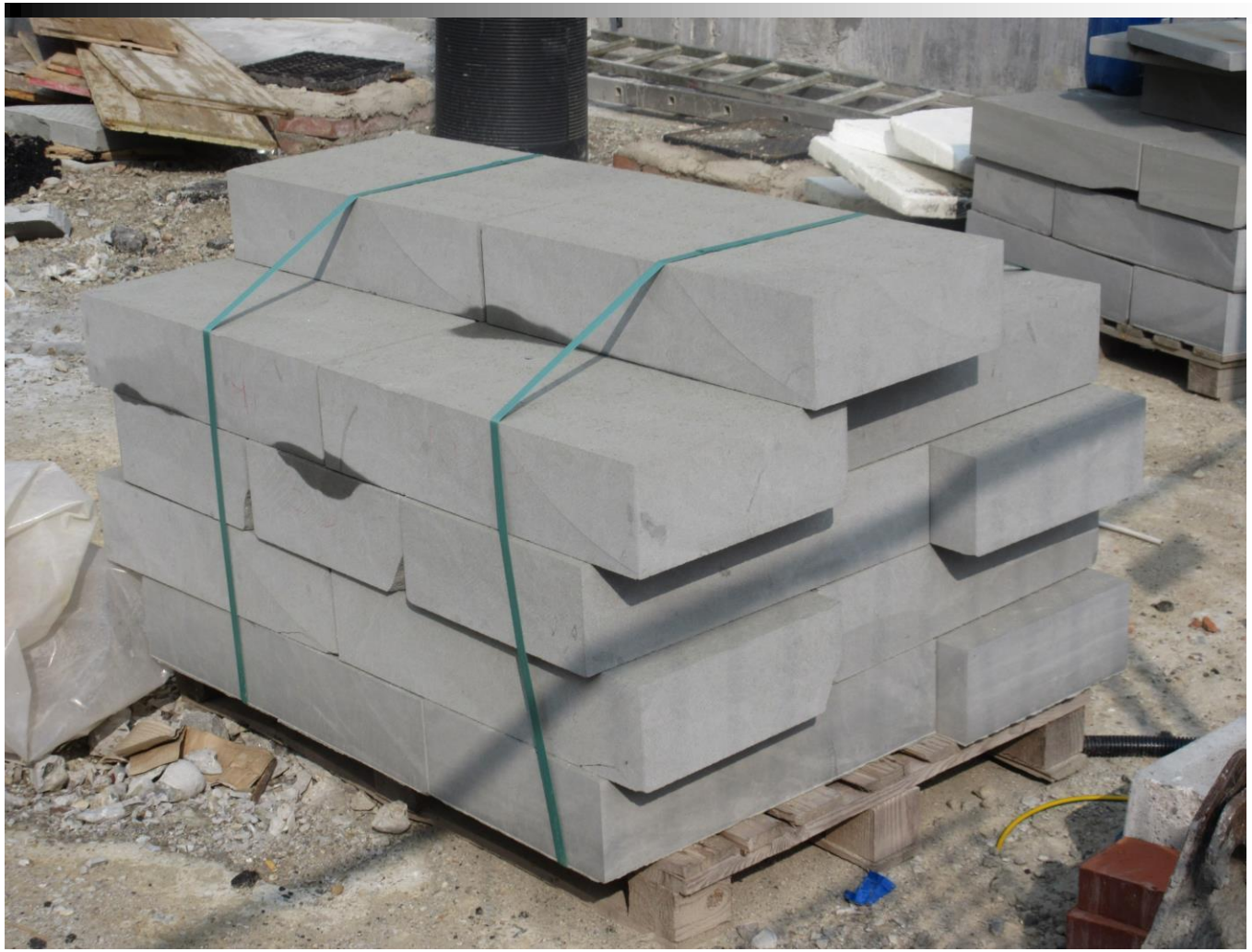
Designer ‘Report’ - Visual examples (5)



Heavy paving slabs, Florence, Italy (Smallwood, August 2018)

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Design and construction method statements

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‘Design and Construction’ Method Statements (MSs) (1)

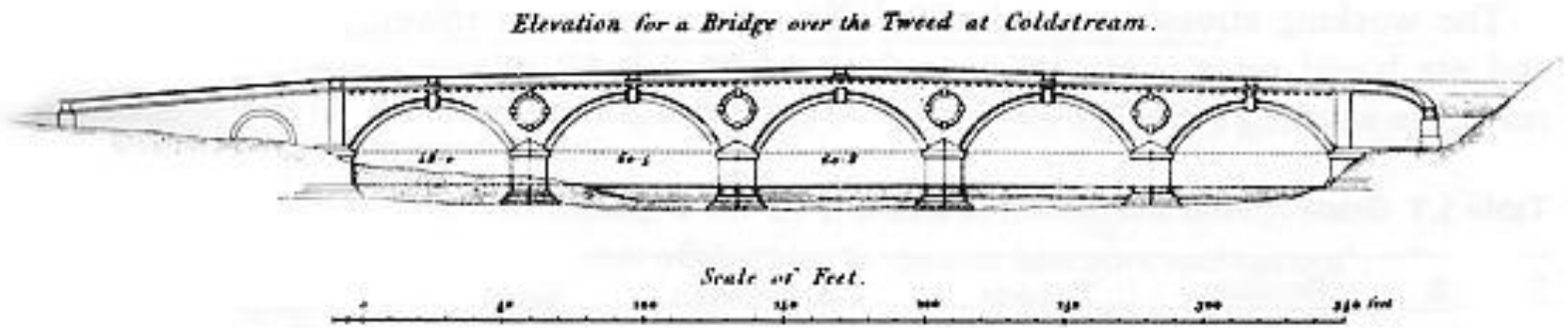

Figure 1: Elevation of masonry Bridge over the Tweed at Coldstream, 1866 (Irwin and Sibbald, 1983)

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‘Design and Construction’ MSs (2)

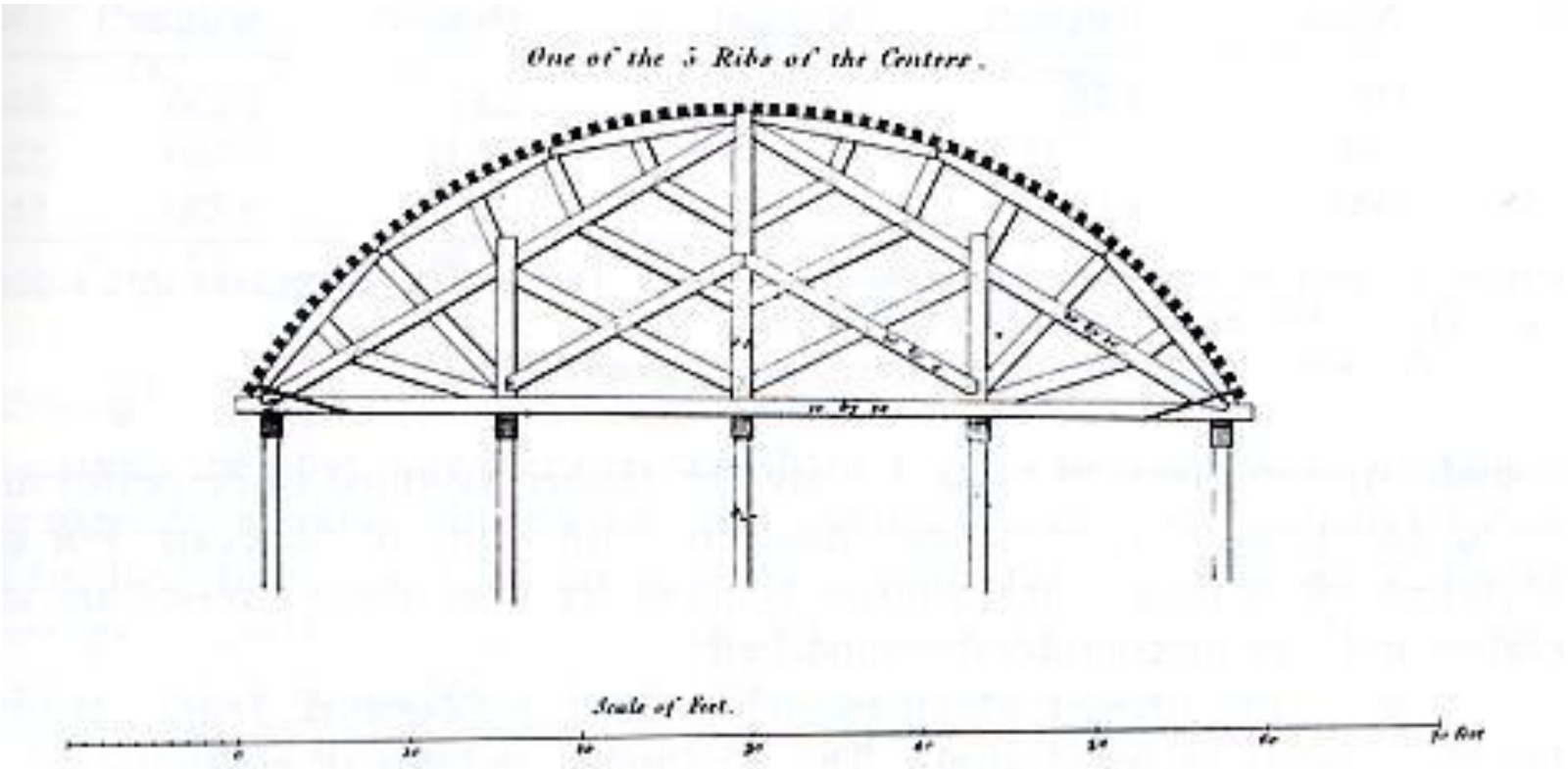

Figure 2: Centering for masonry Bridge over the Tweed at Coldstream, 1866 (Irwin and Sibbald, 1983)

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Role of 'Design and Construction' MSs

- Enable an 'expanded' perspective / overview
- Realise optimum methodology
- Assure quality / integrity of the structure
- Mitigate hazards / Assure H&S
- Complement generic planning endeavours such as programming, site layouts, and temporary works design
- Complement H&S plans
- Provide a reference for referral to during the pre-tender, pre-contract and contract phases - communicate with site management and the workforce

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‘Design and Construction’ MSs (Visuals) (1)

Precast planks / ribs and blocks to composite slab, Plettenberg Bay (Hamp-Adams, 1994)

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‘Design and Construction’ MSs (Visuals) (2)

Precast planks / ribs and blocks to composite slab, Plettenberg Bay (Hamp-Adams, 1994)

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Inclusions in ‘Design and Construction’ MSs

- Description
- Loads e.g. *x* kg per square meter (composite system)
- Hazards and risks e.g. mass of planks (per meter) and blocks (each)
- Interventions and duration e.g. temporary support including bracing, for *x* days
- Precautions e.g. *x* days before *y* load per square meter after pouring ‘overlay’
- General requirements e.g. pre-pour inspection

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Key points

- Design occurs upstream of construction
- Designers influence H&S directly and indirectly
- Directly through: general design; choice of structural frame; details; method of fixing, and specification of materials and finishes
- ‘Prevention through design’ means just that:
  - HIRA identifies raw risk
  - Eliminate, substitute, or ‘engineering controls’ e.g. ‘design and construction’ method statements
  - Residual risk
- Designers are liable for the impact of design on construction H&S

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References (1)

- Mount Isa Mines Limited (MIML) and National Safety Council of Australia (NSC). 1992. Practical, Effective Construction Safety. Brisbane: MIML and NSC.
- Prinsloo, K. 1997. Beeld, 27 August, p.3.
- 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. 2000. A study of the relationship between occupational health and safety, labour productivity and quality in the South African construction industry. Unpublished PhD Thesis. University of Port Elizabeth, Port Elizabeth.
- Smallwood, J.J. 2004. The influence of engineering designers on health and safety during construction. Journal of The South African Institution of Civil Engineering. 46(1), 2-8.

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References (2)

- The National Spiritual Assembly of the Bahia'is of India. 2002. The Dawning Place of the Remembrance of God. New Delhi: Thomson Press.

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