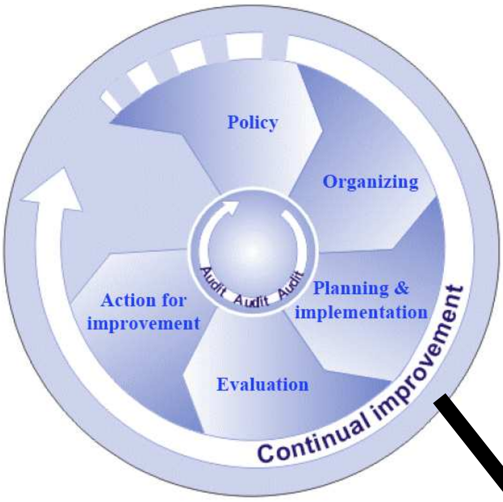
International Labour Office Training Programmes
Occupational Safety & Health for the Construction Industry

Construction OS&H

A training course construction companies ('contractors')



Model Course Handbook

A systematic programme for improving

procedures and practices

for the benefit of all who participate

in this major and socially important industry

"The primary goal of the ILO today is to promote opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and human dignity."

(Juan Somavia, ILO Director-General)

Construction OS&H
For construction companies (‘contractors’)

COURSE HANDBOOK

INTRODUCTION

Construction is a five trillion US dollar global industry, according to recent estimates from FIDIC, the International Federation of Consulting Engineers (http://www.fidic.org/). It is a huge provider of employment for around 150 million people, 75% of whom are to be found in developing countries. Today, however, few workers are directly employed in direct labour organisations in the public sector, or by large general contractors; 90% of construction firms worldwide are micro-enterprises, employing less than ten workers. In Europe, 97% employ less than 20 workers. There are huge numbers of people in the informal economy and large numbers who are supposedly, although not genuinely, “self employed”.

There are two main areas for social development opportunity provided by the construction industry:

> Firstly, the product itself. That is, the benefits to society through the provision of much needed infrastructure, which may be roads, housing, schools, hospitals, power and transport.
>
> Secondly, the process, which can provide desperately needed jobs, but also jobs which respect internationally recognised Labour Standards and National labour laws.

‘Building’ is both a process and a product

There are clear opportunities during the project construction and operation to expand both the number and the quality of jobs available. Specifically, the procurement phase is the key for clients to plan for and insist on all their contractors providing decent working conditions and high standards of safety, health and welfare for the workforce and everyone involved in their project. Labour practices and working conditions need to be addressed during design and procurement if they are to be included and costed in the contract sum and complied with during the construction phase.

There is an extremely high level of competition in the construction industry and in traditional competitive tendering contractors win bids by lowering their costs. Labour is a major component of these costs. Thus the winning tender may well be the one which pays the lowest wages, does not provide safety equipment or have coverage for accidents, and which has the largest proportion of informal workers, for whom no tax or social security is paid, and who are not covered in practice by any legal or social protection.

In this situation, the construction contract becomes a potentially important mechanism both for taking forward the implementation of labour standards and for demonstrating the benefits. There is a clear need for very strong contract clauses that relate specifically to labour standards to be included. This places formal responsibility on the contractor, but it is important to develop a process around the contract, which involves awareness raising for the client, designers, project management, contractor and all employers, as well as for the workforce, and which puts in place agreed mechanisms for monitoring compliance.

Construction clients, consultants, contractors, and workers should share the view that the Occupational Safety and Health (OS&H) of the workforce is a paramount concern in construction, recognizing the clear ethical and legal responsibilities to prevent deaths, injuries and ill-health. In addition to basic moral and legal obligations, there are sound economic reasons to prioritise the prevention of injuries and ill-health on construction projects. Not only can an accident cripple or kill a worker, it can shut a job down, thereby delaying the project's schedule, and it can expose parties, particularly clients, to civil claims for compensation and criminal charges and fines from the enforcement authorities.

Safety and health legislation in many countries is increasingly holding clients responsible for the safety and health of the workforce on their construction projects. This responsibility is generally passed on to designers and project managers, or directly to contractors and sub-contractors. Hence the terms on which these services are procured are critical in ensuring that the responsibility is taken seriously and the interests of the client are safeguarded.

Modular training programme

This Handbook is a collection of the main content of a comprehensive training progamme for construction contractors, structured as 'Module Summaries' on the topics listed below, for participants to take away and use for reference and guidance after the course.

Modules A-D explain the fundamental issues and principles of project Occupational Safety and Health required by today's construction industry.

Modules E-H explain OS&H managerial processes and procedures, and how these should be applied to the practical running of a safe and healthy project.

Modules I-N provide the technical knowledge that contractors and their employees require in order to understand construction operations so that they can plan and manage them accordingly.

A series of checklists are provided in Module Summary P: Conclusion.

Module code	MODULE SETS & TITLES
	Fundamental modules
A	Fundamental principles
B	General duties
C	Safe and healthy working environment
D	Workers' perspectives
	Project management modules
E	Principles of safe project management
F	Planning and control for OS&H
G	Processes and systems
H	Welfare and project site
	Technical modules
I	Personal protective clothing and equipment
J	General plant and equipment
K	Vertical movement
L	Horizontal movement
M	Working at or below ground level
N	Working at height
	Integration and concluding modules
O	Project (not detailed in this handbook)
P	Conclusion

THE SECTIONS IN THIS HANDBOOK

The contents of the Module Summaries are as shown in outline below.

A: FUNDAMENTAL PRINCIPLES

(Photo by Fiona Murie, BWI)

Summary of content	
1.	Preface
2.	‘Decent Work’ and ‘well-being at work’
3.	Ethics and humanity
4.	Corporate social responsibility
5.	National policy
6.	Need for a holistic culture and systems
7.	Requires real commitment from all involved
8.	Basic concepts of hazards and risks
9.	The business case for OS&H and business decisions
10.	Monitoring, reporting and reviewing performance
11.	Appendix: Decent Work, SafeWork
12.	Brief bibliography

1 PREFACE

" …… the promotion of the common welfare."

(from the Constitution of the International Labour Organisation (ILO))

"The Conference recognizes the solemn obligation of the International Labour Organization to further among the nations of the world programmes which will achieve …. adequate protection for the life and health of workers in all occupations"

(ILO Declaration of Philadelphia, May 1944)

The training programmes described in this set of documents, entitled **Construction OS&H,** have been produced by the ILO and Building and Woodworkers International (BWI), working in partnership. The principal authors were: Professor Richard Neale, Emeritus Professor of Construction Management, University of Glamorgan, Wales, UK; and Fiona Murie, Director, Occupational Health and Safety, and Construction Coordinator, BWI.

"For the BWI, the most effective way to ensure that workers' interests are protected in the work place is through legislation and regulation. In this connection, we work with the International Labour Organization (ILO) to lobby for the implementation of ILO standards and their respect in World Bank agreements."

(http://www.bwint.org)

This Module Summary explains the 'Fundamental Principles' of effective occupational safety and health management, under the headings listed in the table above. It begins with a review of the ILO programmes 'Decent Work' and SafeWork', before progressing to a discussion on ethics and corporate social responsibility, leading into the relationship between these international policies and procedures and national polices. The need for a holistic acceptance of these policies and commitment by all involved is then advocated, followed by a brief introduction to the fundamental concepts of hazards and risk. A 'business case' for OS&H is then argued, and the Module Summary concludes with an explanation of the need and the procedures for monitoring and improving OS&H performance.

A brief bibliography is given at the end of this Module Summary.

2 DECENT WORK AND ‘WELL-BEING’ AT WORK

“The primary goal of the ILO today is to promote opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and human dignity.”

(Juan Somavia, ILO Director-General; http://www.ilo.org/global/About_the_ILO/Mainpillars/WhatisDecentWork)

“This Report proposes a primary goal for the ILO in this period of global transition — securing decent work for women and men everywhere. It is the most widespread need, shared by people, families and communities in every society, and at all levels of development. Decent work is a global demand today, confronting political and business leadership worldwide. Much of our common future depends on how we meet this challenge.”

(“Decent Work”, Report of the Director General, ILO 87th Session, June 1999.)

The International Labour Organisation’s extensive programme entitled “Decent work for all” is based on the following statements:

“Work is central to people's well-being. In addition to providing income, work can pave the way for broader social and economic advancement, strengthening individuals, their families and communities. Such progress, however, hinges on work that is decent. Decent work sums up the aspirations of people in their working lives.”

(ILO's vision of decent work http://www.ilo.org/global/About_the_ILO , downloaded 27 01 2009)

“At the level of the firm, the key social protection issue is occupational health and safety. Every year about 250 million workers suffer accidents in the course of their work, and over 300,000 are killed. Taking account of those who succumb to occupational diseases, the death toll is over 1 million people a year. Yet international concern with awareness of health and safety at work remains surprisingly modest, and action is limited. Many developing and transition countries have little public information on this subject and need to reinforce their capacity to design and implement effective policies and programmes. Even today, many new investment decisions continue to ignore safety, health and environmental considerations.”

(“Decent Work”, Report of the Director General, ILO 87th Session, June 1999. P64.)

Decent Work has initiated the SafeWork programme:

InFocus — SafeWork: Security and productivity through safety and health at work

Taking accidents and diseases together, the global estimate of work-related deaths amounts to at least 1 million per year. The SafeWork programme will aim to create worldwide awareness of the dimensions and consequences of work-related accidents, injuries and diseases. It will promote the goal of basic protection for all workers in conformity with international labour standards, and it will enhance the capacity of member States and industry to design and implement effective preventive and protective policies and programmes. This may include the strengthening of the labour inspectorate. The primary focus will be on hazardous occupations.

The programme's approach will be two-pronged. First, it will create alliances and partnerships by launching activities that ILO constituents, non-governmental organizations and human rights groups can use in advocacy campaigns and to press for vigorous action by governments. Second, it will support national action through an integrated programme of direct technical assistance. This will include developing management tools and monitoring and information services that will help prevent occupational accidents and diseases and protect both workers and the environment. Activities will include:

- a worldwide advocacy campaign;
- a global statistical programme;
- national programmes of action;
- training programmes; and
- technical meetings for the international exchange of information and experiences on workers' safety and health.

("Decent Work", Report of the Director General, ILO 87th Session, June 1999. P64.)

A statement on the SafeWork programme by the Director General of the ILO is given in the Appendix.

3 ETHICS AND HUMANITY

Ethically, the ILO's view of OS&H is quite clear:

- Safety and health is a human right
- Safety and health is a value
- Human damage is incalculable

(http://www.ilo.org/public/english/protection/safework/cis/oshworld/xvwc/congrep/sld002.htm)

The quotations below illustrate the human scale of the problem in this industry.

"In construction at least 108 thousand workers are killed on site every year, that figure represents 30 per cent of all fatal injuries. That is one person dying every five minutes because of bad, and illegal, working conditions. The construction industry has a deservedly notorious reputation as being dirty, difficult and dangerous.

Workers are killed, injured and made sick whilst carrying out routine jobs. The hazards are well known and so are the prevention measures. The overwhelming majority of "accidents" are absolutely predictable and preventable. They are caused by failure to manage risks, or by straightforward negligence on the part of the employer."

(BWI web site http://www.bwint.org/default.asp?Issue=OSH&Language=EN)

Ethical considerations are therefore fundamental to any consideration of OS&H, which revolves around the value placed on human life, and this varies dramatically throughout the world. It is often said that rates of death and injury are related to the stage of a nation's development; that is, poor countries lack the resources to protect their workers during the development phase, because the resources are just not available. Perhaps the victims of this point of view are seen to be sacrificing themselves for the good of their country.

This point of view provokes questions about the reasons for continued poor OS&H performance in the so-called 'advanced countries'. The article below shows a 9% decrease in fatalities in the United Kingdom during 2007/08. This is seen to be a good achievement. But there were still 72 fatalities in this period the UK, which has one of the most developed OS&H systems in the world. What could be the reasons for this?

10 NEW CIVIL ENGINEER 06.11.08 | www.nce.co.uk

NEWS

HEALTH & SAFETY

Construction industry fatalities fall by 9%

By Seán Flynn

Fatalities in construction fell by 9% from 79 to 72 in 07/08

09%

Fatalities in construction fell by 9% last year, but the rate of reported major injury remains the highest of any main industry group, Health and Safety Executive (HSE) statistics revealed last week.

There were 72 fatal injuries to workers in construction in 2007/08, seven fewer than the previous year.

Of these 72 fatalities, 54 were employees and 18 were self-employed, compared to 54 and 25 in 2006/07. Fatal injuries in construction nevertheless accounted for 31% of all fatal injuries at work 2007/08.

The rate of fatal injury to workers in construction decreased to 3.4 per 100 000 workers, from 3.8 per 100 000 workers in 2006/07. The rate of fatal injuries in construction had been falling until last year, when a spike of fatal injuries was blamed on non-English speakers being more vulnerable in construction.

An HSE spokesman said the number of deaths and injuries had been falling until last year.

(Courtesy of New Civil Engineer: www.nce.co.uk)

This problem is discussed in excellent general review of this issue is provided by an ILO report “Introductory report: Beyond death and injuries: The ILO's role in promoting safe and healthy jobs. An extract from this report is given below.

“The pace of global socioeconomic development over the past 50 years, together with scientific and technical progress, has brought about an unprecedented volume of research and knowledge concerning risk management in general and the control of public and workplace risks in particular. Moreover, the advent of computer, Internet and other electronic communication systems has made this knowledge easier to access globally.

Such knowledge has been translated into a massive compendium of international, regional and national regulatory frameworks, as well as technical standards, guidelines, training manuals and practical information covering all the different aspects of occupational safety and health (OSH) for all branches of economic activity.

In most countries, the social dialogue mechanisms necessary for addressing work-related issues including OSH have been progressively established at both national and enterprise levels. Legal and technical instruments, tools and other measures to prevent occupational accidents and diseases have been put in place in all countries, albeit at different levels of comprehensiveness, sophistication, implementation and enforcement capacity.

Yet, despite this formidable expenditure of effort and resources, a plateau seems to have been reached when it comes to achieving decent, safe and healthy working conditions in reality. The latest ILO estimates indicate that the global number of work-related fatal and non-fatal accidents and diseases does not seem to have changed significantly in the past 10 years. This discrepancy between the level of efforts and results has many reasons, many of them brought on by the globalization of the world's economies. A closer look at the statistics shows that, although industrialized countries have seen steady decreases in numbers of occupational accidents and diseases, this is not the case in countries currently experiencing rapid industrialization or those too poor to maintain effective national OSH systems, including proper enforcement of legislation."

The text shown in highlight above states the fundamental problem that the **Construction OS&H** programmes have been designed to challenge.

In a very thorough book 'Ethics for the built environment', Peter Fewings makes the case that the size of the construction firm has a major influence:

"Accident statistics in the UK have shown that more fatalities have occurred on small contractors' sites than on large contractors' sites …"

"It is generally considered that a smaller organisation cannot easily absorb the start-up costs of a health and safety regime and therefore is stuck with a more risky commercial choice .."

At the highest level of a company, the ethical culture and practices originate in an ethics policy. Fewings quotes the ILO as being a leader in this field and mentions also past United States' President Clinton's 'no sweat' campaign, "which was instrumental in signing up companies to a trendsetters' register for companies who were prepared to lead the way in ensuring better conditions of work and better health and safety in the sweat shops of some emerging economies". The ILO is quoted as reporting that a large majority of companies in the USA have ethical codes but fewer European companies have such codes.

Peter Fewings’ book is highly recommended for further information on the topic of ethics in the built environment, and Chapter 6, “The ethics of construction quality, safety, health and welfare”, is especially relevant. The title of this chapter demonstrates the contemporary managerial understanding of the terms ‘quality’ and ‘Total Quality Management’, attaching very comprehensive meanings and looking at the various elements of time, cost, quality, safety, welfare, physical and social environment as a complete system which links all those involved in the project. This is an understanding of ‘quality’ that is embraced wholeheartedly by **Construction OS&H**.

There are, nevertheless, some encouraging signs that some companies in the ‘developed world’ are adopting an ethical and humanitarian perspective. The road sign below was seen by one of the authors of these training programmes when driving through some major highway works in the United Kingdom. Signs such as this are unusual, but emphasise an increasingly ethical and humanitarian view of occupational safety and health.

Please drive carefully and
observe the speed limits

Our employees do not
come to work to get
injured or killed

Another good example is taken from an advertisement by Murphy, a UK construction company:

“Experts in construction
Experts in safety

> **At Murphy, nothing comes higher on our list than safety. And to achieve such high safety standards, we make sure our workforce is full trained and ready for anything, whatever the conditions, whatever the project. The Health and safety of our employees is paramount”**

This company has made its full OS&H policy document available on the Internet.

Bovis Lend Lease has also established a clear policy for achieving high standards of OS&H but also general welfare. This international construction organisation makes a very clear commitment, as the followings example shows:

“Bovis Lend Lease will operate Incident & Injury Free and is committed to realising this wherever the Group has a presence. This philosophy reaches every part of the Group’s operations and extends to clients, suppliers, subcontractors and other stakeholders.

Bovis Lend Lease will:

- *Invest in what it takes to achieve this vision.*
- *Empower its employees to demonstrate leadership in making this vision a reality.*
- *Proactively work with all stakeholders including clients, designers, contractors and the workforce to make this vision a reality, and remains prepared to walk away rather than compromise the Group’s commitment to safety.*
- *Own and act on this vision. This requires a mindset intolerant of any injury or incident regardless of frequency or severity.*

Bovis Lend Lease believes:

- *That working Incident & Injury Free is a choice and a basic human right.*
- *Those who view Incident & Injury Free working as a given, and make this happen, will become leaders in the property industry.*

Bovis Lend Lease recognises:

- *That this vision is achievable if our employees and stakeholders are totally committed to it.*
- *That the commitment to being Incident & Injury Free requires individuals to take a personal stand and in doing so, demonstrate great courage and trust.”*

(The ILO is grateful to Bovis Lend Lease for the use of this quotation. It is 209 words long, so has been used under the convention of ‘Fair Use’ which allows a maximum of 400 words to be used without seeking formal permission.)

4 CORPORATE SOCIAL RESPONSIBILITY

Corporate Social Responsibility (CSR) is a concept and term that has become commonly used in recent years. The ILO defines it as:

“a way in which enterprises give consideration to the impact of their operations on society and affirm their principles and values both in their own internal methods and processes and in their interaction with other actors. CSR is a voluntary, enterprise-driven initiative and refers to activities that are considered to exceed compliance with the law.”

(ILO Subcommittee on multinational enterprises, GB.295/MNE/2/1 Geneva, March 2006)

The above committee paper continues with an illustration of the complexity of this concept:

“There is considerable debate on CSR and on the role of enterprises in society. Some are concerned that the expectations of enterprise CSR initiatives extend well beyond what might be considered as the legitimate role of an enterprise in society: CSR cannot substitute for the role of government. While others might agree with the primacy given to the law and its implementation, they note that CSR should not be confused with what society considers as the social responsibilities of enterprises: CSR is a voluntary concept involving responsibilities unilaterally identified by enterprise management.”

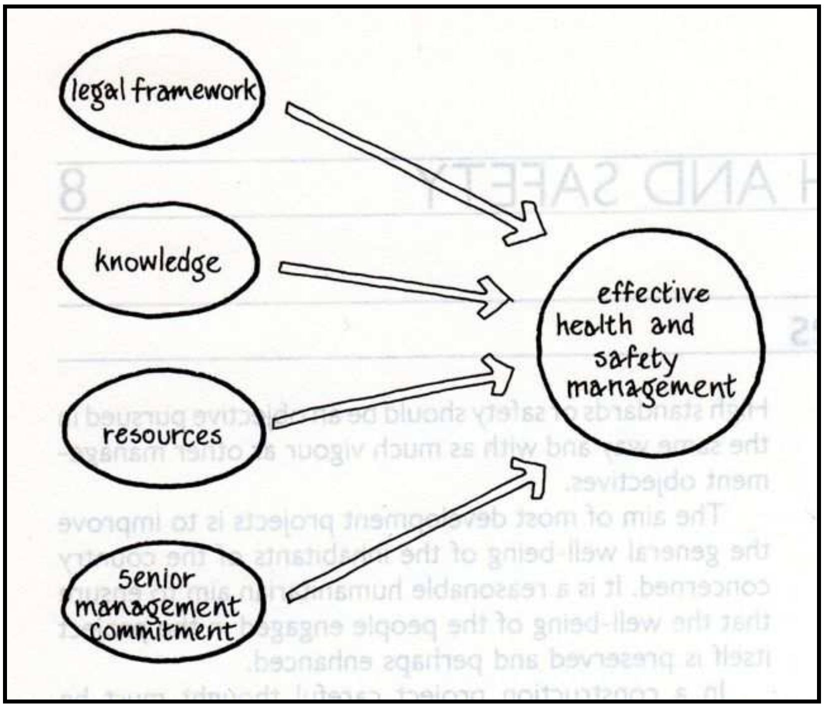
For a full discussion on this topic in the context of **Construction OS&H**, there is an excellent book by Mike Murray and Andrew Dainty, ‘Corporate social responsibility and the construction industry’; details are given in the Knowledge Base (see below). A chapter on the application of CSR to OS&H, written by John Smallwood and Helen Lingard, is especially relevant, and the following quotation makes the ethical point that the scope of CSR should include the well-being of all employees:

“… all people and organisations should be conscious and mindful of the health and well-being of each other, and their workers respectively. The results of managerial actions have extended consequences. These consequences are often experienced by people who have no control over the actions that caused them and, therefore, there is an argument that these consequences should be considered when decisions are made. If decisions can hurt or harm people in ways that are outside their individual control, then the issue is a moral one, which requires ethical analysis.”

(The ILO is grateful to Professors John Smallwood and Helen Lingard for the use of this quotation. It is 89 words long, so has been used under the convention of ‘Fair Use’ which allows a maximum of 400 words to be used without seeking formal permission.)

5 NATIONAL POLICY

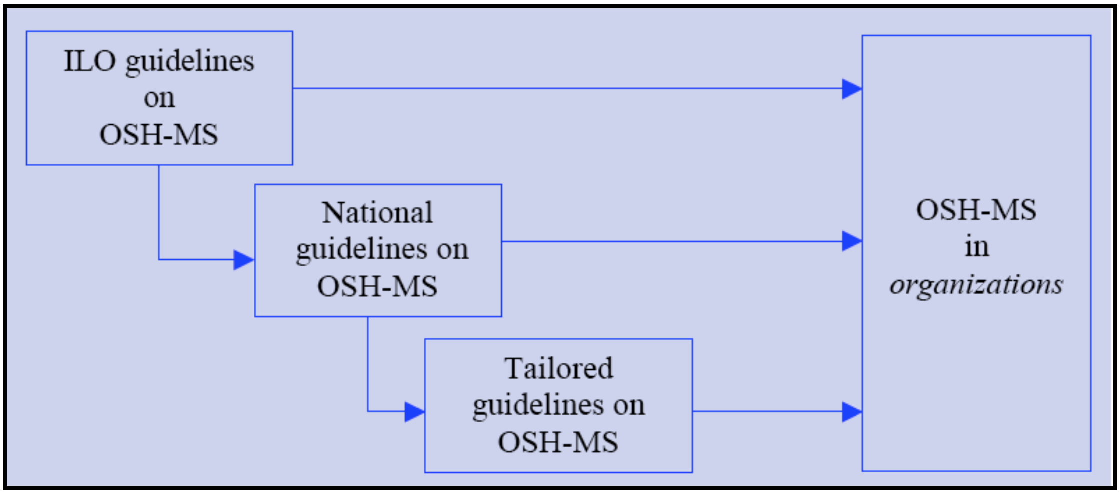
In 1984 the ILO published a book entitled "Managing construction projects" (see Knowledge Base) which identified four essential "principal factors in effective health and safety management", as shown in the following diagram:



The need for a legal framework was described as follows:

> **LEGAL FRAMEWORK**
>
> Most countries have a legal framework to ensure some degree of occupational health and safety. This legal framework usually lays down basic requirements of good employment practice, such as a minimum age for the employment of children. There may, in addition, be specific technical requirements relating to construction: for example, restrictions on the use of blue asbestos in buildings because of its detrimental effects on human health; or a simple technical construction requirement that the top of a ladder must be secured.
>
> In some industrialised countries this legal framework has become extensive and detailed. In many developing countries it is rudimentary. Regardless of its level of sophistication and comprehensiveness, a legal framework can provide only a technical basis from which a coherent safety policy may be developed. Accidents and ill-health are not, as is so often believed, the result of straightforward technical failures; they result from a combination of social, organisational and technical problems.

The implementation and enforcement of comprehensive national policies and regulations is recognized as being a fundamental key to improvement. The ILO proposes a hierarchy of guidelines and policies, from the ILO's international guidelines, through nationally established regulatory bodies to produce national guidelines and regulations, through to tailored guidelines for specific organizations or groups. This hierarchical structure and process should result in effective OS&H management in organizations. This is shown diagrammatically below:



(From: Guidelines on occupational safety & health management systems, ILO-OSH 2001)

The ILO's recommendations for a national OS&H system are as follows:

ESSENTIAL ELEMENTS OF A NATIONAL OSH SYSTEM

- Legislation, and any other relevant OSH instruments;
- One or more authorities or bodies responsible for OSH;
- Regulatory compliance mechanisms, including systems of inspection;
- A national tripartite advisory mechanism addressing OSH issues;
- Arrangements to promote at the enterprise level, cooperation between employers and workers;
- OSH information and advisory services;
- Systems for the provision of OSH training;
- Occupational health services;
- Research on OSH;
- A mechanism for the collection and analysis of data on occupational injuries and diseases;
- Provisions for collaboration with relevant insurance or social security schemes covering occupational injuries and diseases; and
- Support mechanisms for a progressive improvement of OSH conditions in micro, small and medium-sized enterprises, and in the informal economy.

But, as the next two sections show, a legal framework cannot improve OS&H on its own; three other principal factors must also be applied.

6 NEED FOR HOLISTIC CULTURE AND SYSTEMS

A construction project may be viewed as a matrix of time-based 'stages' as the project progresses from its inception to completion and commissioning, and at each of these stages a number of organizations and people are involved, each to a varying extent according to the activities in the stages. A simplified, general matrix, based on a traditional form of contract in which design and construction are separate activities, is shown below. The density of the shading in the boxes gives an indication of the amount of engagement of the different industry groups in the project at each stage.

Of course, this represents a simplification; for example in a design-and-build project the Procurement stage would precede the Design stage, and the amount of community engagement would depend on where the project is located. But the matrix does indicate how complex even quite small and straightforward projects can be, and how care must be taken to consider all those involved when designing and implementing an OS&H management system.

The real challenge is to make sure that systems are fully implemented throughout the project, for all those engaged in it. An obvious example of this problem is that it is frequently the case that a client insists on putting a strong OS&H clause in the contract with the main contractor, but this clause may not be repeated all the way down to a small labour contractor.

THOSE INVOLVED	PROJECT STAGES				
	Briefing	Design	Procurement	Construction	Commission
Client					
Authorities					
Project managers					
Local residents					
Designers					
Contractors					
Other consultants					
Sub-contractors					
Suppliers					
Workers					
Users					

The second and third 'principal factors' shown in the above diagram in Section 5 were summarized in the ILO Guide as follows:

THE NEED FOR KNOWLEDGE

Most people will take steps to reduce risk if they have sufficient knowledge of its existence. They need to know not just that the risk exists, but where, when and with what ferocity it will emerge. The key element is knowledge. The distribution and effective use of knowledge is a major management contribution to safety. With better information, instruction and training, most health and safety problems could be avoided. The ILO publication *Accident prevention* (Geneva, 2nd ed., 1983) provides valuable guide-lines in this respect.

The difficulty faced by managers is in making people fully aware of the need for safety. The key feature is the direct personal relevance of the information provided. General warnings, such as statutory warning notices displayed in works canteens, seem to have little effect. The project management team must take a positive approach to providing relevant, concise and clear information to the people involved, and do their utmost to ensure that this information is assimilated and acted upon.

RESOURCES

It is obvious that accidents and illness mean additional costs, and perhaps disruption of a project. It is, however, difficult to quantify these effects in financial terms, and equally difficult to quantify the financial benefits that may arise from the effective management of health and safety. Any measures taken which require the use of resources additional to the minimum required for "production" may therefore be seen only as additional expense. This expense may be significantly reduced if health and safety are given careful thought at the outset; but any safety policy must accept that some resources must be expended in achieving purely humanitarian objectives.

7 REQUIRES REAL COMMITMENT FROM ALL INVOLVED

The following quotation from the 1984 ILO book "Managing construction projects" remains relevant today:

"High standards of safety should be an objective pursued in the same way and with as much vigour as other management objectives. The aim of most development projects is to improve the general well-being of the inhabitants of the country concerned. It is a reasonable humanitarian aim to ensure that the well-being of the people engaged in the project itself is preserved and perhaps enhanced."

This philosophy places responsibility on all those engaged in construction projects to make the safety and health of themselves and those that they are working with one of their main priorities. This is essential to the effective application of OS&H principles and practices in an organization. The examples given above from Bovis and Murphy are very good examples of positive policies.

Senior management commitment is obviously crucial:

"The employer should show strong leadership and commitment to OSH activities in the organization and make appropriate arrangements for the establishment of an OSH management system".

(ILO-OSH-2001)

and the fourth 'principal factor' shown in the above diagram in Section 5 was summarized in the ILO Guide as follows:

"Only senior management has the influence, power and resources to take initiatives and set standards. Positive attitudes of senior managers will be reflected in a high degree of health and safety awareness throughout the project. The converse is also true, and lack of demonstrable interest by senior management in the welfare of the people involved will have a strongly detrimental effect on general morale and team spirit."

(ILO Guide to Construction Projects)

The project matrix given in Section 6 above shows how complex even modest construction projects can be in terms of all those involved, so it may be very difficult to follow such policies through to implementation in the workplace. Nevertheless, this can be achieved. A very progressive and encouraging project can be found in the rebuilding of the Baphuson Temple in Angkor, Cambodia, as described by an excellent short video on www.ilo.tv.org (See Knowledge Base). The video describes how good health and safety practices have been used during the re-construction of this historic temple. Workers have a large role in the design and application of safe working, and in training fellow workers. The site is also used as a demonstration project and for on-site training.

8 BASIC CONCEPTS OF HAZARDS AND RISKS

The following quotations are taken from the ILO-OSH-2001 (see Knowledge Base):

Hazard: The inherent potential to cause injury or damage to people's health

Hazard assessment: A systematic evaluation of hazards

Risk: A combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event

The following extracts from ILO-OSH-2001 explain the ILO's approach to managing hazards:

"3.10.1.1. Hazards and risks to workers' safety and health should be identified and assessed on an ongoing basis. Preventive and protective measures should be implemented in the following order of priority:
(a) eliminate the hazard/risk;
(b) control the hazard/risk at source, through the use of engineering controls or organizational measures;
(c) minimize the hazard/risk by the design of safe work systems, which include administrative control measures; and
(d) where residual hazards/risks cannot be controlled by collective measures, the employer should provide for appropriate personal protective equipment, including clothing, at no cost, and should implement measures to ensure its use and maintenance."

Clause 3.10.1.2 states that hazard prevention and control procedures or arrangements should be established and should:
"(a) be adapted to the hazards and risks encountered by the organization;
(b) be reviewed and modified if necessary on a regular basis;
(c) comply with national laws and regulations, and reflect good practice; and
(d) consider the current state of knowledge, including information or reports from organizations, such as labour inspectorates, occupational safety and health services, and other services as appropriate."

These basic concepts of hazards and risks are explained and developed more thoroughly in the Module Summary "Processes and systems".

The table below summarises some of the fundamental hazards which are likely to be encountered on construction sites. It is based on a publication by safe@work published by the State of Victoria Department of Education & Training in 2002: See www.sofweb.vic.edu.au. It is designed for school students who are taking their work experience in the construction industry, which all construction clients, design teams and contractors should encourage.

Hazard	Possible harmful effects
Powered tools and non-powered tools, including jackhammers, bolt-cutters and hand-held cutting saws	• Exhaust fumes • Contact with electrical conductors • Contact with cutting blades • Part of equipment breaking up, flying material
Working at height	Falls with potential for serious or fatal injury
Climbing on heavy construction equipment	Falls with potential for serious or fatal injury
Excavations	Collapse of excavations can bury people, causing crushing or asphyxiation
Mobile plant, including mobile platforms and moving traffic	Being struck by vehicles
Un-levelled terrain	Trips and falls
Cement products and other hazardous substances	• Dermatitis • Burns • Abrasion • Inhalation of harmful particles
Manual handling (involving bending, reaching, stretching, pulling, lifting, repetitive motions, and awkward posture)	Muscular disorders, including sprains and strains
Excessive noise	Long term exposure can cause deafness
Vibration	Musculoskeletal disorders
Heat, cold, wet and other weather conditions	• Heat rashes • Heat stress • Dehydration • Sunburn • Long-term exposure to UV radiation can cause cataracts and skin cancers • Frostbite • Hypothermia
Fatigue	• Cramps • Numbness
Inadequate amenities e.g. drinking water, toilets and washing facilities	Poor hygiene causes infections and allows then to spread
Sexual harassment and workplace bullying	• Emotional stress • Fear and anxiety • Physical illness

(The ILO is grateful to the State of Victoria Department of Education & Training for the use of this table, which has been adapted for use in Construction OS&H. It is 207 words long, so has been used under the convention of 'Fair Use' which allows a maximum of 400 words to be used without seeking formal permission.)

9 THE BUSINESS CASE FOR OS&H AND BUSINESS DECISIONS

“Disease and injury do not go with the job nor can poverty justify disregard for workers’ safety and health”

(ILO-OSH-2001)

No ‘business case’ should replace this basic ethical concept, but rational business arguments can lend support to it. ILO-OSH-2001 sets the context:

“Today, technological progress and intense competitive pressures bring rapid change in working conditions, work processes and organization. Legislation is essential but insufficient on its own to address these changes or to keep pace with new hazards and risks. Organizations must also be able to tackle occupational safety and health challenges continuously and to build effective responses into dynamic management strategies. These Guidelines on occupational safety and health management systems will support this effort.”

and what may be called “**the social business case**” has been described as follows:

“Changes in technology and production systems have led to changes in social consciousness, and to a new awareness of personal identity and human rights. Increasing consumer choice and access to knowledge and new means of communication have made individuals and social institutions not merely subjects but also potential actors in the process of globalization. Social preferences influence market outcomes and have an impact on corporate reputations. A good corporate social image is increasingly essential for business success.”

(ILO Decent Work Report, Section 1)

“We promote the social dimension of sustainable development in economic growth, environmental conservation and society since it will not make construction more expensive. For example, a good working environment reduces the risks of heavy physically demanding work, leads to fewer accidents at work, fewer sick days and thus shorter times and lower costs for the total construction.”

(BWI web site)

Professor Alan Griffith of Sheffield Hallam University, UK, (author of ‘Developing an integrated quality, safety and environmental management system’, see Knowledge Base) has contributed the following framework to this Module for the analysis of a business case.

"The business case and the economic case for OS&H must focus on:

- *OS&H is simply not optional – construction is dependent upon much and detailed legislation and regulation, so to discount on economic grounds is a non-starter.*

- *OS&H approaches do not put a price on life – it is a given that the safety of personnel is placed first and foremost irrespective of cost.*

- *The ramifications of OS&H if personnel get injured far outweigh any cost of not putting in place the requisite OS&H approach on construction projects.*

- *OS&H is a simple performance indicator which can/will be checked and verified at any pre-selection/pre-tender stage - many governmental organisations routinely check the OS&H record/performance of all tendering contractors.*

- *Organisations that invoke good OS&H practices and systems are generally diligent in other project performance indicators as this is a good indicator of ethos, culture and systematic approach.*

- *The OS&H management system is the cost item but the cost effective/cost reduction approach is to maximise the corporate system and minimise the project application (i.e. keep it simple, task effective, not based in bureaucracy/red-tape.*

- *Make the OS&H approach vested in the workforce through routine OS&H practice rather than implement OS&H as a managerial stick. The cost then becomes intrinsic to the workforce performance and not the management approach."*

An excellent and brief guide (nine pages) to preparing a business case has been published by the Government of Australia. (See "Guidance on preparing a simple OHS business case" in the Knowledge Base).

Guidance is also available from http://osha.europa.eu/en/topics/business/performance and http://www.osha.gov/dcsp/products/topics/businesscase/index.html.

An excellent case study which illustrates the social business case for responsible and effective OS&H practices is given in a Chapter by Smallwood and Lingard in the book "Corporate social responsibility in the construction industry", which is summarised in the Knowledge Base. This case describes the actions of an Australian company to avoid liability to its workers who had been exposed to toxic asbestos by legalistic changes to the structure of the company, including moving its parent company to the Netherlands. A special Commission of Enquiry by the New South Wales Government described the company's actions as 'a corporate washing of hands'. The publicity generated through this whole affair led to a 30% fall in the company's shares, and in the end, at enormous cost, the company did provide compensation for those employees who were affected.

In very practical ways, the business arguments for effective OS&H practices include:

- Incidents (accidents) have a very negative effect on staff motivation and morale generally
- Incidents cause delays and disruption, which has financial costs
- Delays and disruption may result in overall project delays
- Incidents may result in damage to the works, requiring remedial work
- The number and severity of incidents has an effect on insurance premiums
- A poor reputation for OS&H makes it difficult to recruit good employees
- A poor reputation for OS&H may influence potential clients, who may not wish to have their own reputations tarnished

10 MONITORING, REPORTING AND REVIEWING PERFORMANCE

As a final conclusion from the preceding sections of this Module, all organisations should strive towards 'zero incidents' and provide a healthy working environment for all those involved in all their construction projects. This can only be achieved through the formulation, application and continual assessment, revision and improvement of comprehensive management systems.

The ILO's 'Guidelines on occupational safety and health management systems' provides expert guidance on such systems, which are depicted diagrammatically below:

The cycle of 'continual improvement' shown in the diagram is a crucial concept, and the information provided in the preceding Sections shows that, in the construction industry, there is much scope for improvement.

FINALLY

‘Hazards Magazine’ is a useful way to keep up to date: www.hazards.org

11 APPENDIX

Decent Work, Safe Work

by Juan Somavía

Director-General, International Labour Office

The right to life is the most fundamental right. Yet every year 1.2 million *[as of 1999; 2.2 million according to 2005 figures]* men and women are deprived of that right by occupational accidents and work-related diseases. By conservative estimates workers suffer 250 million *[as of 1999; 270 million according to 2005 figures]* occupational accidents and 160 million *[according to both 1999 and 2005 figures]* occupational diseases each year. Deaths and injuries take a particularly heavy toll in developing countries, where large numbers of workers are concentrated in primary and extractive activities such as agriculture, logging, fishing and mining - some of the world's most hazardous industries.

This social and economic burden is not evenly distributed. Fatality rates in some European countries are twice as high as in some others, and in parts of the Middle East and Asia fatality rates soar to four-fold those in the industrialized countries with the best records. Certain hazardous jobs can be from 10 to 100 times riskier. Likewise, insurance coverage for occupational safety and health varies widely in different parts of the world: workers in Nordic countries enjoy nearly universal coverage while only 10 per cent or less of the workforce in many developing countries is likely to enjoy any sort of coverage. Even in many developed countries, coverage against occupational injury and illness may extend to only half the workforce.

The International Labour Organization was founded to ensure everyone the right to earn a living in freedom, dignity and security, in short, the right to decent work. We have never accepted the belief that injury and disease "go with the job". In the course of this century industrialized countries have seen a clear decrease in serious injuries, not least because of real advances in making the workplace healthier and safer. The challenge is to extend the benefits of this experience to the whole working world.

SafeWork is designed to respond to this need. It's primary objectives are: (a) to create worldwide awareness of the dimensions and consequences of work-related accidents, injuries and diseases; (b) to promote the goal of basic protection for all workers in conformity with international labour standards; and (c) to enhance the capacity of member States and industry to design and implement effective preventive and protective policies and programmes.

The programme will pursue a two-pronged approach. It will create alliances and partnerships by launching activities which can be used by ILO constituents, non-governmental organizations and human rights groups in advocacy campaigns and in calling for vigorous action by governments. Second, it will support action at the national level through an integrated programme of direct technical assistance. This will include the development of management tools and monitoring and information services designed to prevent occupational accidents and diseases and to protect the health and welfare of workers and the environment.

The primary focus will be on hazardous occupations. It will target workers in highly hazardous occupations, categories of workers vulnerable on account of gender or age, and workers in the urban informal sector who usually lack basic health protection.

The success of our effects depends on mobilizing our constituency in the world at large including the many committed professionals in the occupational safety and health community. I would, therefore, like to call on governments, employers' and workers' organizations of our member States and the international community to put the elimination of workplace hazards at the top of the public agenda.

I would like to invite the international donor community to support our effort to lift this unacceptable burden on the world's workforce. Finally, I would like to call on you, the readers of this message, to join us in our global campaign to ensure decent working conditions for all working women and men throughout the world.

12 BRIEF BIBLIOGRAPHY

Title	Ethics for the built environment
Author	Peter Fewings
Type of source	Book, 377 pages
Publication or other source details	Taylor and Francis, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN, UK and 270 Madison Avenue, New York, NY 10016, USA
Date & ISBN/ISSN	2009, 0:0-415-42982-X and 3:0-415-42982-5
Summary of contents	Part I: Theory and application 1. Development of an ethical framework for the built environment 2. Ethical dilemmas and decision-making 3. Business ethics and corporate social responsibility policy 4. The development of professional ethical codes 5. Discrimination and human resources ethics in the built environment 6. The ethics of construction quality, safety, health and welfare 7. The planning ethics 8. Ethics of sustainability: a UK example 9. Trust and relationships 10. Bribery and corruption 11. Delivering ethical improvement through contractual good faith Part II: Case studies of good practice
Comments on relevance	This is an excellent review of ethics within the context of this training programme, and Chapter 6 is especially relevant

Title	Documents from the Murphy Group
Type of source	Advertisement, OSH policy and certificate from a major British Isles construction company
Publication or other source details	Murphy Group web site www.murphygroup.co.uk
Date & ISBN/ISSN	15 11 2008 and other dates
Summary of contents	These three documents give an interesting insight into a major construction company. An advertisement has safety as its major focus, and from the web site given the company’s policy documents may be downloaded and also the certificate for compliance with OHSAS 18001
Comments on relevance	Good example for the Contractors’ package

Title	Bovis Lend Lease web site
Type of source	Web site of a major international construction company
Publication or other source details	http://www.bovislendlease.com/llweb/bll/main.nsf
Date & ISBN/ISSN	This information downloaded November 2008
Summary of contents	This summaries three web pages entitled: • Asia: Bovis Lend Lease Pharmaceutical honoured for its Safety Excellence at National Awards • United Kingdom: Bovis Lend Lease sets new industry standard for tower crane safety • Bovis Lend Lease Wins Three Safety Awards in the USA These are of general interest as examples of a company with a very strong commitment to OS&H whose achievements are being recognised by external organisations. The UK web site features a new application of digital communications to the control of tower cranes: "The Crane Integrated Safety System (CISS), developed jointly by Bovis Lend Lease and Aspect International, increases visibility for tower crane operatives enhancing communications between operatives and their respective banksmen, and it is hoped that the CISS system will set new safety standards within the industry."
Comments on relevance	Very relevant to the Contractors' package

Title	Introductory report: Beyond death and injuries: The ILO's role in promoting safe and healthy jobs
Type of source	Report to a conference
Publication or other source details	XVIII World Congress on Safety and Health at Work, June 2008, Seoul, Korea Author: Al Tuwaijri, Sameera et al http://www.ilo.org/public/english/protection/safework/wdcongrs18/safework_report.pdf
Date & ISBN/ISSN	International Labour Office, Geneva: ILO, 2008. ISBN: 978-92-2-121332-1 (print) ISBN: 978-92-2-121333-8 (web pdf)
Summary of contents	**Introduction** **I – Overview** Work-related fatalities, accidents and diseases A promotional framework for OSH OSH and safety culture OSH and management systems National OSH policy National OSH systems National OSH programmes National OSH profiles **II – ILO action on OSH, 2005-2008** Promotion, awareness raising and advocacy The World Days for Safety and Health at Work Development of specific OSH standards and instruments Technical assistance Promotion of ILO OSH standards Labour inspection Knowledge development, management and dissemination International collaboration Silicosis Asbestos HIV/AIDS and the workplace Chemical safety, GHS and SAICM Other areas of collaboration **III – Looking to the future** Foresight and OSH Emerging risks Physical risks Biological risks Chemical risks Risks related to nanotechnologies Workers well-being Changing patterns in the workforce The informal economy Migrant workers The gender dimension Ageing of workers **Conclusions** **Annexes**
Comments on relevance	This is a most useful and relevant report, bringing much general thinking and documents up to date. Essential reading for all trainers in OS&H.

Title	Corporate social responsibility in the construction industry
Author(s)	Edited by Mike Murray and Andrew Dainty
Type of source	Book, 410 pages
Publication or other source details	Taylor & Francis, 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN, United Kingdom. Simultaneously published in the USA & Canada by Taylor & Francis, 270 Madison Avenue, new York, NY 10016.
Date & ISBN/ISSN	2009. 0:0-415-36207-5 (hbk); 36208-3 (pbk); 0:0-203-01233-X (ebk)
Summary of contents	This is a book of 16 papers in five parts, as follows: 1. Evolution of CSR in the construction industry 2. Impact of construction on communities 3. Prevalence and nature of corrupt practices 4. Sustainable development 5. International perspectives on corporate social responsibility in construction There are 28 authors from a wide range of professions, which in itself illustrates the diverse meanings that can be attached to this term.
Comments on relevance	Chapter 1 by Mike Murray and Andrew Dainty gives a good introduction, but Chapter 12 “OH&S and CSR” by John Smallwood and Helen Lingard is an excellent review of how CSR relates to OS&H.
Other information	Very relevant to Module Summary 1: ‘Fundamental Principles’

Title	Managing construction projects: A guide to processes and procedures
Author(s)	Edited by A D Austen and R H Neale
Type of source	Book, 158 pages
Publication or other source details	International Labour Office, Geneva
Date & ISBN/ISSN	1984. 92-2-103553-0
Summary of contents	Introduction A building project A civil engineering project Organisation and management functions Planning Procurement Control Health and Safety Communication and reporting Planning techniques Appendices: checklists, job description for a project manager, glossary, select bibliography
Comments on relevance	Although now an old book, it provides a clear and straightforward review of the topic in an international context, much of which is still relevant. It forms the basis of the project management element of **Construction OS&H**
Other information	Note that Chapter 8 gives a simple review of OS&H under the following headings: Objectives; participants; principal factors; activities; causes of accidents; project management team functions.

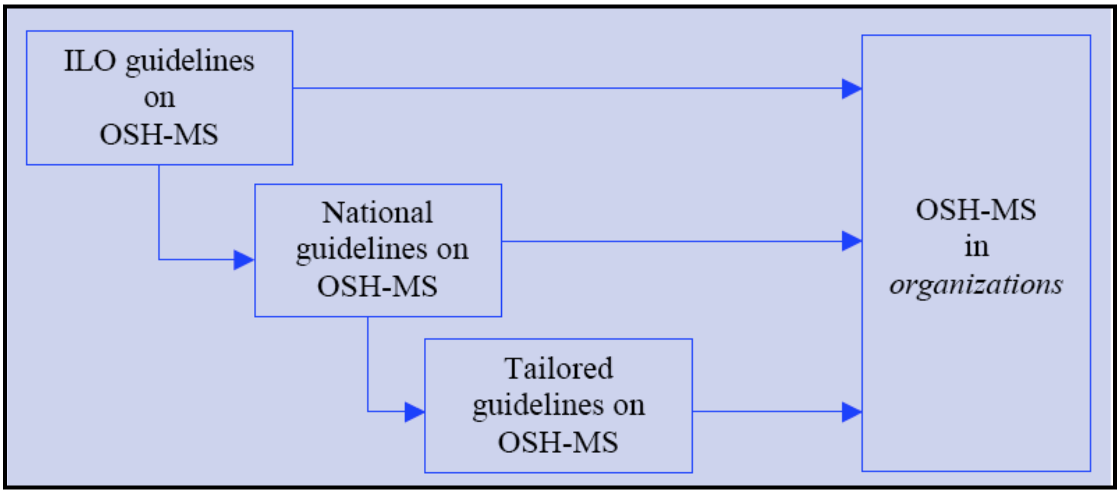
Title	Guidelines on occupational safety & health management systems
Author(s)	ILO SafeWork In Focus programme
Type of source	Report
Publication or other source details	ILO-OSH 2001
Date & ISBN/ISSN	2001. ISBN 92-2-111634-4
Summary of contents	The positive impact of introducing occupational safety and health (OSH) management systems at the *organization1* level, both on the reduction of hazards and risks and on productivity, is now recognized by governments, employers and workers. These guidelines on OSH management systems have been developed by the International Labour Organization (ILO) according to internationally agreed principles defined by the ILO's tripartite constituents. This tripartite approach provides the strength, flexibility and appropriate basis for the development of a sustainable safety culture in the *organization.* The ILO has therefore developed voluntary guidelines on OSH management systems which reflect ILO values and instruments relevant to the protection of workers' safety and health. The practical recommendations of these guidelines are intended for use by all those who have responsibility for occupational safety and health management. They are not legally binding and are not intended to replace national laws, regulations or accepted standards. Their application does not require certification. The employer is accountable for and has a duty to organize occupational safety and health. The implementation of an OSH management system is one useful approach to fulfilling this duty. The ILO has designed these guidelines as a practical tool for assisting *organizations* and competent institutions as a means of achieving continual improvement in OSH performance. The Guidelines cover national policy and OS&H systems in the organisation.
Comments on relevance	Very fundamental set of principles

Title	Rebuilding Baphuon Temple in Angkor, Cambodia
Author(s)	ILO
Type of source	Short TV programme
Publication or other source details	http://tv.ilo.org/
Date & ISBN/ISSN	© 1996 - 2008 International Labour Organization (ILO)
Summary of contents	Describes how good health and safety practices have been used during the re-construction of this historic temple. Good demonstrations of working platforms, safety harnesses, eye protection, etc. Workers have a large role in the design and application of safe working. The site is also used as a demonstration project and for on-site training.
Comments on relevance	Very good visual aid on OS&H Used as a training exercise in this package
Other information	Simple to download from tv.ilo, other relevant videos also available.

Title	Guidance on preparing a simple OHS business case
Author(s)	Australian Government, Australian Safety and Compensation Council
Type of source	Nine page booklet
Publication or other source details	Requests and inquiries concerning reproduction and rights should be addressed to Commonwealth Copyright Administration, Attorney-General’s Department, Robert Garran Offices, National Circuit, Barton ACT 2600 or posted at http://www.ag.gov.au/cca
Date & ISBN/ISSN	© Commonwealth of Australia 2007 ISBN 978-0-642-32705-5
Summary of contents	“This document provides guidance for occupational health and safety (OHS) practitioners, officers and managers on how to prepare an effective business case for introducing an OHS solution at the workplace.” 1.Introduction Why is OHS important? What is an OHS Business Case? Direct Costs Indirect Costs 2. How do I prepare an OHS Business Case? 3. Cost-Benefit Analysis 4. Business case format
Comments on relevance	This is an excellent and succinct guide to the subject.

Title	Hazards Magazine
Type of source	Quarterly magazine, 36-40 pages, available on the Internet
Publication or other source details	Hazards, PO Box 4042, Sheffield, S8 2DG, England Telephone +44 114 201 4265 Subscription: Jawad Qasrawi sub@hazards.org Editorial Rory O'Neill editor@hazards.org www.hazards.org
Date & ISBN/ISSN	ISSN 0267 7296
Summary of contents	“Hazards is the only independent, Union-friendly magazine to win major international awards. Workplace unions are your best hope for better, safer work - and Hazards provides the information and resources to make the union job easier. Hazards looks behind the company safety hype, and gives union answers to workplace problems. Using a global network of union safety correspondents, Hazards makes sure you have the best information available anywhere.”
Comments on relevance	This magazine provides an excellent means of keeping up to date
Other information	Especially relevant to the ‘Workers’ perspectives’ parts of **Construction OS&H**

B: GENERAL DUTIES



Summary of content	
1.	Preface
2.	ILO Convention C167, Recommendation R175 and the Code of Practice
3.	Duties of authorities, employers, self-employed, and workers
4.	Duties of construction clients and designers
5.	Legal principles & legislation
6.	Enforcement and audit
7.	Continual improvement
8.	Hazards and their prevention
9.	Brief bibliography

1. PREFACE

The Module Summary “Fundamental Principles” summarised principles that have to be applied through a framework of specified duties, legal powers and enforcement. As stated in the Fundamental Principles, the aim is continual improvement to achieve ‘zero incidents’ and a healthy environment.

This Module Summary is based on reviews of international agreements on the duties of governments, employers and workers, and begins with the relevant ILO documents. The duties of construction clients and their designers are then stated, followed by a review of legal principles and legislation in an international and national context. Enforcement and audit of these required duties is then explained. An important aspect of the work of the ILO and BWI is the aim of ‘continual improvement’, and this leads on to a discussion of hazards and their prevention, which is a development of that described in ‘Fundamental Principles’

The form of this Module Summary is that some quite lengthy extracts from the above documents have been included in Section 2, but the main purpose of the Module Summary is to provide a simplified guide to the main duties and responsibilities, as given in the subsequent Sections. Most of this Module Summary is taken from the following ILO documents:

- C167 Safety and Health in Construction Convention, 1988
- R175 Safety and Health in Construction Recommendation, 1988
- “Safety and Health in Construction: A code of Practice” which was published in 1992 and provides guidance for the implementation of C167 & R175
- ILO report to XVIII World Congress on Safety and Health at Work, June 2008, Seoul, Korea, which is an update on progress

A brief bibliography is given at the end of this Module Summary.

2 ILO CONVENTION C167, RECOMMENDATION R175 AND THE CODE OF PRACTICE

C167 is fundamental to Construction OS&H. It states an internationally agreed basis of legal requirements that should give effect to good OS&H practices and procedures. The fundamental requirements are reproduced below.

I. SCOPE AND DEFINITIONS

Article 1
1. This Convention applies to all construction activities, namely building, civil engineering, and erection and dismantling work, including any process, operation or transport on a construction site, from the preparation of the site to the completion of the project.

2. A Member ratifying this Convention may, after consultation with the most representative organisations of employers and workers concerned, where they exist, exclude from the application of the Convention, or certain provisions thereof, particular branches of economic activity or particular undertakings in respect of which special problems of a substantial nature arise, on condition that a safe and healthy working environment is maintained.

3. This Convention also applies to such self-employed persons as may be specified by national laws or regulations.

Article 2
For the purpose of this Convention:

(a) The term ***construction*** *covers:*

(i) building, including excavation and the construction, structural alteration, renovation, repair, maintenance (including cleaning and painting) and demolition of all types of buildings or structures;

(ii) civil engineering, including excavation and the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, dams, river and avalanche and sea defence works, roads and highways, railways, bridges, tunnels, viaducts and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies;

(iii) the erection and dismantling of prefabricated buildings and structures, as well as the manufacturing of prefabricated elements on the construction site;

(b) the term ***construction site*** *means any site at which any of the processes or operations described in subparagraph (a) above are carried on;*

*(c) the term **workplace** means all places where workers need to be or to go by reason of their work and which are under the control of an employer as defined in subparagraph (e) below;*

*(d) the term **worker** means any person engaged in construction;*

*(e) the term **employer** means:*

(i) any physical or legal person who employs one or more workers on a construction site; and

(ii) as the context requires, the principal contractor, the contractor or the subcontractor;

*(f) the term **competent person** means a person possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skill for the safe performance of the specific work. The competent authorities may define appropriate criteria for the designation of such persons and may determine the duties to be assigned to them;*

II. GENERAL PROVISIONS

Article 3
The most representative organisations of employers and workers concerned shall be consulted on the measures to be taken to give effect to the provisions of this Convention.

Article 4
Each Member which ratifies this Convention undertakes that it will, on the basis of an assessment of the safety and health hazards involved, adopt and maintain in force laws or regulations which ensure the application of the provisions of the Convention.

Article 5
1. The laws and regulations adopted in pursuance of Article 4 above may provide for their practical application through technical standards or codes of practice, or by other appropriate methods consistent with national conditions and practice.

2. In giving effect to Article 4 above and to paragraph 1 of this Article, each Member shall have due regard to the relevant standards adopted by recognised international organisations in the field of standardisation.

Article 6
Measures shall be taken to ensure that there is co-operation between employers and workers, in accordance with arrangements to be defined by national laws or regulations, in order to promote safety and health at construction sites.

Article 7
National laws or regulations shall require that employers and self-employed persons have a duty to comply with the prescribed safety and health measures at the workplace.

Article 8
1. Whenever two or more employers undertake activities simultaneously at one construction site:

(a) the principal contractor, or other person or body with actual control over or primary responsibility for overall construction site activities, shall be responsible for co-ordinating the prescribed safety and health measures and, in so far as is compatible with national laws and regulations, for ensuring compliance with such measures;

(b) in so far as is compatible with national laws and regulations, where the principal contractor, or other person or body with actual control over or primary responsibility for overall construction site activities, is not present at the site, he shall nominate a competent person or body at the site with the authority and means necessary to ensure on his behalf co-ordination and compliance with the measures, as foreseen in subparagraph (a) above;

(c) each employer shall remain responsible for the application of the prescribed measures in respect of the workers placed under his authority.

2. Whenever employers or self-employed persons undertake activities simultaneously at one construction site they shall have the duty to co-operate in the application of the prescribed safety and health measures, as may be specified by national laws or regulations.

Article 9
Those concerned with the design and planning of a construction project shall take into account the safety and health of the construction workers in accordance with national laws, regulations and practice.

Article 10
National laws or regulations shall provide that workers shall have the right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on the working procedures adopted as they may affect safety and health.

Article 11
National laws or regulations shall provide that workers shall have the duty to:

(a) co-operate as closely as possible with their employer in the application of the prescribed safety and health measures;

(b) take reasonable care for their own safety and health and that of other persons who may be affected by their acts or omissions at work;

(c) use facilities placed at their disposal and not misuse anything provided for their own protection or the protection of others;

(d) report forthwith to their immediate supervisor, and to the workers' safety representative where one exists, any situation which they believe could present a risk, and which they cannot properly deal with themselves;

(e) comply with the prescribed safety and health measures.

Article 12
1. National laws or regulations shall provide that a worker shall have the right to remove himself from danger when he has good reason to believe that there is an imminent and serious danger to his safety or health, and the duty so to inform his supervisor immediately.

2. Where there is an imminent danger to the safety of workers the employer shall take immediate steps to stop the operation and evacuate workers as appropriate.

Article 13

SAFETY OF WORKPLACES
1. All appropriate precautions shall be taken to ensure that all workplaces are safe and without risk of injury to the safety and health of workers.

2. Safe means of access to and egress from all workplaces shall be provided and maintained, and indicated where appropriate.

3. All appropriate precautions shall be taken to protect persons present at or in the vicinity of a construction site from all risks which may arise from such a site.

R175 adds some important recommendations for further action, as given in the following extracts:

6. The measures to be taken to ensure that there is organised co-operation between employers and workers to promote safety and health at construction sites should be prescribed by national laws or regulations or by the competent authority. Such measures should include:

(a) the establishment of safety and health committees representative of employers and workers with such powers and duties as may be prescribed;

(b) the election or appointment of workers' safety delegates with such powers and duties as may be prescribed;

(c) the appointment by the employer of suitably qualified and experienced persons to promote safety and health;

(d) the training of safety delegates and safety committee members.

7. Those concerned with the design and planning of a construction project should take into account the safety and health of the construction workers in accordance with national laws, regulations and practice.

8. The design of construction equipment, tools, protective equipment and other similar equipment should take account of ergonomic principles.

9. Construction work should be planned, prepared and undertaken in such a way that:

(a) risks liable to arise at the workplace are prevented as soon as possible;

(b) excessively or unnecessarily strenuous work positions and movements are avoided;

(c) organisation of work takes into account the safety and health of workers;

(d) materials and products are used which are suitable from a safety and health point of view;

(e) working methods are employed which protect workers against the harmful effects of chemical, physical and biological agents.

10. National laws or regulations should provide for the notification to the competent authority of construction sites of such size, duration or characteristics as may be prescribed.

11. Workers should have the right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on the working procedures adopted as they may affect safety and health.

Health Hazards
41.
(1) An information system should be set up by the competent authority, using the results of international scientific research, to provide information for architects, contractors, employers and workers' representatives on the health risks associated with hazardous substances used in the construction industry.

(2) Manufacturers and dealers in products used in the construction industry should provide with the products information on any health risks associated with them and on the precautions to be taken.

(3) In the use of materials that contain hazardous substances and in the removal and disposal of waste, the health of workers and of the public and the preservation of the environment should be safeguarded as prescribed by national laws and regulations.

(4) Dangerous substances should be clearly marked and provided with a label giving their relevant characteristics and instructions on their use. They should be handled under conditions prescribed by national laws and regulations or by the competent authority.

(5) The competent authority should determine which hazardous substances should be prohibited from use in the construction industry.

42. The competent authority should keep records of monitoring of the working environment and assessment of workers' health for a period prescribed by national laws and regulations.

43. The manual lifting of excessive weights which presents a safety and health risk to workers should be avoided by reducing the weight, by the use of mechanical devices or by other means.

44. Whenever new products, equipment and working methods are introduced, special attention should be paid to informing and training workers with respect to their implications for safety and health.

The Code of Practice (CoP)

This code [also] provides guidance in the implementation of the provisions of the Safety and Health in Construction Convention, 1988 (No. 167), and the Safety and Health in Construction Recommendation, 1988 (No. 175).

The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;

(b) ensuring appropriate design and implementation of construction projects;

(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.

Note also:

The provisions of this code should be considered as the basic requirements for protecting workers' safety and health.

And

The provisions of this code should be applied to self-employed persons as may be specified by national laws or regulations.

2.2.5. Employers should arrange for regular safety inspections by competent persons at suitable intervals of all buildings, plant, equipment, tools, machinery, workplaces and systems of work under the control of the employer at construction sites in accordance with national laws, regulations, standards or codes of practice. As appropriate, the competent person should examine and test by type or individually to ascertain the safety of construction machinery and equipment.

3 DUTIES OF AUTHORITIES, EMPLOYERS, SELF-EMPLOYED, AND WORKERS

General duties

Note that C167 & R175 apply to 'all construction work'.

'General duties' have to be considered for the project as a whole, from start to finish, taking into account all those involved. As explained in Section 6 (the need for a holistic culture and systems) of the Summary for Module 1 "Fundamental principles", a construction project may be viewed as a matrix of time-based 'stages' as the project progresses from its inception to completion and commissioning, and at each of these stages a number of organisations and people are involved, each to a varying extent according to the activities of each stage.

A simplified, general matrix, based on a traditional form of contract in which design and construction are separate activities, is shown below. The density of the shading in the boxes gives an indication of the amount of engagement in the project at each stage.

This matrix depicts the complexity of the organisation of a construction project and indicates how difficult it is to ensure that the safety and health of all those involved is not impaired in any way.

THOSE INVOLVED	PROJECT STAGES				
	Briefing	Design	Procurement	Construction	Commission
Client					
Authorities					
Project managers					
Local residents					
Designers					
Contractors					
Other consultants					
Sub-contractors					
Suppliers					
Workers					
Users					

Authorities

The international agreements C167 & R175 stated above require that the relevant national authorities:

- Acknowledge their responsibilities under these agreements
- Consult with employers and workers
- Put in place national laws, regulations, standards and codes to implement them
- Put in place comprehensive inspection regimes

Employers

Employers must note that on projects with multiple ‘employers’, one of them shall be deemed to be the ‘principal contractor’ and will have overall responsibility for OS&H, but each employer remains responsible for their own OS&H.

Employers must:

- Co-operate with each other
- Evacuate immediately all employees from imminent danger
- Ensure that all workplaces are safe and that there are safe means to get to and from them
- Establish OS&H committees with employer and worker representatives
- Employ qualified OS&H persons to ensure compliance
- Offer appropriate training to all relevant persons
- Ensure that all workers are suited (by age, physique, health and skill) to the tasks they undertake and are made aware of all relevant OS&H provisions
- Take effective measures to protect all those in the community in which the construction project is based.

Self-employed

- Employers must co-operate with self-employed persons
- Self-employed persons have the same OS&H rights as all others employed on the project

Workers

All workers:

- Have the right to participate in the process of ensuring OS&H
- Have the right to remove themselves from danger
- Must co-operate with their employers and comply with all OS&H measures
- Must take care of their own safety and the facilities provided
- Must report risks outside their control

4 DUTIES OF CONSTRUCTION CLIENTS AND DESIGNERS

The client

The project matrix shown in Section 3 begins with the client, with whom ultimate responsibility must lie because this is the person or organisation that created the project and will pay for it. Without the client, there would be no project, so no person would be at risk.

In order to ensure that the whole project – from start to finish - is managed with the safety and health of all as a principal performance criterion, the client must appoint a project manager for the whole of its duration. Only in this way can the duties described below be enforced.

The role of the project manager and the management of projects is explained in more detail in the Module Summary 5: Principles of safe project management.

Designers

Designers and planners must:

- Include careful consideration of OS&H in all their designs, plans and working methods
- Endeavour to 'design out' hazards
- Give careful consideration to the design of all equipment and tools, including consideration of ergonomics

5 LEGAL PRINCIPLES & LEGISLATION

The provisions of the international agreements outlined above have to be implemented through national laws. Although it is difficult to generalize internationally, legal requirements can be considered under two distinct headings: national or criminal law, and contract law.

National or criminal law

Almost all countries have national legislation to ensure that employees are protected from injury at work. A range of more specific regulations and schedules usually supports these general laws. National laws or regulations should provide for general duties of clients, designers, engineers and architects to take into consideration the safety and health aspects when designing buildings, structures or construction projects generally.

Infringement of these laws is a criminal offence, but it is often the case that the penalties for, say, causing the death of a worker by negligent OS&H provision are considerably less than for a case of homicide. This attitude that somehow deaths on construction sites are just a fact of life, compared to homicide which is considered to be intentional, is one of the prime causes of the appalling accident performance of the construction industry.

Good examples of national laws and regulations can be found on the web site of the USA Occupational Safety and Health Administration: www.osha.gov.

Contract law

Within the framework of national law, more specific provision for effective OS&H must be made through the contract for the construction project. This is especially important when the national OS&H law is weak.

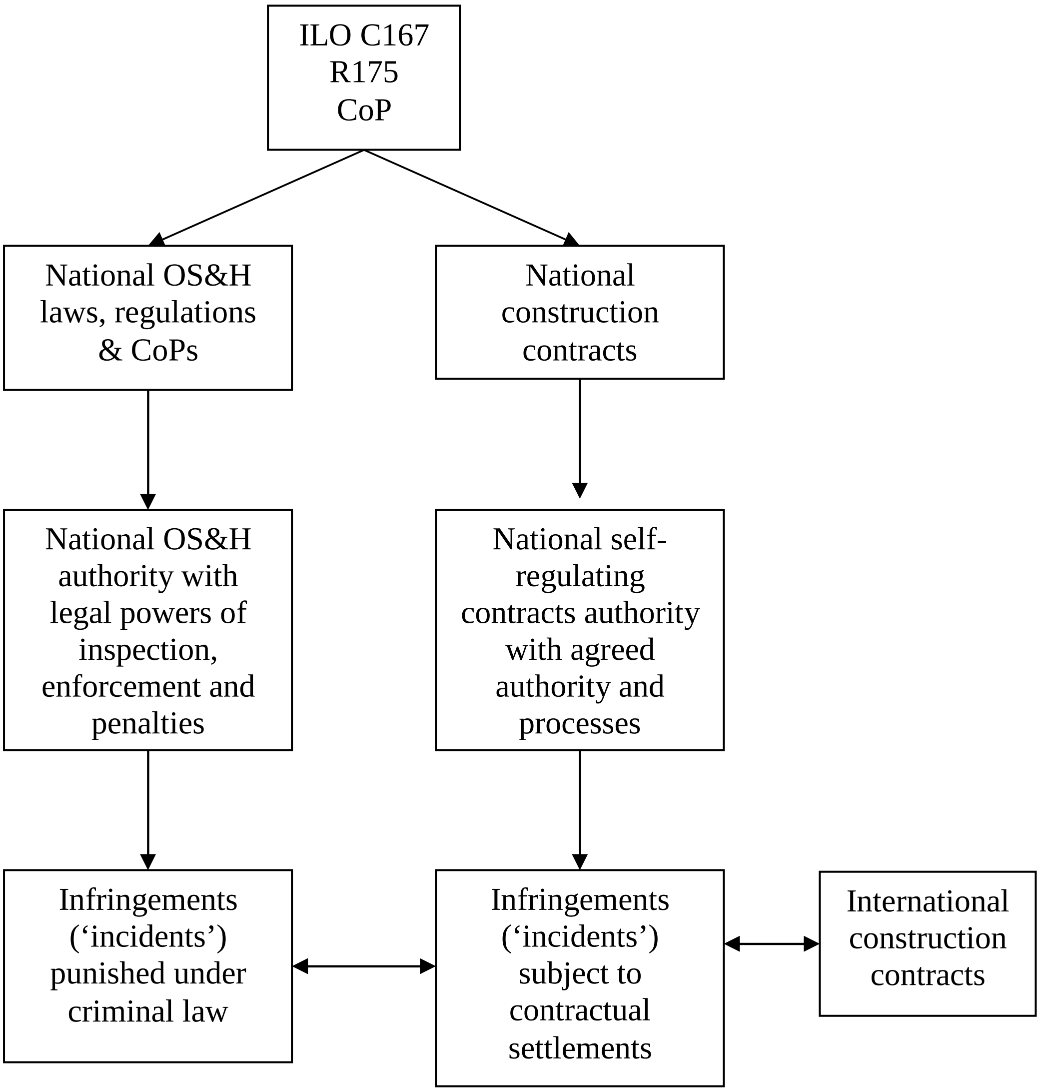
As stated in Section 4 above, the ultimate responsibility lies with the client[1], who must require those submitting tenders to make provision for the cost of safety and health

[1] In some forms of contract, the 'client' is referred to as the 'employer', but in the context of OS&H this terminology is confusing so it is not used in Construction OS&H.

measures during the construction process. This provision must include the requirement that it is taken forward in all subcontracts and employment arrangements.

Contracts are explained in more detail in the Module Summary 5 “Principles of safe project management”.

In outline, the structure of legal requirements for OS&H is as shown in the diagram below.



(This process and diagram was formulated by Richard Neale from an analysis of documents in the Knowledge Base, together with his own understanding developed from years of practical and academic experience)

6 ENFORCEMENT AND AUDIT

This topic will, be covered in more detail in Module Summary 7: Processes and systems, so only a brief introduction will be given here.

The ILO report to XVIII World Congress on Safety and Health at Work, June 2008, Seoul, Korea, offers the following outline of a national system.

ESSENTIAL ELEMENTS OF A NATIONAL OSH SYSTEM

- Legislation, and any other relevant OSH instruments;
- One or more authorities or bodies responsible for OSH;
- Regulatory compliance mechanisms, including systems of inspection;
- A national tripartite advisory mechanism addressing OSH issues;
- Arrangements to promote at the enterprise level, cooperation between employers and workers;
- OSH information and advisory services;
- Systems for the provision of OSH training;
- Occupational health services;
- Research on OSH;
- A mechanism for the collection and analysis of data on occupational injuries and diseases;
- Provisions for collaboration with relevant insurance or social security schemes covering occupational injuries and diseases; and
- Support mechanisms for a progressive improvement of OSH conditions in micro, small and medium-sized enterprises, and in the informal economy.

Such a system sets up a national basis for enforcement and audit, but the same conference report contains the following statement (page 11):

"Good governance in the workplace requires competent and well-resourced labour inspection systems, with modern inspection practices that focus on prevention. However, there are still substantial concerns about the lack of resources allocated to labour inspectorates in many countries, weakening the impact of national OSH policies and programmes at the enterprise level."

So, where resources for inspection, enforcement and audit are inadequate, more responsibility is placed on the employers, who have a duty to enforce their stated commitments to OS&H by:

- Arranging regular safety inspections by competent persons, including testing where necessary
- Scheduling these inspections purposefully and at regular and appropriate intervals
- Including all parts of the facilities, workplaces, equipment and systems of work in the inspections

This inspection regime must apply to the whole project and everyone and everything within it, regardless of employment contracts or ownership.

7 CONTINUAL IMPROVEMENT

Good management is a relentless process. Setting objectives and making and implanting plans is not a ‘one-off’ activity at the start of a project, but an on-going, every day task. A simple way of looking at this is that all actions require to be followed up and appropriate further actions taken if required. Thus all actions should have a ‘feedback loop’, which informs the manager whether the action intended is proceeding or whether further action is required in order to achieve the required outcome.

The OS&H statistics of the worldwide construction industry are so poor that only by adopting an attitude of striving for continual improvement can real progress be made. The diagram below is taken from ILO-OSH 2001 and gives an indication of how such a process may be envisaged.

Therefore, all those involved in a construction project have a ‘general duty’ to strive towards continual improvement and a ‘zero incident’ OS&H record, in all five stages of the project, as shown in the diagram below.

OS&H PROCESSES & PROCEDURES	PROJECT STAGES				
	Briefing	Design	Procurement	Construction	Commission
Policy Organizing Planning & implementation Evaluation Action for improvement					

8 HAZARDS AND THEIR PREVENTION

Hazard*:* The inherent potential to cause injury or damage to people's health.
It is an inherent feature of a project.

Risk*:* A combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event.
It is therefore a statistical concept of whether a potential hazard will actually be allowed to have an effect.

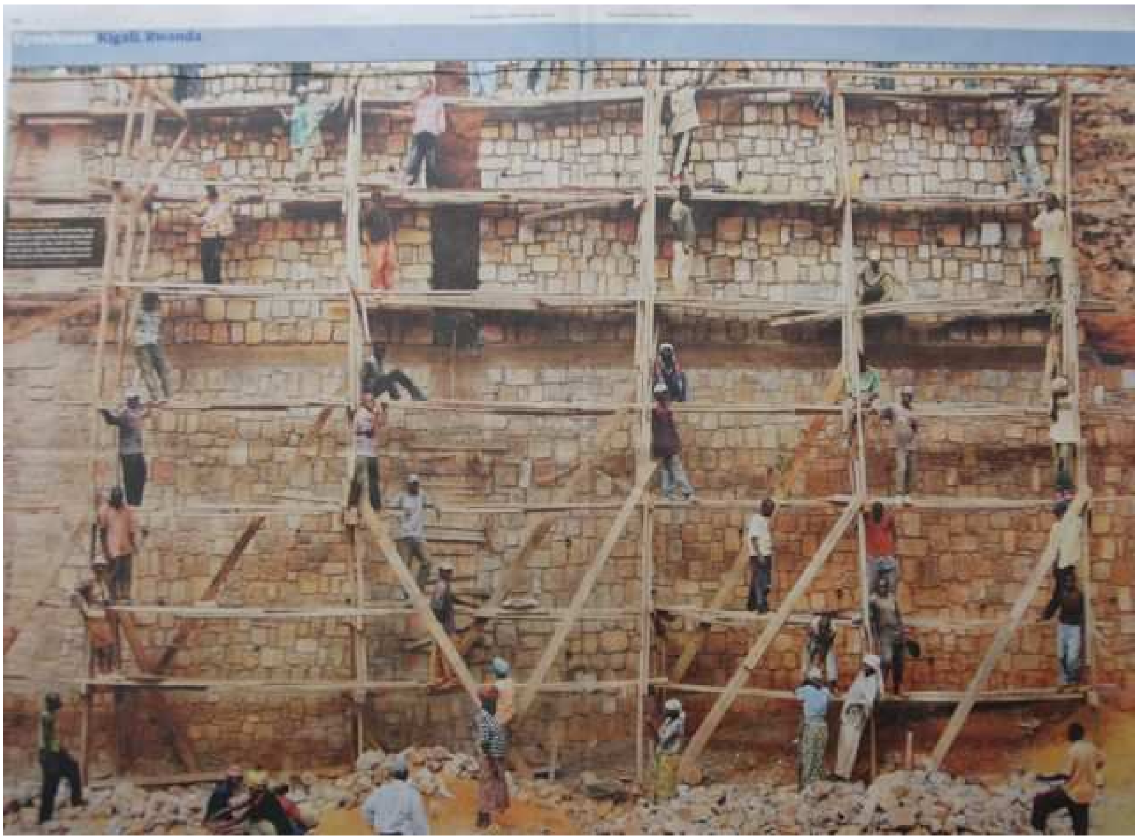
In terms of the General Duties of all concerned in a construction project:

- Clients, designers and planners, contractors and subcontractors all have a duty to eliminate hazards as far as possible - for example by changing an aspect of a design
- Workers have a duty to contribute their own expertise and point of view
- Workers have the right to avoid exposing themselves to risks

These simple concepts are fundamental to **Construction OS&H** and will be explained further in other Modules.

FINALLY!

Everyone has a duty to improve OS&H – we must be able to do better than this!



9 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	C167 Safety and Health in Construction Convention, 1988
Author(s)	The General Conference of the International Labour Organisation
Type of source	ILO Convention concerning Safety and Health in Construction
Publication or other source details	Convention: C167 Place: Geneva Session of the Conference: 75
Date & ISBN/ISSN	Date of adoption: 20:06:1988 Date of coming into force: 11:01:1991
Summary of contents	I. Scope and definitions II. General provisions III. Preventive and protective measures IV. Implementation V. Final provisions There are also some useful cross-references at the end.
Comments on relevance	The core document for **Construction OS&H**, containing fundamental general provisions and much detailed guidance.
Other information	This Convention has very similar detailed content to the ILO's Code of Practice, 1992, which is also summarised in this Knowledge Base.

Title	R175 Safety and Health in Construction Recommendation, 1988
Author(s)	The General Conference of the International Labour Organisation
Type of source	ILO recommendation concerning safety and health in construction
Publication or other source details	Recommendation: R175 Place: Geneva Session of the Conference: 75
Date & ISBN/ISSN	Date of adoption: 21:06:1988
Summary of contents	I. Scope and Definitions II. General Provisions III. Preventive and Protective Measures IV. Effect on Earlier Recommendations There are also some useful cross-references at the end.
Comments on relevance	A very useful supplementary document for Construction OS&H, relates to C167 and the ILO Code of Practice
Other information	C167 and the Code of Practice are also summarised in the Knowledge Base.

Title	Introductory report: Beyond death and injuries: The ILO's role in promoting safe and healthy jobs
Type of source	Report to a conference
Publication or other source details	XVIII World Congress on Safety and Health at Work, June 2008, Seoul, Korea Author: Al Tuwaijri, Sameera et al http://www.ilo.org/public/english/protection/safework/wdcongrs18/safework_report.pdf
Date & ISBN/ISSN	International Labour Office, Geneva: ILO, 2008. ISBN: 978-92-2-121332-1 (print) ISBN: 978-92-2-121333-8 (web pdf)
Summary of contents	**Introduction** **I – Overview** Work-related fatalities, accidents and diseases A promotional framework for OSH OSH and safety culture OSH and management systems National OSH policy National OSH systems National OSH programmes National OSH profiles **II – ILO action on OSH, 2005-2008** Promotion, awareness raising and advocacy The World Days for Safety and Health at Work Development of specific OSH standards and instruments Technical assistance Promotion of ILO OSH standards Labour inspection Knowledge development, management and dissemination International collaboration Silicosis Asbestos HIV/AIDS and the workplace Chemical safety, GHS and SAICM Other areas of collaboration **III – Looking to the future** Foresight and OSH Emerging risks Physical risks Biological risks Chemical risks Risks related to nanotechnologies Workers well-being Changing patterns in the workforce The informal economy Migrant workers The gender dimension Ageing of workers **Conclusions** **Annexes**
Comments on relevance	This is a most useful and relevant report, bringing much general thinking and documents up to date. Essential reading for all trainers in OS&H.

C: SAFE AND HEALTHY WORKING ENVIRONMENT

(Photo by Fiona Murie, BWI)

Summary of content
1. Preface
2. Causes of OS&H incidents ('accidents') and injuries
3. Diversity of the workforce
4. Safety of workplaces
5. Health hazards
6. Inspection and maintenance
7. Appendix: BWI Construction Hazards Fact Sheet
8. Brief bibliography

1 PREFACE

"Preventing injuries and ill health in construction"

"You might think that the active, outdoor life in the construction sector would keep you fit and healthy. Quite the reverse is true and the construction industry has a deservedly notorious reputation as being dirty, difficult and dangerous.

More than 100, 000 people suffer fatal injuries on building sites every year. That means that one person is killed in a site accident every five minutes. Many hundreds of thousands more people suffer serious injuries and ill health because of bad, and often illegal, working conditions.

The fragmentation of the industry and the widespread use of flexible employment practices seriously undermine trade union capacity to organise in the sector. Downsizing, outsourcing, the use of labour-only sub contracting and the so-called self-employed has a negative impact on the management of health and safety. Responsibilities for planning and coordination of health and safety are often unclear, and compliance with health and safety law is generally poor.

Informal contractual conditions in the sector make it difficult for workers to exercise their rights, and to push for more progressive and effective prevention initiatives based on workers participation, collective bargaining and training on skills and health and safety. The consequence of poor management standards in the sector is the deterioration of working and living conditions and an alarmingly high incidence of injuries.

To make matters worse, many governments do not have a coherent legislative and policy framework for prevention. Self-regulation in construction is increasingly widespread, and the relevant administrations frequently have a permissive, passive attitude towards employers who ignore health and safety laws, even when this leads to the death of a worker."

"Deaths on Site - Predictable but not Prevented"

"The real tragedy behind the statistics is that deaths are preventable. Most people are killed whilst carrying out perfectly routine work, where the hazards are well known. Deaths from these causes can and should be avoided by the use of collective prevention measures."

These passages are taken from the "BWI Construction Hazards Fact Sheet" on the BWI web site (See Appendix, Section 7 below). They set the scene for this Module, which is summarized under the headings given in the table above.

The Summary begins with an analysis of the causes of 'accidents' and injuries, which gives the **Construction OS&H** assessment of this important subject. Since this is an international training package, the diversity of the human workforce worldwide is discussed, making the point that a 'one size fits all' approach cannot work in practice. Specific guidance is then given on the need to make all workplaces safe and ways of reducing health hazards. The Module Summary concludes with recommendations for inspection and maintenance.

This Module Summary is based mainly on the following sources of information:

- ILO C167 Safety and Health in Construction Convention, 1988 ('C167')
- The BWI web site: http://www.bwint.org ('BWI')
- ILO Code of Practice: Safety & health in construction ('ILO Code')
- ILO Safety, health and welfare on construction sites: a training manual ('ILO Manual')
- ILO Managing international construction projects: an overview ('ILO Overview')

For further information on these sources see the Brief bibliography, Section 8 below.

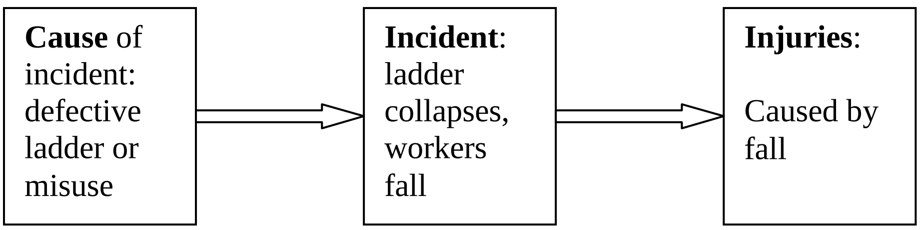
2 CAUSES OF OS&H INCIDENTS ('ACCIDENTS') AND INJURIES

The word 'accident' has at the root of its meaning an understanding that it is unexpected and unpredictable, that it occurs entirely by chance and that there is no apparent cause. **Construction OS&H** is based on the belief, as stated by BWI above, that most 'accidents' are in fact preventable and so are not in fact 'accidents' but 'preventable OS&H incidents'. True 'accidents' are in fact rare occurrences. This is the basis for the 'zero incident' philosophy.

In OS&H literature, the term 'causes of accidents' is used in different ways, so its meaning has to be clarified for **Construction OS&H**. To illustrate this point through a simple example, imagine that some workers were injured because the ladder that they were climbing broke, so they fell to the ground and were injured. The safety officer reported the incident using the standard form, and entered the cause of the 'accident' using common terminology as a 'fall from height'. In fact, the fall was the incident not the cause, because the cause was a defective ladder, or perhaps misuse or overloading of the ladder.

The following diagram illustrates the use of the terms in **Construction OS&H**, based on this simple example.

Causes, OS&H incidents and injuries



But note also:

“Accident prevention is often misunderstood, for most people believe wrongly that the word “accident” is synonymous with “injury”. This assumes that no accident is of importance unless it results in an injury. Construction managers are obviously concerned with injuries to the workers, but their prime concern should be with the dangerous conditions that produced the injury – with the “incident” rather than the “injury”. On a construction site there are many more “incidents” than injuries. A dangerous act can be performed hundreds of times before it results in an injury, and it is to eliminate these potential dangers that managers’ efforts must be directed. They cannot afford to wait for human or material damage before doing anything. So safety management means applying safety measures before accidents happen.”
(ILO Manual)

Some typical and common forms of incident are listed below:

Falls from heights	Falls from scaffolding, maintenance cradles, mobile access towers, ladders, roofs, etc.
Slips	Slips from roofs, into trenches, over handrails, on oil. Include trips over materials, badly fitting scaffold boards, etc.
Being struck by moving objects	Materials falling from a height (e.g.: off scaffolds) Materials being handled by cranes, etc.
Electrical hazards	Excavating live cables, misuse of electrical power tools, demolition, etc.
Confined spaces – Asphyxiation	Drainage works especially maintenance, basement excavations, large diameter piles (inspection), underground storage tanks, etc.
Machinery	Excavation plant, cranes, hoists, etc.

(ILO Overview)

A comprehensive and persuasive review by BWI of OS&H incidents in construction is given in the Appendix.

There is a number of reasons to study the causes of incidents. These include:

- Legal investigations to apportion blame and assess compensation for those injured
- To determine the adequacy of the plant and equipment used and to improve its performance if found to be defective
- To investigate the materials and components used, to review their suitability for future use and, if defective, to determine how they may be improved
- To review the management and OS&H systems to determine where they were deficient, with the aim of ‘continuous improvement’.

Within the ‘systems approach’ explained in the Module Summary 7: “Processes and systems”, comprehensive and purposeful studies of the causes of incidents should be an integral part of the normal OS&H processes of review and audit.

Simple example of hazards and risks: erection of scaffolding

The picture below shows workers erecting a scaffold. No safety measures appear to be visible, so this is highly dangerous. Following the systematic construction OS&H process advocated in Module 7: "Processes and systems" would provide the following analysis.

Workers erect scaffolding in Shenyang in NE China
(From The Guardian 24 March 2009)

The general **hazard** is 'working at height'; specific **hazards** include

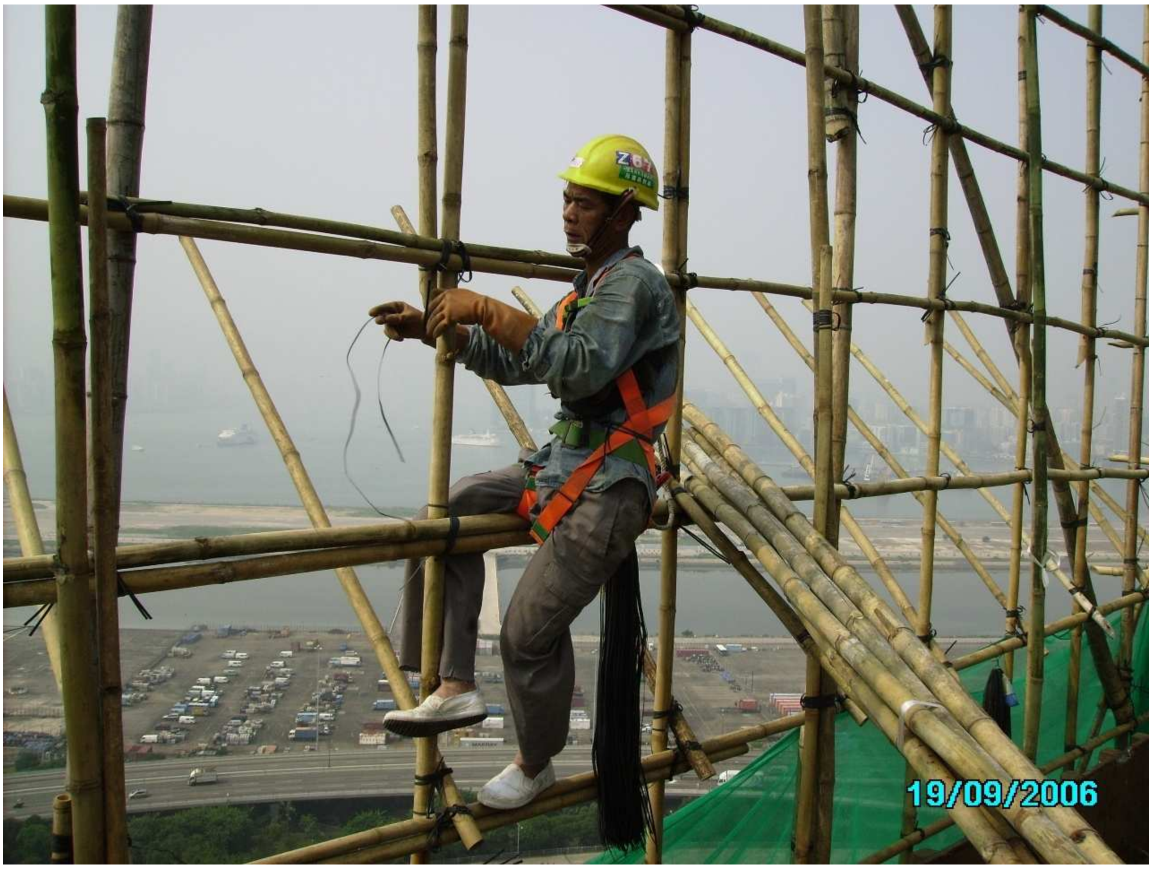
- Potential to fall from the scaffold
- Collapse of the un-braced scaffold

The **risk** is obviously very high, because this is clearly a very dangerous activity; but it is also severe, because a fall would almost certainly be fatal.

If a worker is killed or injured as a result of working on this scaffold, the **cause** will be a failure to control the hazard and risks, it **will not be a 'fall'**

A **risk assessment** should endeavour to reduce the risks. This would include:

- Completing the scaffold as it is erected, lift-by-lift, by installing bracing, decking, handrails, toe-boards, ladders etc. In this way, each lift will provide a solid basis for the erection of the next.
- Providing personal protective equipment (PPE). An example is the hard hat, gloves and safety harness shown in the picture below (note also from this picture the positive effects of government action to protect workers).



"Hong Kong's bamboo scaffolders continue to work at ever-increasing heights – but they now have to follow government safety codes and design guidelines"
[From the paper "Hong Kong-bastion of bamboo scaffolding", by M Ramanathan, Proceedings of ICE-Civil Engineering, Volume: 161, Issue: 4, November 2008.
Photograph by the author of the paper, Muthukaruppan Ramanathan}

The Construction OS&H systems approach to eliminating the causes of ‘preventable OS&H incidents’

Thorough implementation of the recommendations advocated in the elements of **Construction OS&H** are designed to prevent ‘preventable OS&H incidents’. The principal elements are as follows:

- Senior management commitment
- Strong policies
- Comprehensive participatory processes and procedures
- A systematic way of assessing and managing hazards and risks
- Well-developed preventative safety culture
- Good project briefing
- Strong contract clauses in all contracts
- Effective OS&H plans by all parties involved
- Effective OS&H processes and procedures
- Safety through design of the permanent works
- OS&H as a central part of project planning and organisation
- Design of the temporary works
- Competent management and supervision
- Safe materials and components
- Safe plant and equipment
- Good workplace design
- Good welfare facilities

3 DIVERSITY OF THE WORKFORCE

One of the key requirements of good OS&H practice is to ‘match the task to the person’. Human beings range widely in physical and mental characteristics, and to take a ‘one size fits all’ approach to allocating tasks to workers will cause problems.

(Photo: Fiona Murie, BWI)

The ILO Code of Practice states:

“2.2.7. Employers should provide such supervision as will ensure that workers perform their work with due regard to their safety and health.”

And

“2.2.8. Employers should assign workers only to employment for which they are suited by their age, physique, state of health and skill.”

The need to recognise this diversity is discussed further in Module Summary 8: “Welfare and project site”.

The ILO Code also refers to ‘ergonomics’:

“2.2.6. When acquiring plant, equipment or machinery, employers should ensure that it takes account of ergonomic principles in its design and conforms to relevant national laws, regulations, standards or codes of practice and, if there are none, that it is so designed or protected that it can be operated safely and without risk to health.”

This topic is explained clearly in the ILO Manual:

“10.1 Fitting work to people: Ergonomics
The technical development of the construction industry has led to reliance on machines and technical equipment for much heavy work previously done by hand. Although there are still many tasks on site which are carried out using manual labour, it is difficult to envisage high-rise building construction without cranes, excavators, concrete mixers or pile drivers. Mechanization has, however, brought new problems to the workplace.

Technology changes faster than people and technological change often exceeds people’s ability to adapt. As a construction worker, you know the difference between a tool that is well suited for you and for the job, and one that is not. You also soon become aware of the difference between a comfortable working posture and one that is uncomfortable. Ergonomics or human engineering is a multidisciplinary way of looking at the interrelationship between the worker, the workstation and the working environment. Ergonomics plays a key role in the humanization of work, in increasing productivity, and in improving safety and health.

Even with new and modern technologies a lot of heavy work is still done by hand. Tools, machines and equipment are in many cases old-fashioned, poorly designed or badly maintained. Many operatives on construction sites are unskilled. Heavy loads frequently have to be carried up and down stairs, ladders and scaffolds, and people working on construction sites often suffer from low back pain or injury to muscles and joints.

The construction industry has a wide range of jobs and processes. These change according to the stage of the project. They involve consideration of:

- *working positions, both standing and sitting;*
- *work which is especially strenuous;*
- *the use of hand tools and equipment.”*

An illustration of the use of new technology to protect workers is shown in the photos below. The first shows a mechanical lifting device. The second shows two workers are using the device for lifting the heavy paving slabs, all of which is ergonomically very sound.

(Photo: Richard Neale. Skanska project, Cardiff, Wales, UK)

(Photo: Richard Neale Skanska project, Cardiff, Wales, UK)

4 SAFETY OF WORKPLACES

(Photo: Fiona Murie, BWI)

The 'workplace' above is chaotic, disorganised and really unsafe. There is no 'edge protection' to prevent falls from the edge of the workplace, there is a lot of material lying around that can cause workers to trip and fall, and there is no safe means of access or egress for the beam soffit formwork carpenters. The workers are wearing no personal protective equipment - helmets, boots etc.

The important subject of safety of workplaces is explained comprehensively in the ILO Code, which is summarized below.

Generally

All appropriate precautions should be taken: to ensure that all workplaces are safe and without risk of injury to the safety and health of workers; and to protect persons present at or in the vicinity of a construction site.

Means of access and egress

Adequate and safe means of access to and egress from all workplaces must be provided, indicated where appropriate and maintained in a safe condition.

Housekeeping

Should include provisions for the proper storage of materials and equipment and the removal of waste. Loose materials obstruct means of access and egress. Causes of slips or trips should be avoided.

Precautions against the fall of materials and persons

Adequate precautions should be taken to protect any person who might be injured by the fall of materials, tools or equipment.

All openings through which workers are liable to fall should be kept effectively covered or fenced.

"Edge protection": guard-rails and toe-boards should be provided to protect workers from falling from elevated work places. Wherever the guard-rails and toe-boards cannot be provided adequate safety nets or safety sheets should be erected and maintained or adequate safety harnesses should be provided and used."

The photo below shows a 'protective fan' projecting from the building to catch falling objects, good edge protection and a securely fenced site to exclude the public and protect the workforce from road traffic.

(Photo: Richard Neale. 'Old Town', Geneva, Switzerland)

More ‘fans’ are shown in more detail below, together with a metal edge protection system.

(Photo: Richard Neale. St David’s 2 project, Cardiff, Wales, UK)

Prevention of unauthorised entry

Construction sites in built-up areas and alongside vehicular and pedestrian traffic routes should be fenced to prevent the entry of unauthorised persons.

(Photo: Richard Neale. St David’s 2 project, Cardiff, Wales, UK)

Visitors should not be allowed access to construction sites unless accompanied by a competent person, or receive effective site induction training and be provided with the appropriate personal protective equipment.

Fire prevention and fire fighting

All appropriate measures should be taken by the employer to avoid the risk of fire; control quickly and efficiently any outbreak of fire; and bring about a quick and safe evacuation of persons.

Sufficient, secure and suitable storage must be provided for flammable liquids, solids and gases. Precautions must be taken to avoid ignition of all combustible materials and regular inspections should be made of places where there are fire risks.

Welding, flame cutting and other hot work should only be done on the orders of a competent supervisor after appropriate precautions, as required, are taken to reduce the risk of fire.

Places where workers are employed should be provided with suitable and sufficient fire-extinguishing equipment, which should be easily visible and accessible, which must be properly maintained and inspected at suitable intervals by a competent person. Access to fire-extinguishing equipment such as hydrants, portable extinguishers and connections for hoses should be kept clear at all times.

All supervisors and a sufficient number of workers must be trained in the use of fire-extinguishing equipment, so that adequate trained personnel are readily available during all working periods and workers must be suitably trained in the action to be taken in the event of fire, including the use of means of escape. Suitable visual signs should be provided to indicate clearly the direction of escape in case of fire.

Sufficient and suitable means to give warning in case of fire should be provided and such warning should be clearly audible in all parts of the site where persons are liable to work. There should be an effective evacuation plan so that all persons are evacuated speedily without panic and accounted for and all plant and processes shut down.

Notices should be posted at conspicuous places indicating the nearest fire alarm and how to contact the nearest emergency services.

Lighting

Where natural lighting is not adequate to ensure safe working conditions, adequate and suitable lighting, including portable lighting where appropriate, should be provided at every workplace and any other place on the construction site where a employee may have to pass.”

5 HEALTH HAZARDS

Article 28 of the ILO Convention 167 states:

HEALTH HAZARDS
1. Where a worker is liable to be exposed to any chemical, physical or biological hazard to such an extent as is liable to be dangerous to health, appropriate preventive measures shall be taken against such exposure.

2. The preventive measures referred to in paragraph 1 above shall comprise-
(a) the replacement of hazardous substances by harmless or less hazardous substances wherever possible; or
(b) technical measures applied to the plant, machinery, equipment or process; or
(c) where it is not possible to comply with subparagraphs (a) or (b) above, other effective measures, including the use of personal protective equipment and protective clothing.

3. Where workers are required to enter any area in which a toxic or harmful substance may be present, or in which there may be an oxygen deficiency, or a flammable atmosphere, adequate measures shall be taken to guard against danger."

(Photo: Fiona Murie, BWI)

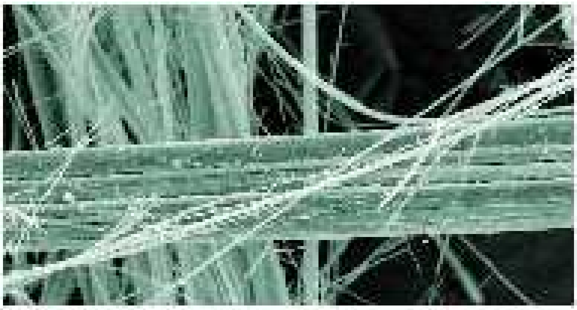
The photo above shows a respirator. For more information on protection from health hazards, see the Module Summary 9: "Personal protective clothing and equipment".

"4. Waste shall not be destroyed or otherwise disposed of on a construction site in a manner which is liable to be injurious to health."

Asbestos

Asbestos was extensively used in buildings in the past, as insulation and fire-proofing. It is still being used in some countries.

Exposure to asbestos is a highly dangerous material to human health. Asbestosis and lung cancer are dose-related diseases, meaning the more asbestos one breathes, the more likely the person is to get sick. Mesothelioma is different; it can be obtained from very small amounts of asbestos. Asbestos workers' families may get mesothelioma from the dust the workers bring home on their clothes or from exposure to houses and materials with asbestos.



(Photo: BWI)

Exposure to asbestos-bearing materials is now a particular risk in demolition.

Workers may be more at risk from the presence of asbestos than almost any other category of worker.

Exposure to asbestos that was commonly used in sprayed insulation on columns and on the underside of ceilings and roofs for fire protection or for thermal insulation is common and very dangerous.

Stringent precautions need to be taken to avoid contaminating the general atmosphere and to prevent breathing in of the dust.

Material containing asbestos must be removed in isolation from other work, and workers must wear positive pressure breathing apparatus and protective clothing, and be trained in their use and the techniques of asbestos removal. Where possible, wet methods of asbestos removal should be adopted rather than dry methods.

Special arrangements need to be made by management for the safe disposal of asbestos-contaminated debris. The best way to deal with asbestos is to employ a specialist company.

BWI offer good guidance on their Internet site: See http://www.bwint.org/default.asp?Issue=asbestos&Language=EN, and a comprehensive PowerPoint presentation is included in the 'Module PPPs' as Module PPP 3a - BWI - Asbestos'.

HIV/AIDS

This is one of the most serious and complex health issues in the construction industry in countries where HIV/AIDS is a common or even epidemic illness. The ILO has a Code of Practice (http://www.ilo.org/public/english/protection/trav/aids/publ/bcctoolkit.htm) and a training manual that all those involved with managing or coping with this illness will find useful. The Code of Practice is based on the following 'Key Principles':

A workplace issue. HIV/AIDS is a workplace issue because it affects the workforce, and because the workplace can play a vital role in limiting the spread and effects of the epidemic.

Non-discrimination. There should be no discrimination or stigma against workers on the basis of real or perceived HIV status - casual contact at the workplace carries no risk of infection.

Gender equality. More equal gender relations and the empowerment of women are vital to preventing the spread of HIV infection and helping people manage its impact.

Healthy work environment. The workplace should minimize occupational risk, and be adapted to the health and capabilities of workers.

Social dialogue. A successful HIV/AIDS policy and programme needs cooperation and trust between employers, workers, and governments.

No screening for purposes of employment. Testing for HIV at the workplace should be carried out as specified in the Code and should be voluntary and confidential, and never used to screen job applicants or employees.

Confidentiality. Access to personal data, including a worker's HIV status, should be bound by the rules of confidentiality set out in existing ILO instruments.

Continuing the employment relationship. Workers with HIV-related illnesses should be able to work for as long as medically fit in appropriate conditions.

Prevention. The social partners are in a unique position to promote prevention efforts through information, education and support for behaviour change.

Care and support. Workers are entitled to affordable health services and to benefits from statutory and occupational schemes.

6 INSPECTION AND MAINTENANCE

Regular OS&H inspections are required to ensure that the requirements of safe workplaces are maintained. These inspections will be part of the **Construction OS&H** "Active OS&H management" system, as described in Module Summary 7: "Processes and systems" and should follow the simple principles given below.

All workplaces must be inspected, and the results recorded by a ‘competent person’:

- Before being taken into use
- At periodic intervals thereafter as prescribed in the agreed OS&H plan
- After any alteration, interruption in use, exposure to weather or any other occurrence likely to have affected their suitability for use by employees as a workplace

Inspection by the ‘competent person’ should more particularly ascertain that:

- The workplace is suitable and adequate for the proposed work and agreed method statement
- Materials, components and equipment to be used are sound and do not present a hazard to the employees
- The working platform is of sound construction and stable
- All the required safeguards are in position and their use is understood by the employees

Non-compliance must be reported to the line-manager immediately, and where non-compliance represents an immediate danger the ‘competent person’ should have the power to order work to cease and the employees to be evacuated urgently.

‘Competent person’ on a project in Dar es Salaam.
Note the lightweight, ventilated safety waistcoat
(Photo: Richard Neale.)

Note also from C167:

Article 34
Reporting of accidents and diseases
National laws or regulations shall provide for the reporting to the competent authority within a prescribed time of occupational accidents and diseases.

7 APPENDIX

Extract from:

BWI Construction Hazards Fact Sheet
Source: BWI web site http://www.bwint.org/default.asp?index=323&Language=EN&Print=1

Preventing injuries and ill health in construction. You might think that the active, outdoor life in the construction sector would keep you fit and healthy. Quite the reverse is true and the construction industry has a deservedly notorious reputation as being dirty, difficult and dangerous.

More than 100, 000 people suffer fatal injuries on building sites every year. That means that one person is killed in a site accident every five minutes. Many hundreds of thousands more people suffer serious injuries and ill health because of bad, and often illegal, working conditions.

The fragmentation of the industry and the widespread use of flexible employment practices seriously undermine trade union capacity to organise in the sector. Downsizing, outsourcing, the use of labour-only sub contracting and the so-called self-employed has a negative impact on the management of health and safety. Responsibilities for planning and coordination of health and safety are often unclear, and compliance with health and safety law is generally poor.

Informal contractual conditions in the sector make it difficult for workers to exercise their rights, and to push for more progressive and effective prevention initiatives based on workers participation, collective bargaining and training on skills and health and safety. The consequence of poor management standards in the sector is the deterioration of working and living conditions and an alarmingly high incidence of injuries.

To make matters worse, many governments do not have a coherent legislative and policy framework for prevention. Self-regulation in construction is increasingly widespread, and the relevant administrations frequently have a permissive, passive attitude towards employers who ignore health and safety laws, even when this leads to the death of a worker.

Deaths on Site - Predictable but not Prevented

The real tragedy behind the statistics is that deaths are preventable. Most people are killed whilst carrying out perfectly routine work, where the hazards are well known. Some of the principal causes of fatal injuries in construction are described below. Although this is not an exhaustive list, these are all priority hazards for prevention. Deaths from these causes can and should be avoided by the use of collective prevention measures.

Any of the circumstances described below can be a recipe for disaster. However, the lack of collective prevention measures is particularly dangerous when combined with work organisation factors. That is the management failures which characterise the industry: spectacularly poor housekeeping; chaotic working conditions; lack of planning and coordination; lack of training and supervision, and the intense productivity and time pressure.

Falls:

The number one construction killer in any country is falling from heights, and this is principally due to the lack of proper edge protection in a variety of construction tasks:

Scaffolding falls
Inadequate, improvised scaffolding with no proper access or no guard rails to prevent falls. Often scaffolding is erected by unqualified operatives, and thereafter the lives of everyone who works from the scaffold are endangered. Scaffolding is often improvised using inappropriate materials. Common, fundamental scaffolding problems are:

- the base is not stable
- materials used to construct the scaffold are defective or unsuitable
- it has no guard rails or has guarding that creates a false sense of security
- it has no proper access, so workers are obliged to perform acrobatics
- it has only single, or insufficient, boards and is full of traps, resulting in more balancing acts for the workers
- it is not properly tied in to the building

The overloading of scaffolding for storage of materials is often the straw that breaks the camel's back and leads to the collapse of the scaffold.

All of these factors can and do kill. It seems almost ridiculous to mention the absence of toe boards, netting, fall arrest systems and other more sophisticated equipment.

Other causes of falls

- Unprotected openings, stairwells and shafts inside buildings, (for lifts, heating, air conditioning, ventilation)
- No edge protection in roof work to prevent falls, or falling through fragile roofs (particularly asbestos cement roofs) due to lack of crawling boards.
- Demolition work.
- Inappropriate use of ladders.
- Inappropriate use of hoists.
- Fatal Crush injuries and being struck by falling objects.
- Excavations which are not shored up (or at least sloped) may be unstable and collapse, particularly after rainfall, crushing, burying and asphyxiating the workers trapped below the heavy soil.
- Vehicles operating too close to the edge, where there are no stop blocks, may also cause a cave in.
- Walls collapse when excavations undermine them.
- Buildings collapse when supporting structures are injudiciously altered.

- Falling objects, materials or tools can strike and kill workers. Hard hats can save lives or reduce injuries in many circumstances. The causes are lack of toe boards on scaffolding, lack of tool belts for workers, bad storage and stacking, and poor housekeeping.
- Improper use of hoists and cranes.
- Being struck or crushed by vehicles, due to poor organisation and signalling.
- Overturned dumper trucks, due to overloading, or where gradients are too steep, or approaching too close to excavations.
- Machinery crushing or trapping workers, resulting in fatal injuries.
- Electrocutions.
- Cable strikes.
- Contact with or arcing from overhead cables.

Workers in the building trades are exposed to a wide range of hazardous substances and physical hazards. In many countries, the resulting health problems are not recognised as being work related, and are not reported, recorded or compensated. This social invisibility, this censorship of the true damage to workers health, means that there is no national policy to prevent occupational ill health in the sector. It is a vicious circle. Yet, as with accidents, the causes of ill health are well know and can be prevented or controlled. Improvements can be made by substitution of hazardous materials for safer ones; by the introduction of safe working methods; by the use of good PPE; through information, training and workers participation.

Access to Occupational Health Services and health surveillance is extremely scarce in developing countries. In the informal economy, building workers are excluded from social security and health schemes. Trade unions are working to promote recognition and compensation of occupational ill health. Below, some of the most common health hazards are discussed.

Deafness. Exposure to hazardous noise levels is so widespread as to be routine, and occupational deafness is very common among building workers. Noise reduction methods can be used, for example on compressors, but Personal Protective Equipment and training are essential to prevent hearing loss.

Vibration syndromes. Hand arm vibration can cause damage to blood vessels and nerves that leads to lack of sensitivity in the fingers called Raynaud’s Syndrome. This condition is particularly due to the use of pneumatic tools. Whole body vibration caused by operating heavy machinery and vehicles can cause damage to the spine.

Back injuries. Caused by manual handling of heavy loads, sometimes over long distances. For example bricks, cement blocks and cement bags weighing 50 kilos. Confined spaces, awkward postures, heavy task and productivity demands, and long hours lead to lower back injuries, sciatica, hernias and slipped discs which can put people out of the labour market for good. Other musculo-skeletal disorders, injuries to muscles, nerves, tendons and joints caused by physically demanding work. Risk factors include: uncomfortable postures, forceful and repetitive movements, awkward tools and sustained effort.

In many developing countries work is really labour intensive, there is little mechanisation and tools are rudimentary, recycled and improvised. Typical injuries include: □Bursitis, from kneeling, for example floor laying. □Tenosinovitis is the inflammation of the tendon sheaths due to overuse and repetitive and forceful movements. (eg plasterers, painters, carpenters) □Tendonitis, inflammation of the tendons, especially in the shoulder, is common. Working with the arms reaching above shoulder level is a typical cause of this problem. (eg plasterers, carpenters, painters). Neck problems are also widespread in these occupations. □Epicondilitis, more commonly known as tennis elbow, caused by the impact absorbed when making repeated blows. Arguably, carpenters elbow, or stonemasons elbow might be a more appropriate name for this condition.

Hazardous substances also have a serious impact on building workers health. These may come in the form of liquids, gases, vapours, fumes or dusts. They are contained in a variety of commonly used products and materials in construction. The main exposure route is through inhaling them, but substances such as solvents can also be absorbed through the skin. There may even be some additional exposure from ingestion due to poor hygiene and welfare facilities on site. □□Very often, workers are not aware of what chemicals are contained in the products they use, and are not told about the health hazards and how to avoid them. Renal, hepatic, cardio-vascular problems and central nervous system disorders can result from exposure to hazardous chemicals, such as pesticides and solvents. Respiratory illness, bronchitis, asthma, fibrosis and cancer may also be caused by exposure to certain materials on site.

Commonly used hazardous substances are: □Vapours and fumes □Solvents of many different kinds are used in paints, varnishes, lacquers or adhesives, sometimes several are used in a single product. They can cause central nervous system damage and can harm the skin, liver , kidneys and cardio vascular system and some increase the likelihood of cancer. Painters, for example, have a higher risk of lung cancer. In recent years in the Scandinavian countries 'painters syndrome' has been recognised as an occupational disease. This refers to brain damage caused by solvents affecting the central nervous system. Solvents can also cause reproductive problems. They can reduce fertility, they can cause congenital birth defects, and they can readily cross the placenta and affect the health of the foetus causing malformations or miscarriage. Isocyanates such as TDI and MDI. Used in two pack polyurethane paints and varnishes, bonding agents and resins, paints. These can cause athsma, dermatitis and, in the long term, are associated with cancer and reproductive hazards. □Pesticides, such as insecticides or fungicides. Pesticides are poisons. They are used in timber treatments to protect them from insect infestation or from the elements. Commonly used and dangerous ones are: Lindane, TBTO (tri- butyl tin oxide), PCP (penta-chloro phenol), or CCA compounds (copper, chrome, arsenic). Chemical treatments for damp courses and fire retardants can also be hazardous. Pesticides can also present serious reproductive hazards. □Welding fumes, welding can generate a cocktail of metal fumes of all kinds, depending on what is being welded - painted metals, brass, copper, steel, coated rods, alloys, and so on. Fumes (such as chromium oxide, zinc oxide, or lead to give a few examples) can cause serious health problems in the long term. The respiratory system is affected and, as chemicals are absorbed, they can slowly affect the brain and internal organs.

Dust □All dust is bad for your health. There are higher death rates from respiratory disease, lung and stomach cancers in dusty trades. Dust affects all sites and all trades, but is especially problematic in plastering, demolition, excavations, tunnelling and in certain tasks, such as cutting concrete blocks. Low cost solutions are to get materials pre-cut off site where exhaust ventilation can be used, and to dampen work and isolate dusty work. Good hygiene facilities for washing and changing and proper protective clothing are needed for hazardous jobs, and this is seldom the case in developing countries. □□Ideally, exhaust ventilated tools, and tools fitted with a water supply for dust suppression should be used. Respiratory Protective Equipment needs to be selected carefully as different types give widely varying standards of protection. Unfortunately, what is normally given out as PPE is a "dust mask" made of paper or cloth, rather than filtering respirator masks. □□Cement dust can cause serious respiratory problems over time, such as pneumoconiosis (lung scarring). Cutting concrete blocks can generate huge clouds of silica -containing dust. Plasterers have a high rate of lung cancers because of the dust they inhale. Cement contains lots of chemicals, some of which cause skin problems: lime (calcium oxide), which can cause burns from wet concrete and mortars. These burns can be severe enough to need skin grafts. Chromates, which cause dermatitis from contact with cement in both wet and dry states. This is a very widespread problem. Irritant, or contact, dermatitis is direct damage caused by contact with the skin. Allergic dermatitis is caused by sensitivity to the chromate impurities in cement and can be severe. Once a person is sensitised it is almost impossible to get rid of the allergic reaction. □Silica Breathing in silica can cause silicosis. This means irreversible scarring of the lungs, causing shortness of breath and premature death. Jobs such as stone masonry; sand blasting for cleaning and façade renovation; concrete cutting or drilling; tunnelling and many demolition jobs. Using power tools to cut stone will lead to high exposures. □Wood dust causes respiratory system problems , irritation and allergies, asthma, rhinitis. Some types of wood dust and oils can cause nasal cancer, particularly certain hard woods. Sawdust needs to be controlled. □Medium Density Fibre boards, chip board and plywood, contain glues and urea formaldehyde, and dust from working these materials can cause irritation.

Asbestos should be banned. Safe substitutes exist for all its applications and there is no justification whatsoever for its continued use. Asbestos causes fatal diseases - asbestosis, mesothelioma and cancer of the lung and digestive system. The use of asbestos in building and insulation materials has been widespread for many years. Millions of buildings all over the world contain asbestos, and workers carrying out maintenance, repairs, renovation or demolition work are often exposed without even being aware of it.

Manufactured Mineral Fibres. Certain types of MMFs which are used as substitutes for asbestos mimic its properties so closely that they can also cause fibrosis and lung cancer.

Welfare and biological hazards. Living and working conditions of building workers are poor in developing countries. Many workers live in slums and barely make enough money to feed themselves and their families, so nutrition is poor. Often there is no access to clean drinking water. On many sites, the accommodation offered in the bunk houses is dirty, overcrowded and infested with rats. Tuberculosis, cholera and parasistic diseases from contaminated water can occur. Dengue and malaria, caused by mosquito bites can also be a health hazard. Where pools of water are allowed to accumulate, they make perfect breeding grounds for mosquitoes. Communities around construction sites may also be affected.

HIV AIDS. Migration, including rural -urban migration, to seek work in large construction projects means being away from home and family for long periods. This places construction workers at risk.

Work organisation and Stress. Caused by the hazardous and constantly changing working environment. Noise, dirt, dust, chemicals, work at heights, confined spaces, heavy work, and lack of information and training all contribute. Particularly acute is the fear of accidents, most notably fear of falling. Bullying and pressure is commonplace, and generally the worker, particularly labourers, will have little or no control over how the work is to be done.

8 BRIEF BIBLIOGRAPHY

Title	C167 Safety and Health in Construction Convention, 1988
Author(s)	The General Conference of the International Labour Organisation
Type of source	ILO Convention concerning Safety and Health in Construction
Publication or other source details	Convention: C167 Place: Geneva Session of the Conference: 75
Date & ISBN/ISSN	Date of adoption: 20:06:1988 Date of coming into force: 11:01:1991
Summary of contents	VI. Scope and definitions VII. General provisions VIII. Preventive and protective measures IX. Implementation X. Final provisions There are also some useful cross-references at the end.
Comments on relevance	The core document for **Construction OS&H**, containing fundamental general provisions and much detailed guidance.
Other information	This Convention has very similar detailed content to the ILO’s Code of Practice, 1992, which is also summarised in this Knowledge Base.

Title	BWI web site
Type of source	Web site
Publication or other source details	http://www.bwint.org and refer to the ‘Building and Construction’ button on the left
Date & ISBN/ISSN	Accessed December 2008
Summary of contents	The first page in the Building and Construction section has a very good summary of the characteristics and employment issues of these industries, and sets out BWI’s views: “For the BWI, the most effective way to ensure that worker's interests are protected in the work place is through legislation and regulation. In this connection, we work with the International Labour Organization (ILO) to lobby for the implementation of ILO standards and their respect in World Bank agreements. We promote the social dimension of sustainable development in economic growth, environmental conservation and society since it will not make construction more expensive. For example, a good working environment reduces the risks of heavy physically demanding work, leads to fewer accidents at work, fewer sick days and thus shorter times and lower costs for the total construction.” There are many interesting and relevant articles, especially concerned with women workers with some excellent photos of women at work.
Comments on relevance	There is much in this site of general relevance, and the photos can be downloaded and used in training materials.
Other information	See other BWI source summaries

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	Hong Kong – bastion of bamboo scaffolding
Type of source	Journal article
Publication or other source details	Journal name: Civil Engineering Author(s): Ramanathan DOI: 10.1680/cien.2008.161.4.177 Volume: 161 | Issue 4 Pages: 177 - 183
Date & ISBN/ISSN	01/11/2008. 0965-089X
Summary of contents	Hong Kong's skyline is dominated by some of the world's tallest buildings. Nevertheless, the city still uses bamboo scaffolding for much of its construction work – a traditional skill passed down over 5000 years. Bamboo is sustainable, lightweight and cheap and, as long as it remains fairly dry, a good construction material with significant mechanical properties. Researchers, engineers, environmentalists and bureaucrats have taken an increasing interest in the craft, such that regulations and practice continue to be improved and refined. However, to alleviate remaining design and safety concerns a structural design code is needed.
Comments on relevance	Generally relevant to the Modules 'General plant and equipment' and 'Working at height'.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

Title	Managing international construction projects: an overview
Author(s)	R Neale (Ed)
Type of source	Book, 239 pages
Publication or other source details	International Labour Office, Geneva. International construction management series No 7
Date & ISBN/ISSN	1995. 92-2-108751-4 & 4020-0142
Summary of contents	An edited book with contributions from Richard Neale, Williams Sher, Alistair Gibb and Simon Barber Chapters 1: Construction project management 2: Project management organisation 3: System support for projects 4: Control of quality and quality assurance 5: Site layout and facilities 6: Key considerations for site layout and facility planning 7: Construction site safety 8: Planning case studies 9: Cost analysis case study
Comments on relevance	A useful but very general book, apart from the case studies which are quite detailed. This is the last book (No7) in the series so some detailed case studies were seen to be useful. The planning case study has been adapted to provide an integrative project on OS&H for **Construction OS&H**
Other information	See Tutor’s Guide for more on the content of this book.

D: WORKERS' PERSPECTIVES


(Photo: Fiona Murie, BWI)

Summary of content	
1.	Preface
2.	The Trade Union approach to Occupational Safety and Health: "workers know best"

1 PREFACE

The training programmes described in this set of documents, entitled **Construction OS&H,** have been produced by the ILO and Building and Woodworkers International (BWI), working in partnership with the principal authors, Professor Richard Neale, Emeritus Professor of Construction Management, and Fiona Murie, Occupational Safety and Health Director of BWI.

The other Module Summaries in **Construction OS&H** have explained international perspectives, managerial requirements, practices and procedures, and technical aspects of 'OS&H in the construction industry. This Module Summary balances the whole package by explaining OS&H from the workers' perspective. Fiona Murie, expressing BWI's mission and contribution to improving OS&H in the construction industry worldwide, has written most of it.

> *"Our mission is to promote the development of trade unions in our sectors throughout the world and to promote and enforce workers' rights in the context of sustainable development"*
>
> *(http://www.bwint.org)*

This Module Summary is intended to provide flexible training materials for Trade Unionists and workers in the building trades who are interested in strengthening their activities on health and safety at work. The content is aimed mainly at Trade Union Health and Safety Representatives and can be used in discussion groups of workers and union members.

The main aims are to:

- Identify the main health and safety problems in our workplaces
- Develop a trade union approach to occupational health and safety
- Investigate hazards at work
- Build workers' involvement, awareness, and support on occupational safety and health
- Develop Trade Union organisation to ensure that employers eliminate or control risks
- Develop confidence, knowledge and skills

Trade Union training on health and safety should be:

- Motivating
- Active
- Democratic

It should be action oriented so that it will:

- Lead to practical action in the workplace
- Improve health and safety conditions for workers

Experience has shown us that trade union education should be based upon the principles of co-operation and sharing. These are the basic principles of trade union democracy.

To encourage this process, each of the subjects covered in this Module Summary are intended to support training activities which:

- Are designed to be worked on by small groups of participants
- Have aims describing what should result from the work
- Have a task defining what the small group should do
- Allow groups to report back, compare ideas, and reach conclusions

This Module Summary is in three main sections:

- The Trade Union approach to Occupational Safety and Health: "workers know best"
- Organising for a healthy and safe workplace
- Getting management to make improvements

2 THE TRADE UNION APPROACH TO OCCUPATIONAL SAFETY AND HEALTH: "WORKERS KNOW BEST"

Every year around one hundred thousand people are killed whilst working on building sites – in other words, one person is dying every five minutes because of bad, and very often illegal, working conditions. That horrifying death toll is shocking enough, but it's only the tip of the iceberg. A far greater number of people around the world die from ill health caused by their working conditions in the construction industry.

In the building trades the biggest cause of fatal accidents is falls from heights, and the second biggest is trench cave-ins. There are also many health hazards, including breathing in deadly asbestos fibres contained in asbestos cement materials, or other respiratory diseases caused by dusty work. These risks are well known and so are the solutions to avoiding them. The overwhelming majority of accidents happen during perfectly routine work. They are foreseeable and completely preventable. Building and Woodworkers International encourages and trains trade unionists to represent workers interests and to work with management to help prevent ill health, injuries and deaths. Responsible employers understand the importance of managing health and safety, and the important contribution to prevention of accidents and ill health that is made by workers' health and safety representatives.

However, not all employers are keen to cooperate. They sometimes see the management of health and safety as taking too much time, trouble and money.   By far the greatest risk for our health and safety, in practice, is the negligence of employers who do not comply with even basic legislation to protect people at work. Quite simply, they put profits before people.

We know there is a lot of legislation and guidance on health and safety, although trade unions would like to see much stronger laws.   The big problem is that the laws we do have are so often ignored. Deregulation, chains of subcontractors, self-employment (in particular bogus self employment) and informal contractual conditions make this situation even worse. Workers often have no choice – either they take a dirty and dangerous job, or they will have no job at all.

Trade Unions need to organise around improving working conditions. We need workplace representatives who can identify hazards to health and safety, who can get the support of workers, and who can take forward proposals to management. The

Building and Woodworkers International has a Global Programme on Health ad Safety at Work, which aims to help our affiliated Trade Unions to develop and strengthen their structure, policy and strategy on occupational health and safety.
Principal lines of activity include:

- Institutional Participation – increase Trade Union contribution in tripartite and bipartite structures on health and safety at international, national, and local levels.
- Participation in the Workplace and Collective Bargaining - establishment of Trade Union health and safety representatives and health and safety committees, negotiation of company health and safety policies.
- Global Health and Safety Campaigns – including a worldwide ban on all new use of asbestos, and for better controls over work with existing asbestos.
- Education and Training for Trade Union representatives to help them organise effectively on health and safety.

For more information and resources visit: **www.bwint.org**

What causes injuries and ill health?

Some hazards are very well known. For example, unguarded machinery, or falls from height. Other hazards are not so obvious, but may also cause long term damage to your health. These include dust, chemicals and noise.

Trade unions believe that injuries and ill health are caused because employers fail to provide a safe and healthy working environment. The employer should provide:

- A working environment where hazards are identified, removed or properly controlled before problems occur
- Safe systems of work
- Full information for workers
- Good health and safety training programmes
- Opportunities for workers, through their unions, to negotiate health and safety clauses in collective agreements, and participate actively in health and safety at work

Unions and Health and Safety

The best way to improve health and safety standards in the workplace is through Trade Union organisation. Unions can raise awareness, put pressure on employers, and campaign for negotiated improvements.

There are laws that say what employers should do to prevent injuries and ill health. Government Inspectors are given the task of enforcing the laws. However there are not enough inspectors, and they do not have the resources to effectively police every workplace. Better legislation, more inspectors, and stricter enforcement would be an improvement. However, strong Trade Union organisation is still essential to ensure that employers prevent injuries, ill health, and deaths. No matter how strict the law is, or how many inspectors there are, workers and unions have the direct interest. It is our lives, limbs and health that are at stake.

It is the job of Trade Unions and members at work to try to make sure that the employer keeps to his/her responsibilities. Some of the ways to achieve this are explained below.

Building a strong union membership

Recruiting workers into the union and organising around health and safety can help to build a strong union. Workers and union members have a deep concern about the health of themselves and their fellow workers. But often health and safety is not a priority for action. Many workers accept risks and bad conditions as part of the job; sometimes they are unaware of the hidden hazards; or they are afraid that they will lose their job if they complain.

Workers often face the direct choice between doing a dirty and dangerous job, or having no job at all. When a person is put in that situation, they sometimes choose to ignore the danger of injuries or long-term damage to health. Denying the existence of the risk can give the sensation of dominating the situation, and allows the person to not show or feel fear. This is why we sometimes see this “macho culture” in dangerous trades.

We need to build on the interest of workers and union members where it does exist, and awaken interest where it does not exist. We have to convince workers that if we have solidarity then we can improve working conditions.

With an informed, interested and involved union membership, the union can be an effective vehicle for protecting their health and safety. It is essential that we involve workers and union members from the beginning in identifying hazards at work. We can do this in a variety of ways: through surveys; talking to workers and union members and taking note of their complaints; involving them when we inspect; discussing some of the hidden hazards with them and getting their views.

Electing Union Health and Safety Representative (Reps)

Trained Reps can make a positive contribution to the prevention of injuries and ill health. They are aware of the risks in the workplace, and can work closely with workers to identify risks; investigate complaints, injuries and ill health; inspect the workplace; and take action to ensure that the employer eliminates or controls the risks.

Work organisation

Many Trade Unions ensure that health and safety is a fundamental part of their activities, and is linked to other union organising activity. Many of the issues that Trade Unions tackle have implications for health and safety:

- Work organisation
- Contractual arrangements and wage rates
- Productivity and time pressure
- Shift systems and working hours

These all have a direct impact on our health and safety.

That is why BWI affiliated unions are now including health and safety as an integral part of Collective Bargaining Agreements that they negotiate with employers.

Many BWI affiliates are actively involved in our Global Health and Safety Programme. Activities include, establishing union health and safety committees at work; developing union health and safety policies; training and supporting the development of strong local union representatives who are committed to improving the working conditions for workers and union members.

The activities in this training course will help you to use health and safety as your best organising tool for the workplace.

Employers’ responsibilities

Firstly, and most importantly, remember that it is the employer’s responsibility to make the workplace healthy and safe. People will always try to blame the workers when something goes wrong, but it is the employer who has both the legal responsibilities and the authority to take decisions. Since it is the employer who is in control, it is the role of the Trade Union to insist that the employer behaves responsibly.

Other key elements of a Trade Union approach to health and safety are that:

Employers must
- Eliminate or reduce hazards to workers, rather than expecting workers to adapt to the hazards around them
- Ensure that health and welfare are dealt with as well as the more obvious risks to safety
- Consider the environmental impact of work activity, and the hazards created for local communities

Unions must
- Involve, inform, and educate workers and union members to support the union’s drive for healthy and safe working conditions
- Work as a united body at all levels in the union. Health and safety is no different from any other trade union issue
- Pressurise the employer to eliminate or control risks. Legal standards are helpful but we cannot rely on them

Workplace Trade Union Representatives on Health and Safety

Trade Unions provide information, training and support for workplace Health and Safety Representatives who promote workers’ rights and the prevention of occupational accidents and ill health. There are two main areas for Trade Union engagement in the area of Occupational Health and Safety which are provided for in ILO Convention 155 and Recommendation 164:
- Firstly, at national level through tripartite institutional participation and participation in policy making industry bodies.
- Secondly, workplace participation through Trade Union, or Workers’, Health and Safety Representatives and participation in Management - Trade Union Joint Health and Safety Committees at the workplace.

Requirements on such participation are the subject of ILO C155 and R164, and similar provisions exist in most national jurisdictions. These ILO Instruments provide for:

- Selection of Representatives in health and safety by employees
- Protection of Representatives from victimisation or discrimination
- Paid time off to be allowed to carry out the functions of Representative
- Paid time off to be trained in order to function as a Representative
- The right to receive adequate information from the employer
- The right to inspect the workplace
- The right to investigate complaints from workers on health and safety matters
- The right to make Representations to the employer on these matters and to negotiate improvements
- The right to be consulted over health and safety arrangements
- The right to be consulted about the use of technical advisers by the employer and to call in technical advisers
- The right to accompany health and safety authority inspectors when they inspect the workplace and to make complaints to them when necessary
- Participation, and equal representation, in the Joint Health and Safety Committee

It is impossible to ignore the role of organised labour more generally in the representation of workers interests in health and safety. For example, at national policy level, efforts to redress workers' health and safety directly through collective action are an aspect of the institutional mechanisms of industrial relations in which trade unions are actively engaged in most countries. The practice of representing workers' interests through political lobbying for improvements to health and safety regulation and its enforcement, as well as for improvements to other laws that affect health and safety, is another aspect of Trade Union engagement in health and safety. Formal representation through corporatist bodies for consultation on the governance of health and safety are another means of representing workers' interests in which unions are involved in many countries.

Workers fatigued by overwork in order to secure a basic income, and workers who are temporary and poorly trained all face higher risks to their health and safety. These risks are combated by the role Trade Unions play in delivering better working conditions and through negotiating higher wages and shorter hours. Trade Unions also improve health and safety organisation. A recent survey of over 400 American health and safety professionals found that they regarded formal union negotiations and 'worker activism' as the two most important determinants of an effective health and safety programme.

Workplace Trade Union organisation improves compliance with OS&H laws and regulation, and their implementation is highly dependent on the presence of a union at the workplace. The benefits achieved normally include written health and safety policies and their communication to workers, provision of improved health and safety information and training, the use of health and safety practitioners, written evidence of risk assessment, health and safety audits and inspections, accident investigations and so on.

Participatory workplace arrangements, as provided for in C155 and R164, are associated with improved OS&H management practices, and improved OS&H performance outcomes. Joint Health and Safety Committees with well trained committee members and the use of established channels for relations between management and workers leads to safer, healthier workplaces. This has been demonstrated in studies in all industrialised countries.

The Trade Union will normally have a policy about whether there should be specific union representatives for health and safety or whether Shop Stewards deal with health and safety in addition to their other functions. In most countries there is legislation about workers representatives on Health and Safety, although it may not say that they should be Trade Union representatives. Check the law and collective agreements in your country and workplace to see what rights exist.

The day-to-day functions of Safety Representatives include:

- Talking to workers and union members, and taking up their complaints with management
- Involving, informing, and consulting workers and union members on their priorities, and agreeing strategies for tackling risks
- Systematically inspecting the workplace on a regular basis
- Investigating accidents, ill health and near misses
- Consulting with management
- Monitoring the employer’s performance on health and safety
- Making representations, and negotiating with the employer to ensure the safety and health of workers
- Talking to Government health and safety inspectors
- Participating in joint management-union safety committees in the workplace

Safety Reps in Action

An important part of the Safety Rep’s job is to carry out regular inspections. It enables the Safety Rep to systematically monitor the health, safety and welfare of workers. The inspection will allow the safety Rep to look at the workplace; work organisation; talk to workers to get their views; collect information; and then make proposals to the employer. The Rep should point out the deficiencies in the employer’s systems for health and safety, and make proposals for improvements.

The Safety Rep should inspect the workplace on a regular basis. In some sectors this would be every month, and perhaps every three months for a lower risk workplace. However, in construction there are frequent changes to the worksite and a wide variety of hazards to health and safety, so you may need to inspect daily or weekly.

If legal rights for safety representatives are weak (or do not exist), we should seek to obtain an agreement with management to carry out inspections during working hours. Remember that it is the employer’s job to manage health and safety. Inspections are one of the ways that we can check whether they are managing it properly. If they are not, then we can bring it to their attention in writing, and make sure that they then remedy the problems.

Do-It-Yourself Research In the workplace

There are two main types of research we can use for investigating and improving conditions at work – passive research, where we find existing relevant information on health and safety in our workplace, and active research where we generate new information through inspections and surveys at work.

Passive research

This includes accessing:

- Publications - from leaflets and magazines to encyclopaedias as well as web sites and databases. An important source is manufacturers safety data sheets for materials, chemical products and machinery.
- Experts in governmental and non-governmental organisations, especially trade unions. Experts should be independent.
- Statistics: national, industry or workplace. These include lists of occupational diseases, accident books, compensation records and sick leave patterns. There are many important sources of information on health and safety which already exist. We need to tap into these resources to back us up in negotiating improvements. Getting informed by consulting these is passive research.

Active research

Means we generate new, independent information specific to our workplace. We can then use this information to negotiate improvements in our working conditions. There is a variety of Do-It-Yourself techniques we can use in order to do this. They all involve looking at the workplace and listening to the workers, and placing value on their opinions. Active research is Trade Union organising on health and safety.

Active research includes:

- Risk mapping of the workplace
- Carrying out inspections
- Surveys and interviews on symptoms and hazards
- Body mapping
- Meetings
- Information exchange and training

Carrying Out Workplace Inspections

Communication with workers is the key to finding out the information we need and to negotiating improvements. It is important that we involve workers at all stages of the inspection and make sure we have their support by:

- Finding out their problems and complaints before we inspect
- Talking to them during the inspection
- Reporting back to them after the inspection

There are a number of different types of inspection which include:
- General Inspection, to check all aspects of working conditions
- Inspection after an accident
- Inspection of documents
- Special Inspections, to concentrate in more detail on a particular aspect of the workplace or working conditions. For example, risk of falls, machinery hazards, electrical hazards, chemicals being used or dusty work.

The most important thing in an inspection is to observe what is really going on and how people are actually working. As we go we need to make notes and drawings to help us make a report. We can then organise the investigation and information about risks into the four broad categories described below.

Physical Hazards
- Falls from heights, scaffolds, roofs, ladders, trips and slips
- Excavation hazards and confined spaces
- Machinery, entrapment, cuts
- Transport (forklifts, hoists, cranes)
- Electricity (temporary installations, tools and plant, systems for identifying underground cables)
- Noise and vibration
- Manual handling and lifting, repetitive work, forced postures

Chemical Hazards
- Solvents (paints, lacquers, varnishes, strippers, glues)
- Pesticides (e.g. timber treatments)
- Dust (wood, cement, medium density fibreboard, silica, gypsum)
- Cement burns
- Asbestos dust

Biological Hazards
- Contaminated water supply
- Malaria
- Dengue fever
- Weil’s disease (rats)
- Infectious diseases, such as hepatitis or tuberculosis

Psychosocial hazards
- Poor work organisation, instruction and supervision
- Work overload: long hours, shift work, fast pace, lack of breaks, productivity pressure, being pushed to take shortcuts
- Low pay
- Insecure contractual conditions
- Lack of information and training needed to carry out work and to prevent hazards
- Lack of welfare facilities (toilets, washing and changing facilities, facilities for eating and taking breaks)
- Stress, due to being exposed to risks

- Bullying
- Lack of participation and consultation

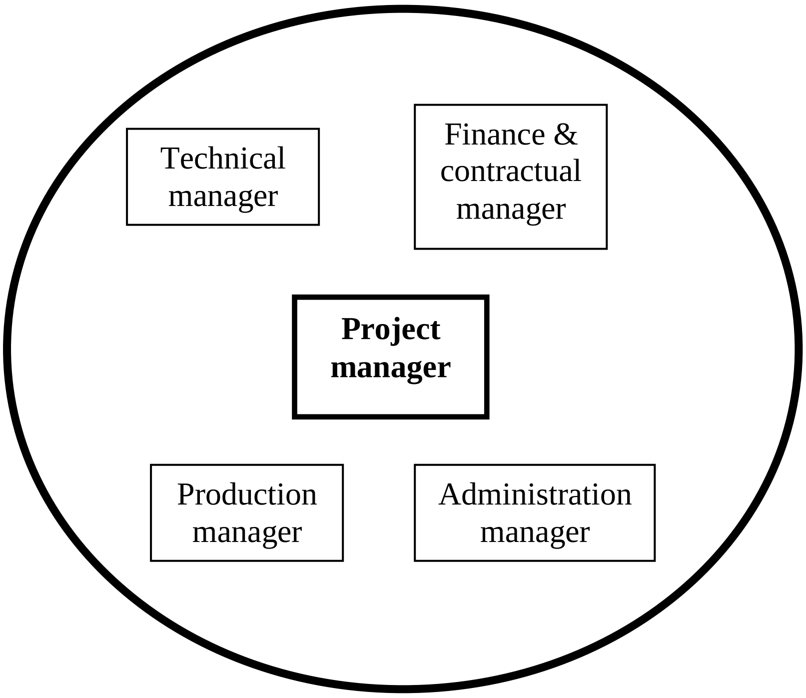
Health Surveys

If one person has a bad back or constant headaches then it’s probably an individual health problem.

If everyone or several people doing the same job have similar health problems it’s almost certainly occupational.

Follow your instincts and follow up with some detective work.

E: PRINCIPLES OF SAFE PROJECT MANAGEMENT



Summary of content	
1.	Preface
2.	Project organisation and management functions
3.	Stages of construction projects
4.	Creating a good preventative OS&H culture
5.	Enforcing good OS&H through procurement and contracts
6.	Brief bibliography

1 PREFACE

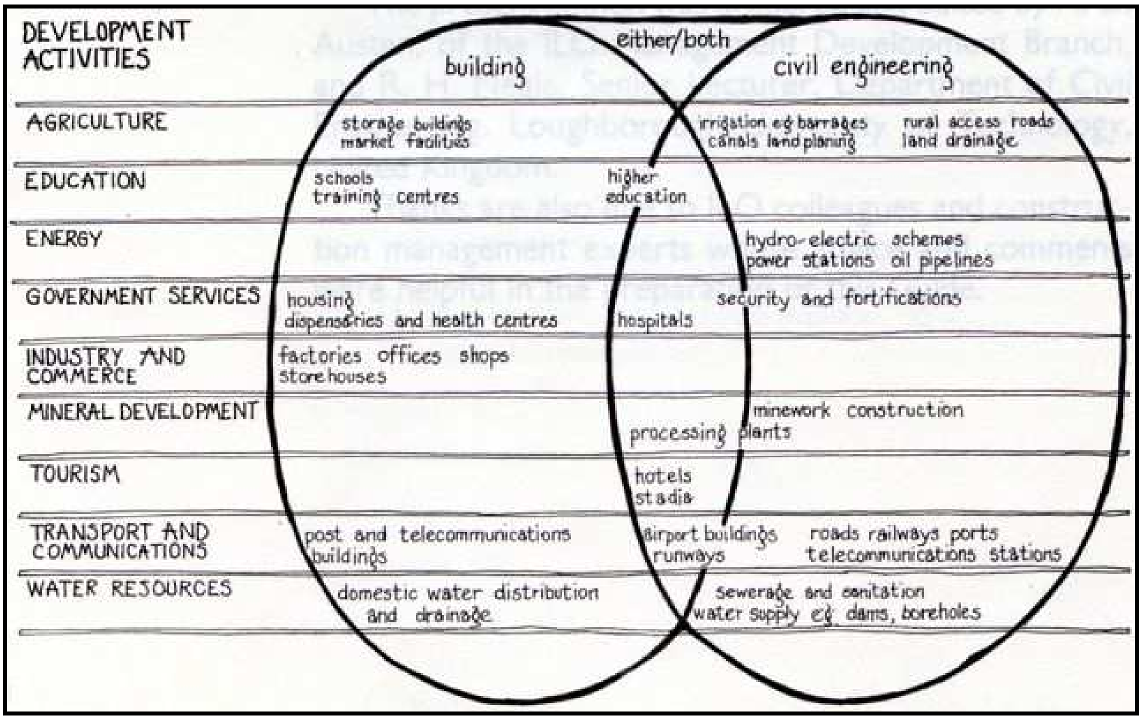
Construction OS&H is set within a project management context, but the principal focus is on OS&H so this context will only be described briefly as a specific subject. It should be noted also that project management is mentioned fairly frequently throughout this training package, so it is entwined in the general principles and practices advocated.

This Module Summary is largely based on the following ILO books:

1. "Managing construction projects: A guide to processes and procedures".
   Edited by A D Austen and R H Neale (1984)

2. "Managing international construction projects: an overview".
   Edited by R H Neale (1995)

The first book was written to accompany a series of ILO training courses in African countries and has been translated into a number of languages. It provides general guidance on the management of construction projects with specific reference to developing countries, emphasising the crucial importance of the construction industry in national development – for example by providing facilities for education, transport, water supply and industry - as shown in the diagram below.



The second book is the final (No 7) volume in the ILO's *International Construction Management Series*. Both have been fully reviewed by international experts during their development.

In addition, the following book is very useful to **Construction OS&H** since it is in the form of a textbook with extensive student learning elements, which make it useful for the Tutor:

"Construction safety management" by Tim Howarth and Paul Watson (2008)

These three books will be referred to in this Summary as the 'ILO Guide', the 'ILO Overview' and 'Howarth and Watson' respectively.

The contents of this Module Summary are as shown in the table above.

2 PROJECT ORGANISATION AND MANAGEMENT FUNCTIONS

General principles of management

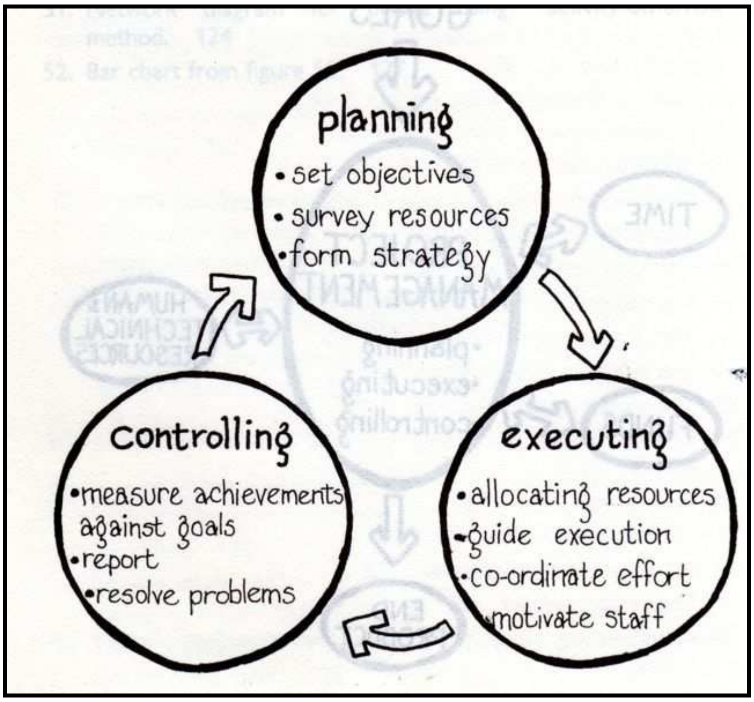
"We define management as the process of designing and maintaining an environment in which individuals, working together in groups, accomplish efficiently selected aims."
[Koontz and Weihrich (See the ILO Overview, p11)].

There is general agreement, developed and maintained over a long period of time, that there are six 'functions of management':

Planning functions
Planning: setting objectives and deciding on future courses of action
Organising: establishing an intentional structure of roles for people to fill in an organisation
Staffing: Filling, and keeping filled, the positions in the organisation structure

Executive functions
Leading: influencing people so that they will contribute to organisation and group goals
Coordinating: "The essence of management"; the achievement of harmony of individual efforts towards the accomplishment of group goals
Controlling: measuring and correcting the actions of subordinates

The ***process*** of managing has three fundamental elements, as shown in the diagram below. These elements form a continuous 'managerial cycle', driving forward towards an agreed goal. It is important to understand that management is not a static function, and that all managers have to be involved in this continuous process.



These principles are wholly consistent with a philosophy of good OS&H practices:

- From the definition of management, one of the 'selected aims' should be to preserve the safety, health and general well-being of all the people involved. This relates closely to 'policy' as explained in Module Summary 7: "Processes and systems"

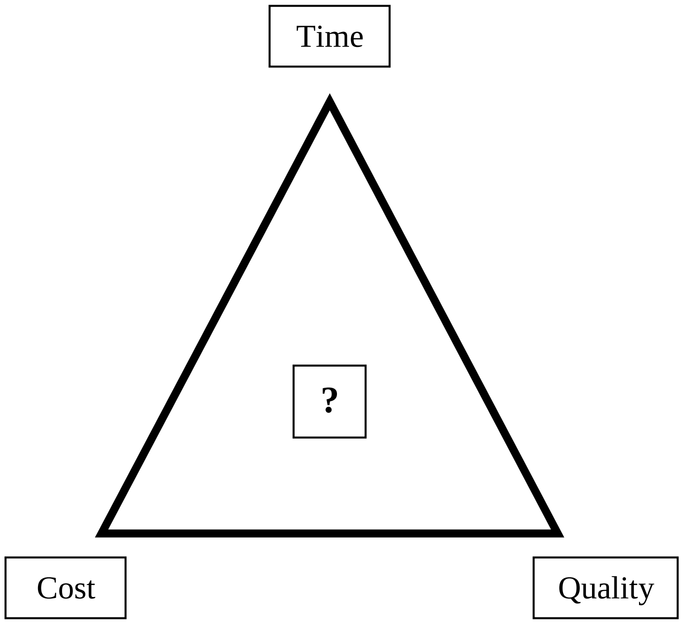
- All six managerial functions should embrace effective OS&H

- All three elements of the managerial process should be employed to ensure effective OS&H performance.

Construction project management

Unlike the management of a factory, which runs at a 'steady state' for much of its existence, construction projects are essentially managed by transitory organisations. Projects have a distinct start and end, often with some very intensive activity in between. This is especially true of most construction projects.

The 'basic view' of the key goals of a construction project is given in the diagram below: the 'project triangle' of quality, cost and time. The project triangle attempts to show that it is difficult to achieve all three goals simultaneously; for example a fast time scale (short project duration) may well result in more cost that a project run at a slower pace; and a low cost project may have to compromise on quality. Essentially, as the management compromise (the question mark box within the triangle) moves closer to achieving one of the three goals, it moves further from the other two.



The basic view ‘project triangle’ of quality, cost and time

This ‘basic view’ represents a very common but very limited view of a project, and a more comprehensive view has to be taken in order to manage a construction project effectively.

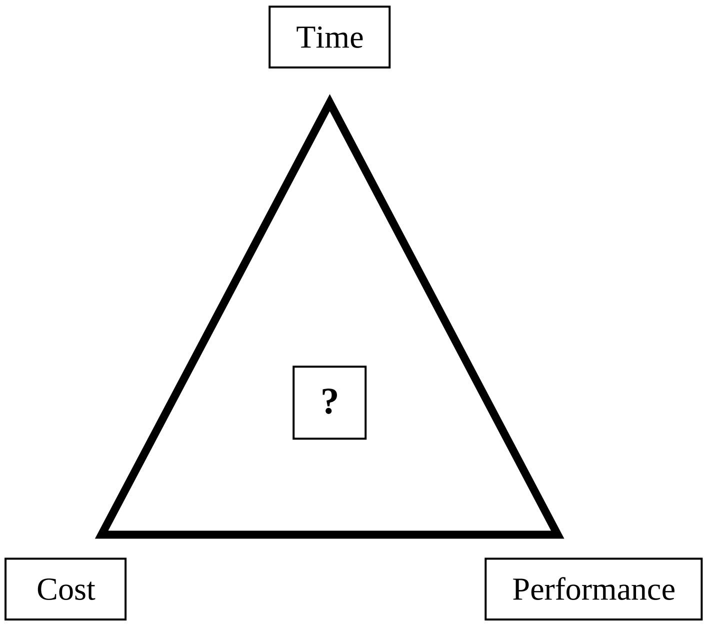
Firstly, although attention during the project development and implementation stages may well be on performance cost and time, the reality is that when the project is complete the client, and many of the other parties involved, tend to forget that a project may have been delivered quickly and cheaply, and will be much more concerned with the quality of the finished facility.

Secondly, modern management methods may reduce the degree of compromise required (i.e. the dimensions of the project triangle are reduced). These methods include ‘value management’ techniques that aim to improve value-for-money, and planning and control techniques that enable faster project delivery without compromising quality.

Thirdly, the project triangle is a narrow economic view of a project, and so is inadequate within the context of Corporate Social Responsibility (CSR), which was discussed in the Module Summary 1: “Fundamental principles”.

A more comprehensive approach is required, sometimes expressed by the term ‘triple bottom line’ of ‘people, planet, profit’, based on economic, ecological and social measures, which originates in the UN to express an approach to international development that is much broader than economic development.

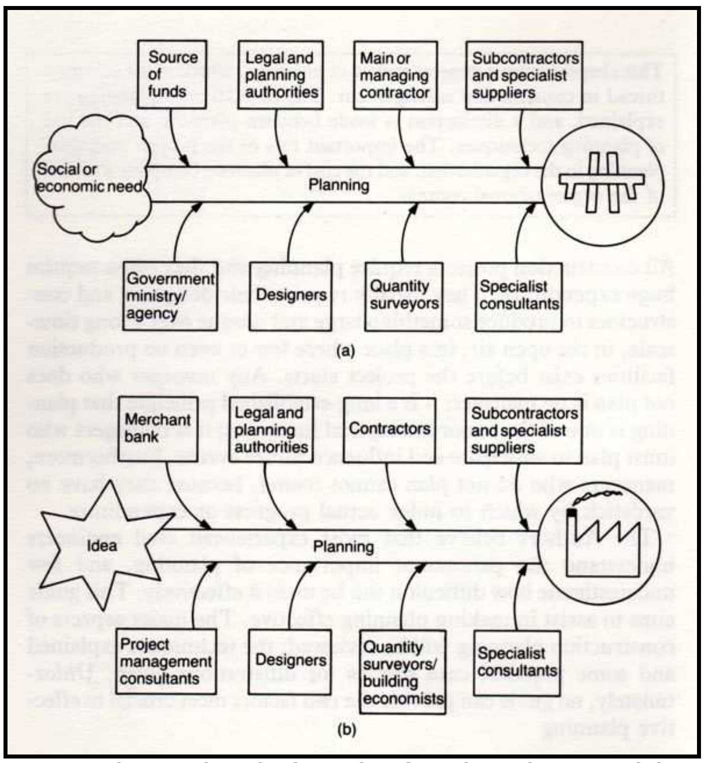
The central issue therefore is ‘Performance’. The ‘project triangle’ will feature as an important concept in almost all construction projects, and reality will often force compromises. But one of the common features of the construction industry is that this project triangle is the only consideration, and that the other two ‘bottom lines’ are optional additions.



The fundamental philosophy of **Construction OS&H** is that 'Performance' must include effective measures of good OS&H; often it does not, and this is what **Construction OS&H** is intending to change.

Project managers and project teams

The diagram below gives examples of people and organisations whose activities must be planned and coordinated during a project. The examples are for a possible public sector project and also for a new private manufacturing facility.



(From "Construction Planning", by Richard H Neale and David E Neale. see Knowledge Base below)

This diagram indicates the complexity of these relationships, and how they are drawn together in a common purpose by effective planning. The role of a project manager is to provide the essential human linkage.

Project managers are essential to the Executive Functions of management, especially *Leading*. Most construction projects will require a number of project managers, who must work together effectively. The main project managers will be:

- Client’s project manager, who will manage the whole project on behalf of the client, from start to finish

- Design team’s project manager, who will work with the client’s project manager and manage the whole design team and its specialist advisors

- Construction company’s project manager, who will manage the whole project within the construction contract, including all the subcontractors and suppliers

These project managers have a very significant responsibility for the implementation of effective measures for OS&H.

Much has been written about project managers, but an old study, taken from the ILO Overview, is reproduced in the table below, and has stood the test of time. Of especial importance to OS&H is the finding that participative decision-making produces the best results.

Summary of major research findings regarding the human element in project management

There is no single panacea in the field of project management. Some concepts and principles work well in some environments, while others are more suited to different environments.

It is important to vest the project manager with as much authority as the environment permits. Once vested with this authority, the project manager is well-advised to use expertise and work challenge as influence modes, rather than formal authority.

Project organizational design must be tailored to the specific task and the environment, but higher levels of authority for the project manager result in less probability of cost and time overrun.

The confrontation or problem-solving approach is generally more successful than the smoothing approach or the forcing mode of conflict resolution.

Participative decision-making styles are generally more successful than other styles. Commitment, teamwork and a sense of mission are important areas of attention in project management.

To attain high levels of perceived success, effective coordination and relations patterns are extremely important. Also, success criteria salience and consensus among the client, the contractor and the project team are important.

Source: B. N. Baker and D. L. Wilemon, 1977.

The key qualities of an effective project manager include:

- Good team leader, builds good relationships
- Has an open and honest management style
- Good communicator - “management as a performing art”
- Focuses on results, has a ‘sense of mission’
- Technically competent - understands the construction process
- Financially competent - understands project income and costs
- Confident & resilient - “when the going gets tough, the tough get going”
- Understands management systems and uses them effectively

Essentially, this means that the project manager:

- Needs to have real authority, but should only use it when absolutely necessary

- Can only be effective if all parties agree on the aims and objectives of the project - client, designers and construction companies must all share the same view of the project

Project management organisation

Much has been written on management structures for construction projects, but fundamentally most medium to large projects require a project manager and four immediate sub-ordinate managers. This basic requirement applies to both clients’ and contractors’ project management.

As stated above, the **project manager** has the overall responsibility for managing and leading the project. If she or he does not take a leading role in implementing good OS&H practices and systems it will be difficult to implement them throughout the project. Instead, implementation will have to rely on rules, regulations and external requirements and inspections, which can never be as effective as wholehearted support from senior managers.

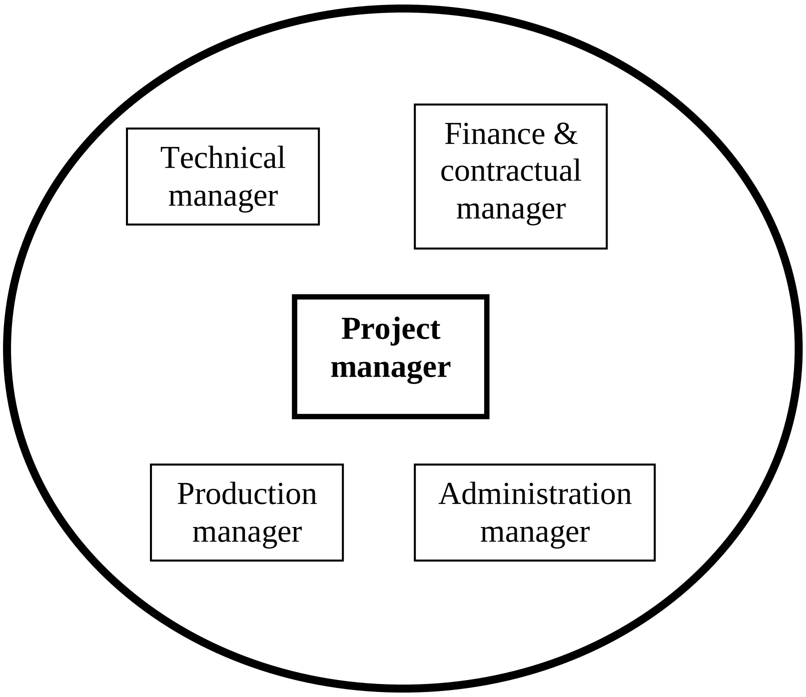
The **production manager** is responsible for the practical delivery and physical production of the project, and will therefore have a very direct influence on OS&H.

The **finance and contractual manager** is responsible for controlling the financial aspects of the project, and since this is often based on the agreements made in the contracts and specifications, this role has to include the contractual aspects of the project. The contract documents should contain robust requirements for OS&H, some of which will have to be paid for explicitly, so the manager can have a very powerful influence on OS&H.

The **technical manager** will have responsibility for sound implementation of all the technical aspects of the project, including the technical aspects of hazard and risk analysis and method statements to ensure that all the work on the project is conducted safely and in a healthy environment.

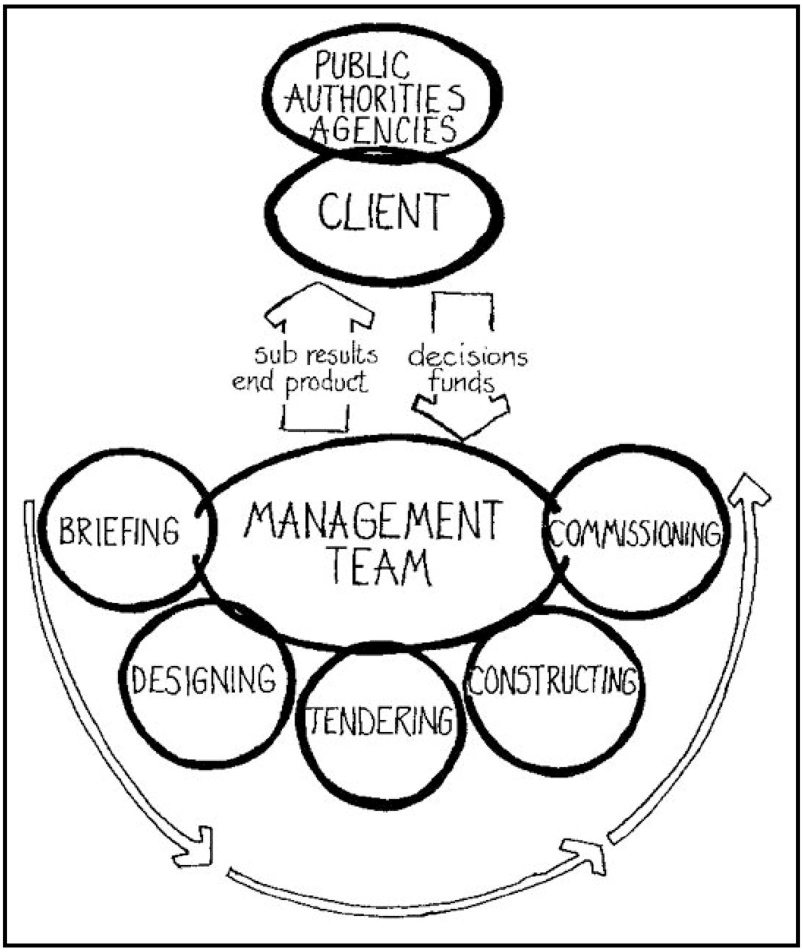
The role of the **administration manager** is becoming increasingly important and challenging. During the past few decades, legislation and the development of business systems (including quality assurance and OS&H) have dramatically increased the scope and workload of administrators, so the person who leads and controls the administration needs to be at the same level of importance as the other three managers who report to the project manager. This manager has prime responsibility for implementing and maintaining all OS&H policies and systems.

The diagram below shows these five managers in the form of a team, in which the project manager is the senior member and leader, and the others have equal authority and responsibility.



This organisation would have been expressed differently 30 or 40 years ago, because it would have been based on the concept of a 'line-and-staff' organisation, in which the production manager would have had a more senior, 'line' responsibility to the project manager and the other three managers would have acted in support, as 'functional managers'. This management structure derives from military structures in which front line soldiers fight the battle and all other parts of the army act in support. This may or may not be the way in which the military still organise themselves, but in terms of modern construction project management it is obsolete and the most effective management structures are much looser and based on teams and teamwork, all working together to achieve the project's objectives.

The ILO advocated this principle of team-working as the basis for project management in the early 1980s (see Austen and Neale 1984), as shown in the diagram below, and its relevance has been reinforced during the past three decades or so.



3 STAGES OF CONSTRUCTION PROJECTS

The stages of a typical construction project, run within a 'traditional contract' in which the design is completed then the contract is let through competitive tendering, are shown in the 'project matrix' below, together with the project teams associated with them. The shading gives an indication of the intensity of their involvement.

PROJECT TEAMS	PROJECT STAGES				
	Briefing	Design	Procurement	Construction	Commission
Client					
Designers					
Contractors					
Other consultants					
Sub-contractors					
Suppliers					

Projects do not necessarily run in this sequence of stages; for example, in a design and build project, procurement would precede design and the contractor would be involved quite intensely in the design stage. Nevertheless, the stages shown are a useful simplification because all these five stages will usually form part of the project process.

The 'project matrix' will be discussed in more detail in the Module Summary 6: "Planning and control for OS&H".

4 CREATING A GOOD PREVENTATIVE OS&H CULTURE

Care must be taken when using the term 'OS&H culture', because it can raise complex issues of definition and interpretation. For example, the following passage is taken from an ILO report of a survey in 2005:

Several respondents, in particular workers' organizations, take the view that the reference to "safety culture" proposed by the Office is problematic. The term is considered to be closely linked with the concept of "behavioural safety" which shifts responsibility for OSH away from the employer onto the worker. Although this inference was not intended by the Office, the proposed Conclusions use the term "preventative safety and health culture" (used in the 2003 Conference conclusions) instead.

(International Labour Conference, 93rd Session, 2005. Report IV (2) Promotional framework for occupational safety and health. http://www.ilo.org/public/english/standards/relm/ilc/ilc93/pdf/rep-iv-2.pdf)

The term 'preventative safety and health culture' is used, therefore, throughout **Construction OS&H**.

Bearing this in mind when reading about 'culture', a very useful explanation of the term is given on the web site of the United States Department of Labor, Occupational Safety and Health Administration (OSHA):
(http://www.osha.gov/SLTC/etools/safetyhealth/mod4_factsheets_culture.html).

"Culture is a combination of an organization's: attitudes, behaviors, beliefs, values, ways of doing things, and other shared characteristics of a particular group of people."

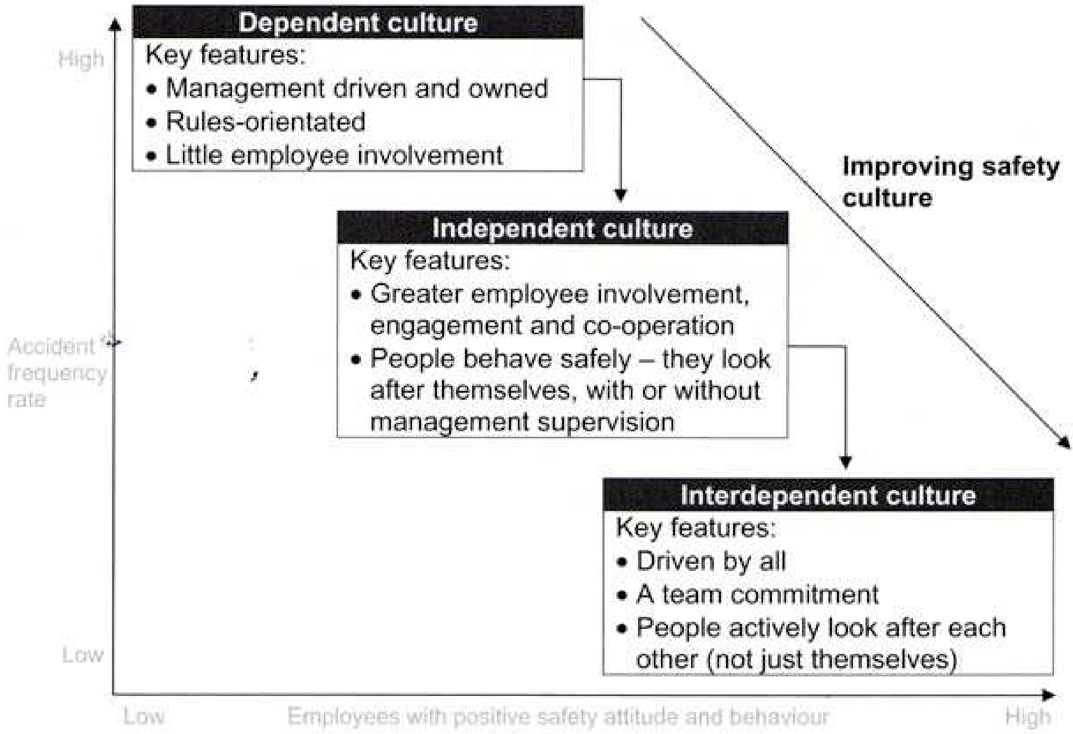
OSHA's web site also provides a very informative and comprehensive explanation of "Creating A Safety Culture" under the following headings:

1. *Why do you want a strong safety culture?*
2. *What is a safety culture - how will it impact my company?*
3. *Building a safety culture*
4. *Obtain Top Management "Buy-in"*
5. *Continue Building "Buy-in"*
6. *Build Trust*
7. *Conduct Self Assessments/Bench Marking*
8. *Initial Training of Management-Supervisory*
9. *Establish a Steering Committee*
10. *Develop Site Safety Vision*
11. *Define Specific Roles*
12. *Develop a System of Accountability*
13. *Develop Measures*
14. *Develop Policies for Recognition*
15. *Awareness Training and Kick-off*
16. *Implement Process Changes*
17. *Continually Measure performance, Communicate Results, and Celebrate Successes*
18. *On-going Support*

(The ILO is grateful to OSHA for the use of this quotation. It is 123 words long, so has been used under the convention of 'Fair Use' which allows a maximum of 400 words to be used without seeking formal permission.)

All those who are involved in managing construction projects should read the full document, which is freely downloadable at:
http://www.osha.gov/SLTC/etools/safetyhealth/mod4_factsheets_culture.html.

Howarth and Watson devote a whole chapter of their book to this subject, and the diagram below illustrates different cultures. This diagram emphasis that central principle of **Construction OS&H** – that close cooperation and real participation of all involved will result in improved OS&H performance.



"The safety culture of a construction organisation is informed and shaped by the attitudes, values and behaviour of all people involved with the organisation or project"

(The ILO is very grateful to Professor Paul Howarth and Tim Watson for permission to use this diagram and quotation.)

5 ENFORCING GOOD OS&H THROUGH PROCUREMENT AND CONTRACTS

Introduction

It is recognised that many measures are needed to improve safety and health in construction, including a strong legal and policy framework, an effective inspectorate and training of workers, supervisors, contractors and health and safety managers in construction. It is often argued that the monitoring and enforcement of health and safety regulations is solely the responsibility of public labour inspection. However, the large number and wide dispersion of construction sites and the scarce resources available for public labour inspection means that it is impossible to inspect all worksites. Therefore, linkages between employment law and procurement process and the terms and conditions of the contract can be used as complimentary mechanisms for ensuring compliance with legislation. Procurement procedures and contract documents act as important mechanisms to remind the parties to the contract of their obligations under the law. This can raise the standard of OS&H on individual projects and has the potential to raise standards in the industry more generally.

The ILO and organisations in the construction industry, notably the construction Trade Unions, have been advocating measures to improve OS&H through legislation and policy initiatives; improved training, skills certification and worker participation; better planning and coordination of construction projects, including better selection and control of subcontractors; and through the use of health and safety management systems. It is only in recent years that attention has begun to focus on achieving good OS&H performance starting “upstream” with the procurement process rather than trying to tackle it only during the construction phase itself.

Methods of contracting

The two main methods of letting contracts for construction projects in use throughout the world are ‘single prime contractor’ and ‘design-build’.

Single prime contracts are the most common form of construction contracting. In this process, the contract documents are usually prepared by a consultant (architect/engineer/cost consultant) for the client (but this may of course be done by the client’s own team). There is usually a direct contract between the client and the consultant(s). The contract documents are then made available to a number of qualified bidders, and the winning contractor enters into a ‘prime contract’ with the owner. The ‘prime contractor’ then enters into a series of subcontracts with other contractors in order to undertake the work. So, the client has a prime contract with the consultant and a separate prime contract with the prime contractor (sometimes referred to as the general contractor).

In a **design-build contract**, a single firm provides both the design and construction services. The client issues a contract to the firm to provide all of the design and construction services for the entire project. If a design-build contract is extended further to include the selection, procurement, and installation of furnishings and equipment, it is called a ‘turnkey contract.’ Once again, most of the work is done by subcontractors.

There are variations on these methods of contracting. For example, a client may employ a construction manager to handle the contract process and manage the whole project. The project manager enters into a series of contracts, including those with specialised contractors to carry out the work. Generally, the work is divided into ‘work packages’ which are reasonably distinct parts of a project: for example, ground-works, structure, cladding, etc.

In recent years, project owners in the construction industry have placed greater emphasis on contractor OS&H qualifications as a means for promoting construction site safety. Careful examination of safety issues in the bidding process has become more common. Increasingly, public procurement laws are being amended to allow the acceptance of other than the lowest bid, on the basis of ‘best value’, with a view to achieving better working conditions, health and safety and other social objectives. It is becoming more widely recognised that previous practices requiring acceptance of the lowest bid is no guarantee of value for money.

Regardless of the method of contracting, OS&H hazards must be identified, controls must be implemented and maintained, and records must be established in order to minimise injuries and illnesses and to ensure compliance with legal requirements.

OS&H in contract documents

It is increasingly common for clients with projects involving complex safety and health risks to incorporate preventative requirements into the contract administration process. These requirements often begin with the contractor pre-qualifying prior to bidding and then progressing through the aspects of actual construction work. The early integration of OS&H criteria into the contractual process has become relatively common today, at least in developed countries, but this has largely been the result of the efforts of progressive clients and construction firms. There has not been a specific, commonly used reference source that offers guidance on how to effectively accomplish this integration.

To best understand the opportunities to incorporate OS&H requirements into contract documents, the client should be familiar with their content and purpose, concentrating on the documents where OS&H requirements can be integrated. Clients must be familiar with terms like “technical specifications”, “general conditions”, “instruction to bidders,” and other terms frequently used when discussing contract documents.

The Contract Documents generally comprise three parts:

1. Bidding Requirements. These describe any bid solicitation, Instructions to Bidders (instructions and procedures to be followed by bidders in preparing and submitting their bids, for use when competitive bids are solicited for construction of a project); Standard Bidding Documents (SBDs), which are the forms to be completed to submit bids), and other information available to bidders. These are requirements that bidders must address in order to prepare and submit a responsive bid, and these can include Labour Clauses on H&S in the SBDs as well as client’s requirements on H&S in the Instructions to Bidders.

2. Contracting Requirements. These describe the actual agreement between the client and the prime contractor, including certificates, General Conditions of Contract (this document is an integral part of the contract, setting forth the rights, responsibilities, and relationships of the owner, contractor, and architect); any supplementary conditions [Conditions of Particular Application (CoPA)] that may be imposed on a specific project, and the Bill of Quantities, itemising pay items. These documents can include H&S requirements in the CoPA and H&S pay items can be included in the Bill of Quantities (BoQ).

3. Construction Documents. These describe all plans, drawings, Technical Specifications, addenda, and other information associated with the actual construction of a specific project. This section of the Contract Documents is often referred to as the Plans and Specifications, and it is in the Technical Specifications where H&S requirements can be addressed in greater detail.

Standard forms of bidding and contract requirements

There are many bid and contract packages around the world, which have been assembled by individual Clients or procurement entities or in country procurement systems. Among the most widely used and internationally recognized forms of contract are those published by the International Federation of Consulting Engineers (Fédération

Internationale des Ingénieurs-Conseils (FIDIC); http://www.fidic.org/). More than 25,000 copies of FIDIC's contract forms are supplied every year. These are: Design, Build and Operate Projects; Plant and Design – Build; EPC Turnkey projects; Short Form of Contract; and, finally, Conditions of Contract for Construction, which is also known as the Red Book, and is used by the World Bank and other Multilateral Development Banks (MDBs) in their lending for infrastructure and development projects. These are drafted by Consulting Engineers in consultation with the UN, Organisation for Economic Co-operation and Development (OECD), MDBs, World Trade Organisation (WTO), the ILO, Contractors Associations, the BWI and others. They contain essential Labour Clauses concerning hours of work, wages and health and safety. These documents are used as the Works Contract at the end of the procurement process, and they establish the relationship between the client, the prime contractor and other contractors, and the role of the client's representative, or consultant.

However, the OS&H clauses contained in these bidding and contract documents are very basic and general and there is very little guidance on how to improve OS&H practices and performance throughout the procurement process, or on how to integrate OS&H into all the Contract Documents.

A contractual process for clients

The development of contract documents integrating OS&H and the range of options that could be considered for incorporation into the specific project is summarized briefly below. This follows the 'normal' process of construction projects.

First steps before tendering

From the initial inception of the project, the client should develop and disseminate a clear policy and strategy for safeguarding the safety and health of the workers on the construction project. The policy should be widely publicised so that procuring officers and potential bidders fully understand the client's priorities.

Selection of consultants

Consultants act on behalf of the client in planning and designing a project and in supervising its construction. They have a responsibility for ensuring that the project is designed, constructed and maintained with minimum risk to the health and safety of the workforce. It is important for the client to remind potential consultants of their responsibility and to set out clearly what will be expected of them.

In a call for expressions of interest, it is important to state the client's objectives for protecting health and safety throughout the design, construction, maintenance and use of the project. The evaluation criteria for short-listing should include objective measures of the consultant's understanding of the major causes of accidents and ill-health on construction sites, including qualifications, courses attended and experience, as well as knowledge of national health and safety legislation and international standards. Consultants should demonstrate their record of performance on past projects, and competence in undertaking risk assessments and identifying prevention measures.

Those submitting full proposals should show how they will meet these objectives in the planning, design and supervision of the project. This should include a proposal for a project-specific Health and Safety plan (HASP) at the design and planning stage and the system for evaluating and managing the OS&H performance of the prime contractor and subcontractors during the selection, bidding and construction phases of the project.

Design Phase

During the design phase, the consultant and other members of the team developing specifications begin the process of translating a vision into an actual construction project. The client will have to stipulate in detail to the contractor the range of acceptable conditions for every aspect of a project. In addition to the technical specifications, the contract must set out responsibilities, rights, and relationships of the client and contractor, and others that may be involved in the project.

Several H&S standards now address specific responsibilities of clients and consultants that must be met as part of the contracting process. These include Health and Safety Management Systems, Hazards Communication, Confined Space Entry and other Permit to Work systems for hazardous tasks, or hazard-specific matters such as working with asbestos, scaffolding or crane erection.

In the United Kingdom, the Construction Design and Management (CDM) Regulations issued in 1994 (see Knowledge Base), set out specific responsibilities for the owner, designer, general contractor, and subcontractors for all construction projects, except very small projects. Requirements include a Safety Planning Supervisor to be appointed to the project and a health and safety management plan to be developed during the design phase.

The consultant should consider OS&H issues during the design phase by incorporating health and safety requirements in the contract for construction and specifying these requirements in the technical specifications. By including OS&H requirements in the contract documents, the contractor is required to implement health and safety activities during construction. The technical specifications should detail the minimum health and safety requirements and the means by which the client verifies compliance during construction.

Procurement (or bidding) phase

Once the contract documents have been prepared, an invitation is made to contractors who may be potential bidders. The client may want to include key OS&H criteria in the Invitation to Bidders, such as contractor pre-qualification criteria (pre-qualification is explained below). Once an apparent lowest cost or best value responsible bidder is identified, the client may want to require contractor participation in a pre-award meeting so that OS&H performance standards and acceptance criteria are clearly understood before entering into the actual contract. OS&H considerations need to be included for the bid package and invitation to bid, pre-bid meetings, bid review, evaluation and contractor selection, and contract award.

Pre-Construction Phase

The client may require pre-project meetings of stakeholders; project specific risk assessments; and/or require that roles and responsibilities of key actors be defined during this phase. At this point, contractor OS&H submissions must be evaluated against the acceptance criteria incorporated in the specification. The client should decide before the bidding phase what level of activity to require during the Pre-Construction Phase, based upon the complexity and hazards of the project.

Construction Phase

All of the training, permits, submittals, meetings, reporting, job site inspections, and other activities necessary to verify that safety and health hazard controls will be implemented in the construction phase must be established in the contract documents. The contractor demonstrates that the detailed Health and Safety Plan outlined in the specification is being followed while performing the work, and that the selected approach achieves the goals in the specification. The contract documents must establish the contractor’s OS&H responsibilities and the client’s right to observe the work and receive specified information.

Contractor pre-qualification and selection

In response to serious concerns and liabilities about OS&H, a growing number of construction clients are using qualification-based contractor selection, in which OS&H performance is increasingly considered a determining factor. Clients and construction managers are using contractor OS&H performance criteria in contracts in order to minimise liability, project delays, property damage, workers’ compensation costs, and in response to corporate commitments to improve workers’ health and safety. Clients should focus particular attention on these construction health and safety risks when initiating a construction project. Increasingly, such risk assessments are performed by contractors in response to requirements incorporated into the bid documents or as a client-required deliverable in the design-build process. Integrated design-build contracts as well as design-bid-build contracts can effectively incorporate many aspects of OS&H at the design phase.

The aim is to improve health and safety practices from design phase, through the bidding and construction phases, all the way to post-construction activities, such as cleaning and maintaining the building. The specific criteria appropriate in a given contract must be evaluated in the context of contractor arrangements and contracting methods. Within the public sector, procurement laws, public bidding laws and associated regulations can include a variety of standards.

Pre-qualification is the first step in identifying responsible candidates for inclusion on the list of firms to invite to bid on the project and may be conducted in two phases: general (relating to the organization as whole) and project specific.

Phase 1: General Pre-qualification

This type of pre-qualification addresses requirements that can be satisfied in advance of any procurement action. Potential contractors are pre-qualified based on certain general criteria, not specifically related to the services and activities involved in the actual work to be contracted. General pre-qualification usually includes information such as past performance indicators as:

- Injury and illness statistics
- Compliance or violations of OS&H laws and regulations
- Enforcement histories
- Insurance ratings
- ‘Near miss’ incident rates
- Inspection regimes

Phase 2: Project-Specific Pre-qualification

Project-specific pre-qualification reviews the contractor experience on identical or very similar projects doing essentially the same tasks that are anticipated. This includes their contractor’s present capabilities, such as:

- OS&H management systems and programmes
- Project specific OS&H plans
- Safety training provided to management and workers
- Availability and qualifications of construction safety managers and staff
- Training to be provided
- Inspection processes

Detailed review of OS&H in contract conditions

The general conditions of the contract define the overall OS&H responsibilities and requirements for contractors. These provisions are contained in a separate Clause of the contract. In general, these OS&H conditions require the contractor to be responsible for initiating, maintaining, and supervising all safety precautions and programs, while complying with all applicable laws and regulations.

General Prime Contractor and Subcontractor OS&H Requirements

The prime contractor receives payment from the client for services rendered. The prime contractor may employ one or more subcontractors to perform some or all of the work. The client has a direct contractual relationship with the prime contractor, who then has individual contractual relationships with subcontractors. The general conditions of the contract between the client and the prime contractor, as well as the contract between the prime and lower-tiered subcontractors, must clearly define the OS&H responsibilities and requirements for each party. These ‘flow down’ provisions are requirements of the contract between the client and the prime contractor and must ‘flow down’ to all subcontractors. The prime contractor is responsible for implementing the overall health and safety programme for the construction project, verifying the implementation of the subcontractor’s health and safety programme.

In no case shall the prime contractor be relieved of overall responsibility for compliance with the requirements for all work to be performed under the contract. To the extent that subcontractors agree to perform any part of the contract, they also assume responsibility for complying with the standards in this part of the work. In the case of subcontracted work, the prime contractor and any subcontractor or subcontractors have joint responsibility. For this reason, a common provision in the contract between the prime and subcontractors is that the subcontractor is responsible for OS&H compliance.

Therefore, the prime contractor’s contract with the client should also include a provision that requires the prime contractor to conduct a health and safety selection process on subcontractors. The client’s contract with the prime contractor should also contain the right to review OS&H documents and to visit the project site while work is ongoing.

Pre-construction and regular coordination meetings between the owner and the prime contractor, as well as between the prime contractor and lower-tiered subcontractors should be specified in the contract documents to allow for sufficient health and safety planning, risk assessment, and coordination during the course of the project.

OS&H work plans and schedules

The prime contractor should be required, in a clause clearly stated in the contract, to submit their company health and safety policy and a project specific health and safety plan (HASP) addressing all applicable OS&H requirements. The detail and complexity of the HASP will be dictated by the size and complexity of the project. Normally, the prime contractor is responsible for preparing the project-wide HASP that addresses potential hazards that may be present on the worksite (e.g fall protection risks and requirements). This project-specific HASP details the hazards posed by construction, the means and methods to be used for preventing or controlling them, and provides adequate safeguards for all construction workers. The prime contractor should require subcontractors to submit a project specific HASP addressing the tasks they will perform.

The specification for the HASP should also indicate how the contractor will address any specific hazards identified in the scope of work. Contractors that do not effectively assess hazards and protect their employees should be excluded from bidding by using safety and health performance and information as selection criteria.

To the extent possible the plan should include risk assessments for each phase or task of the work. This should address the basic steps to perform each phase of work, the hazards associated with each step and a description of how the contractor plans to prevent or control the risks.

On some projects, it is important that the contractor demonstrates they have written procedures to perform certain tasks or types of work. If the scope of work includes work activities such as confined space entry, use of hazardous chemicals, excavations, construction of scaffolds, etc., the contractor should be required to submit their operating procedures for the work.

In the contract, the prime contractor should also have a qualified safety officer at the project site responsible for implementing the HASP. The safety officer should be required to attend all project safety meetings and participate in all activities outlined in the HASP. The prime contractor should require subcontractors to designate a qualified safety representative at the project site with the responsibility for implementing each subcontractor’s HASP.

The prime contractor should be required to provide a detailed schedule of work activities with their bid, with the duration of each work activity shown. The prime contractor should require similar schedules from its lower-tiered subcontractors and integrate these into a master schedule for the project. The prime contractor’s schedule should be required in the contract documents to be maintained current with updated schedules provided to the client at regular intervals.

The proposed hours of operations and days per week the contractor is allowed to work on site is usually stipulated in the contract documents. OS&H issues should be considered in the overall project schedule, because the work schedule and construction sequence is likely to have heath and safety impacts. For example, the amount of night work and overtime should be kept to a minimum to better prevent incidents that can result from fatigue and inadequate lighting. Seasonal considerations should also be taken into account; health and safety concerns to consider may include heat stress, cold stress, inclement weather, biological hazards (e.g. poisonous plants, insects, and animals), and other concerns.

Another safety hazard that should be considered during schedule development is the prevention of falls. Timely erection of permanent stairways and handrails may prevent slips, trips, and falls associated with temporary stairs and scaffolds. The schedule should be designed so that a permanent stairway is constructed at the beginning, or as close as possible to the start of construction. The schedule could also specify that permanent handrails be erected along with the structural steel. The scheduled installation fire protection devices, such as automatic sprinkler systems, fire walls, and fire doors should be planned for the earliest possible time during construction. The permanent electrical systems and equipment should also be installed at the earliest time in the project to control hazards posed by temporary electrical systems.

Employees

The contractor should be required to submit the Curriculum Vitae (CVs) of key personnel identified in the specifications. Bidders should be required to submit CVs for key positions, such as:

- Site Supervisor. The CV should demonstrate that the person has appropriate training, experience, and qualifications to execute the project safely.

- OS&H specialist personnel. The CVs should demonstrate adequate training, experience, and qualifications to execute responsibilities.

- ‘Competent Persons’. Some activities have to be supervised by ‘competent persons’. These activities include scaffold erection, excavation work and confined space entries. ‘Competent persons’ for specific activities should be submitted for review, and should demonstrate training, experience, and authority on the project to carry out their responsibilities.

The prime contractor’s employees and those of their subcontractors should be required to provide written documentation that they have completed all appropriate health and safety training before working on site. This will include health and safety orientation training, and any project-specific health and safety training and hazardous operation training.

The prime contractor and subcontractors should be required to hold regular safety meetings to instruct their employees on all project-related safety procedures and to provide appropriate personal protective equipment and clothing to their employees, provide training in its use and enforce the use of the protective equipment and clothing.

OS&H incidents

In the contract with the client, the prime contractor is usually required to notify the client immediately following any OS&H incident, with a detailed written report and to comply with reporting and record-keeping requirements. The prime contractor flows-down the accident notification and reporting requirement to subcontractors, so that all incidents that occur during the course of the project are reported and investigated in a timely manner.

OS&H Pay Items

Although the general costs of operating good OS&H should be incorporated in the contract costs, there will be items in many contracts that enable the contractors and subcontractors to be paid for compliance. These ‘pay items’ should be specified in the contract documents, in particular the acceptance by the client of the prime contractor’s HASP for the project. These pay items are usually paid as a lump sum, but may also be itemised in a Bill of Quantities.

OS&H pay items may include:

- Different hourly rates for personnel to work in upgraded levels of personal protective equipment (such as respiratory protection)

- A lump sum for providing a qualified full-time health and safety officer for the duration of the project

- A lump sum for establishment and proper functioning of an OS&H Committee

- A lump sum for contractors and personnel attending any required OS&H orientation training

- A unit rate or lump sum for specific air monitoring, air sampling and analysis required to implement industrial hygiene or air quality monitoring, as may be required by the technical specifications

Project Specific Hazards Information

In order to initiate effective OS&H processes and procedures during the contract, specific hazards should be identified in the contract documents. These may include:

- Areas where the work or a portion of the work is to be performed is defined as a confined space

- Any potential fire, explosion or possible release of toxic or hazardous materials associated with the work or in the area where the contractor will be working

- Information related to emergency response and evacuation plan, such as:
  - Alarm systems
  - Evacuation routes
  - Areas of safety and assembly points

- Any hazardous materials or chemicals that are used in the area the contractor may be working, signs and symptoms of exposure, special protective equipment requirements, and copies of specifications for those materials or chemicals

- Known or suspected areas that may have hazardous materials or hazardous contaminants that could affect the contractor's employees or others by the contractor's work, such as the presence of asbestos, lead-based paint, or soils contaminated with hazardous materials

- The presence of other contractors that may be performing work in the same area and any hazards associated with their work such as:
  - Welding or cutting
  - Use of heavy equipment
  - Heavy lifts or use of cranes

- The presence of underground pipes or cables, overhead electrical power-lines

- Construction or demolition activities in an existing structure that could pose a structural collapse hazard if the contractor is not made aware of the existing structure's loading conditions and structural integrity

- Any health and safety requirements specified such as:
  - 100% fall protection
  - Use of hard hats, safety glasses, gloves, respiratory protection and safety footwear
  - Collection and maintenance of Material Safety Data Sheets for hazardous chemicals brought to the site

- Any special work permit requirements such as:
  - Hot work permits needed to coordinate use of spark and flame producing activities such as welding, grinding, or torch cutting
  - Excavation permits to coordinate excavations and ensure the contractor has all needed information for a safe excavation
  - Lock Out/Tag Out permits to coordinate the lock out or tag out of equipment
  - Scaffold erection and inspection to allow all contractors to understand the status of scaffolds present on a project
  - Lift permits to coordinate lifts with cranes
  - Chemical use permits that coordinate the use of chemicals or other materials on a project that could expose other site personnel to airborne hazards such as fumes, vapours, mists, dust, fire or explosion hazards

- The client or prime contractor should require contractors to document implementation of their health and safety programme and address requirements for personal protective equipment, chemical hazard communication, performing periodic health and safety inspections, emergency response procedures, tool and equipment inspections, fire protection, vehicle safety, and site security.

Licences, Certifications and Training Documentation

The contractor should submit copies of all licences, certifications, and training documents. These would include:

- Company and individual employee licenses for work as a general contractor, contractor or specialty work, such as asbestos abatement, crane and equipment operators, or other work that requires specific licenses

- Certificates of inspection for cranes or other heavy equipment

- Certificates of insurance indicating the contractor is adequately insured for general liability and workers’ compensation

- Certification and training documentation in key areas such as welding, electrical work, confined space entry, hazardous waste, site health and safety, asbestos abatement, crane and equipment operations, scaffold erection, excavations, etc.

Implementing the OS&H requirements of the contract during the project

Induction

New employees and visitors to the project should be required to attend an initial OS&H induction that covers the site-specific rules and procedures that must be followed and the disciplinary action that may result if such procedures are not respected.

Inspections

The purpose of OS&H inspections is to ensure that the project is performed in accordance with established standards. There are different types of inspections: self-inspections, equipment inspections and formal safety and health audits. Each contractor on site should be required to perform daily OS&H inspections of their respective work area. In addition, the prime contractor should conduct a minimum of weekly walkthrough inspections of the entire work site and note problems that need to be corrected. These must be communicated to the respective sub-contractors and followed up to ensure that incidents of lack of compliance are corrected. All inspections need to be documented to provide a record of what was found and corrective actions needed or taken. Copies of all inspection reports and follow-up actions should be submitted to the client.

The contract documents should reflect that the client has the right to perform site inspections and observations of construction operations. The purpose of these types of inspections is typically for the owner to have a mechanism to ensure that contractual safety and health obligations are being satisfied throughout the performance of the work.

Site OS&H Meetings

Since conditions are constantly changing on site, regular site meetings are essential to the OS&H performance on the site. The contractor should conduct the meetings but the client will want to establish the right to attend these meetings to help monitor compliance with the contract.

Weekly safety meetings should be held by all contractors and sub-contractors on the site to review safety conditions and ensure any corrective actions are taken. The prime contractor should be required to be at all of these meetings to hear the concerns that are raised and to make sure they are addressed in a timely manner.

Safety Documentation

Numerous documents are created as part of the OS&H processes. These documents are useful during the construction phase to monitor and continuously improve safety performance. Requirements for safety documentation must be incorporated into the contract documents.

Incident/injury reporting

Contractors and sub-contractors should be required to provide to the client immediate notification of incidents (including 'near miss-events') and injuries. The contractor should be required to conduct an investigation of the incident to identify the root causes and corrective actions to prevent further incidents (accidents). Submittal of the investigation report by the prime contractor should be required within 24 hours

Hazardous work permit system

Depending on the nature of the site, a hazardous work permit system may be instituted on site to ensure that essential precautions are followed when working in a hazardous area. Such permits may include confined space entry permits, hot work permits, or work at height permits. Such site-specific hazards and procedures should be included in the project specification and discussed in the initial project safety orientation meeting. Any applicable hazardous work permit system should be specified in the solicitation documentation.

6 BRIEF BIBLIOGRAPHY

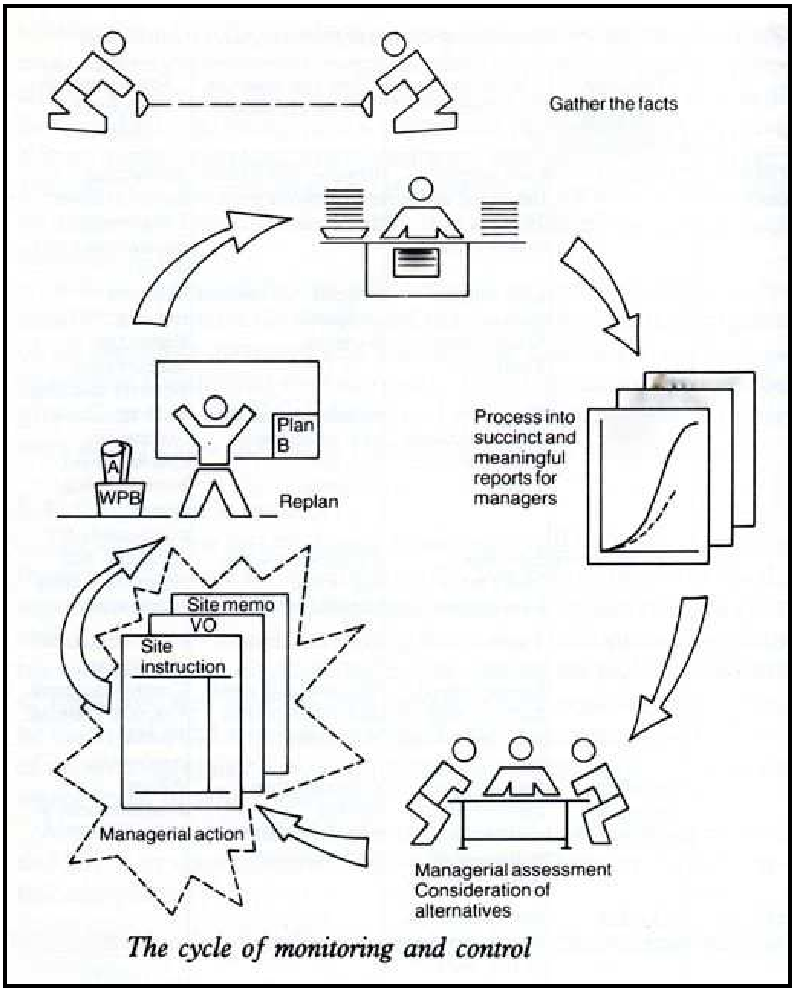
Title	Managing construction projects: A guide to processes and procedures
Author(s)	Edited by A D Austen and R H Neale
Type of source	Book, 158 pages
Publication or other source details	International Labour Office, Geneva
Date & ISBN/ISSN	1984. 92-2-103553-0
Summary of contents	Introduction A building project A civil engineering project Organisation and management functions Planning Procurement Control Health and Safety Communication and reporting Planning techniques Appendices: checklists, job description for a project manager, glossary, select bibliography
Comments on relevance	Although now an old book, it provides a clear and straightforward review of the topic in an international context, much of which is still relevant. It forms the basis of the project management element of **Construction OS&H**
Other information	Note that Chapter 8 gives a simple review of OS&H under the following headings: Objectives; participants; principal factors; activities; causes of accidents; project management team functions.

Title	Managing international construction projects: an overview
Author(s)	R Neale (Ed)
Type of source	Book, 239 pages
Publication or other source details	International Labour Office, Geneva. International construction management series No 7
Date & ISBN/ISSN	1995. 92-2-108751-4 & 4020-0142
Summary of contents	An edited book with contributions from Richard Neale, Williams Sher, Alistair Gibb and Simon Barber Chapters 1: Construction project management 2: Project management organisation 3: System support for projects 4: Control of quality and quality assurance 5: Site layout and facilities 6: Key considerations for site layout and facility planning 7: Construction site safety 8: Planning case studies 9: Cost analysis case study
Comments on relevance	A useful but very general book, apart from the case studies which are quite detailed. This is the last book (No7) in the series so some detailed case studies were seen to be useful. The planning case study has been adapted to provide an integrative project on OS&H for **Construction OS&H**
Other information	See Tutor's Guide for more on the content of this book.

Title	Construction safety management
Type of source	Book and PowerPoint Presentation
Publication or other source details	Tim Howarth, Paul Watson Paperback, 216 pages, Wiley-Blackwell http://eu.wiley.com/WileyCDA
Date & ISBN/ISSN	2008. ISBN: 978-1-4051-8660-5
Summary of contents	An up-to-date textbook on the subject. Very oriented towards being used in an educational course, contains exercises and questions. The web site offers a PowerPoint Presentation on site induction and self-assessment questions. Contents: Introduction: Health and Safety – Overriding Principles. Chapter 1 The Safety Performance of the UK Construction Industry. Chapter 2 The Legal Framework and Enforcement of Construction Health and Safety. Statutory Instruments. Chapter 3 UK Construction Health and Safety Law. Chapter 4 The Construction (Design and Management) Regulations 2007. Chapter 5 Key Site Health and Safety Hazards and Control Measures. Chapter 6 Principles and Practice of Health and Chapter 7 Managing for Health and Wellbeing. Chapter 8 The (Principal) Contractor’s Health and Safety Management System. Chapter 9 Promoting a Positive Health and Safety Culture.
Comments on relevance	Entirely based in a UK context, but contains generally useful materials.

Title	The construction (Design & Management) Regulations 2007
Type of source	This is a legal document approved by the UK Parliament.
Publication or other source details	Crown copyright 2007 UK: The Stationary Office Limited
Date & ISBN/ISSN	This is an Act of the UK Parliament Came into force 6 April 2007
Summary of contents	Comprehensive statutory instrument. Known as the ‘CDM Regs’, these regulations impose very strong safety and health requirements on clients, designers and contractors, and set out ways in which this function must be organised and implemented. Although specific to the UK, a substantial amount of this document is of general application.
Comments on relevance	Very relevant throughout

F: PLANNING AND CONTROL FOR OS&H



(From "Construction Planning" by Neale & Neale)

Summary of content
1. Preface
2. General principles of project planning and control
3. OS&H by design as a key element of project planning and control
4. OS&H performance measurement and management
5. Role and responsibilities of safety specialists
6. Brief bibliography

1 PREFACE

This Module Summary reviews the theory and practice of project planning and control, within the context of effective OS&H. It begins with an explanation of the general principles, and this is followed by a description of how designers can assist in making construction safer. Planning alone is not enough; there has to be good follow-up, so performance measurement and management is discussed. As construction projects and the legislation governing them become more complex, there is an increasingly important need for specialists in OS&H, and a description of their contribution concludes this Module Summary.

The contents of this Module Summary are as shown in the table above.

This Module Summary is largely taken from two ILO books and a specialist book on construction planning:

1. "Managing construction projects: A guide to processes and procedures". Edited by A D Austen and R H Neale

2. "Managing international construction projects: an overview". Edited by R H Neale

3. "Construction Planning". By Richard H Neale and David E Neale.

The first book – 'the 'ILO Guide' - was devised as an accompaniment to a series of ILO training courses in African countries, and has been translated into a number of languages. The second book – the 'ILO Overview' - is the final (No 7) volume in the ILO's International Construction Management Series. Both were fully reviewed by international experts during their development.

The third book was written as a partnership between a lecturer in construction management and the chief executive of a medium sized construction company, so it is based on a good blend of theory and practice.

A fourth book has provided some useful information on planning for OS&H:

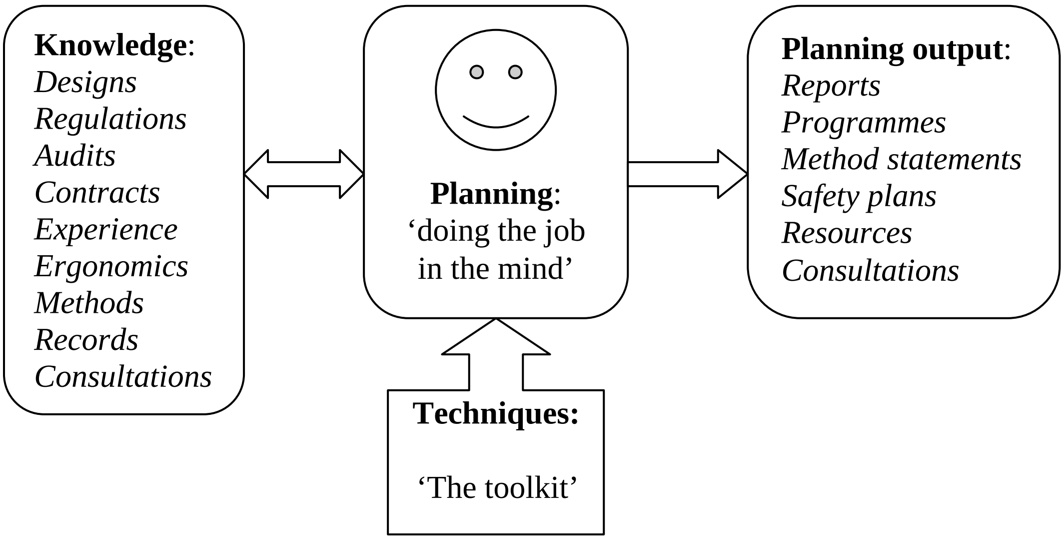
4. "Construction safety management" by Tim Howarth and Paul Watson.

A brief bibliography is given at the end of this Module Summary.

Finally, a Section on 'OS&H by design as a key element of project planning and control' has benefited from the excellent web site of the USA OSHA Alliance 'Design for construction safety': http://www.designforconstructionsafety.org/. This is also summarised in the Brief Bibliography.

2 GENERAL PRINCIPLES OF PROJECT PLANNING AND CONTROL

The diagram below illustrates the construction planning process.



The process has four main elements.

Knowledge is the key to good planning and a large amount of data is often available, especially in the 'digital age'. All those who are or will be involved will usually have some knowledge to contribute to the plan, including experienced workers. This knowledge is usually explored through project team discussions, analyses and technical plans.

Planning is the mental process of thinking through how the work will be done, by whom and with what machinery and equipment. A common and dangerous approach is to plan entirely on the basis of the technicalities of construction and then 'try to make it safe' afterwards. OS&H should be at the forefront of this process of building in the mind, through continually asking such questions as: 'who will do this?"; 'how will they get to it?'; 'what safety precautions will be required?'; 'what training or instruction will be needed?'.

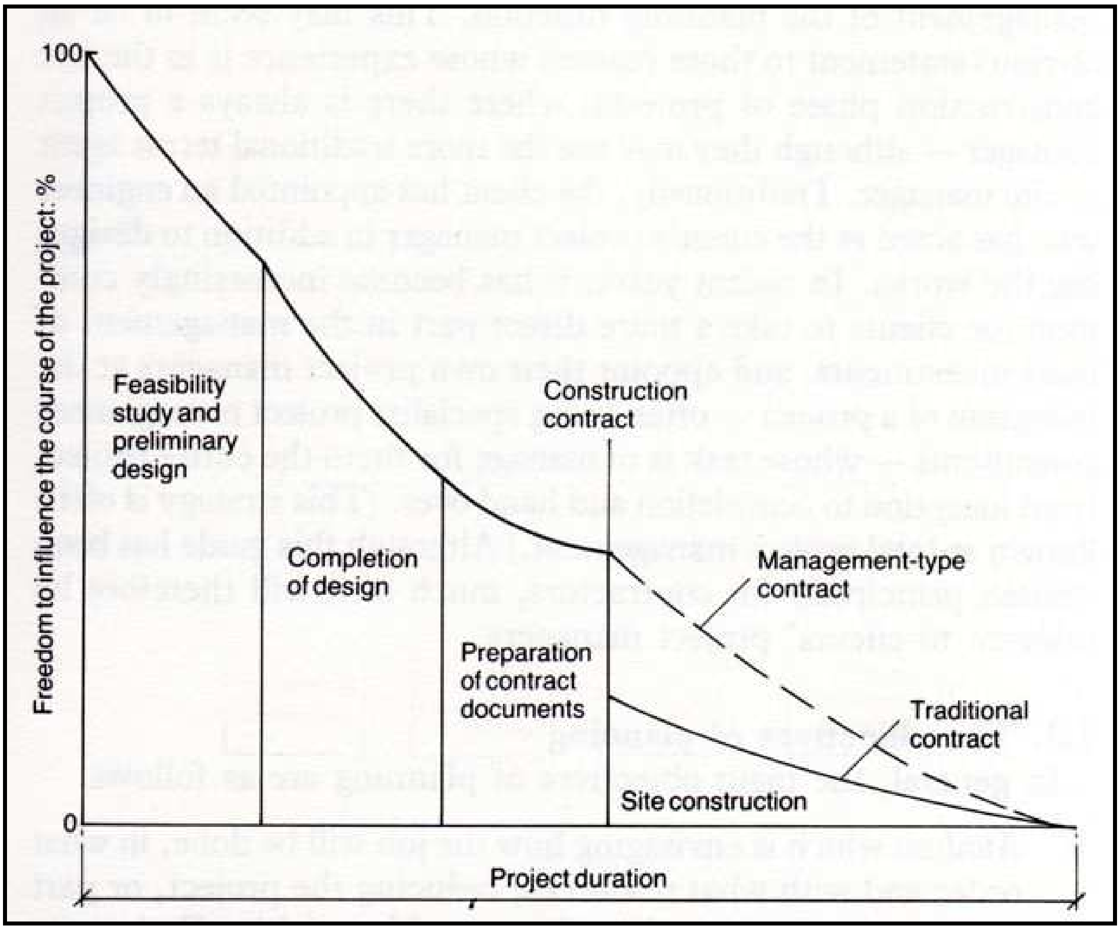
Techniques include commonly used construction planning techniques (the planning 'toolkit') but also hazard and risk analyses and method statements, and 'toolbox' meetings to brief the workers. Construction planning techniques are described in Chapter 10 of the ILO Guide; one reviewer described this Chapter as 'a masterpiece of clarity' so no attempt will be made to re-write it; it is a recommended component part of **Construction OS&H**. Hazard and risk analysis and method statements are explained in Module Summary 7: "Processes and systems".

Planning output is the completed analyses for implementing the construction of the element of the work under consideration. This output must include formal requirements for consultation, explanation, and approval for each part of the work before it is executed.

There are two major OS&H considerations when planning a construction project: the importance of early decisions and the level of detail.

Early decisions

The diagram below illustrates how the ability to influence the course of a project diminishes as the project progresses. At the very beginning of a project, the client, designers and the project managers may have almost a 'blank sheet of paper', but after contracts have been let and work has started, any changes can become wasteful and expensive.



(From "Construction Planning" by Neale & Neale)

An example of an early decision is given in the two photos below, which show the installation of the cladding of a major building. An early decision was made to prefabricate the cladding, rather than to erect it piece-by-piece, *in-situ*. So, the whole construction process of erecting scaffolds and causing workers to assemble complex combinations of components outside and often at height was removed to the relatively safer and climatically kinder environment of a factory, and the erection process became an exercise in lifting and installing quite large elements.

Lifting a panel from the special frame on the low-loader.

(From Chartered Institute of Building (CIOB) "Prefabricated modules in construction")

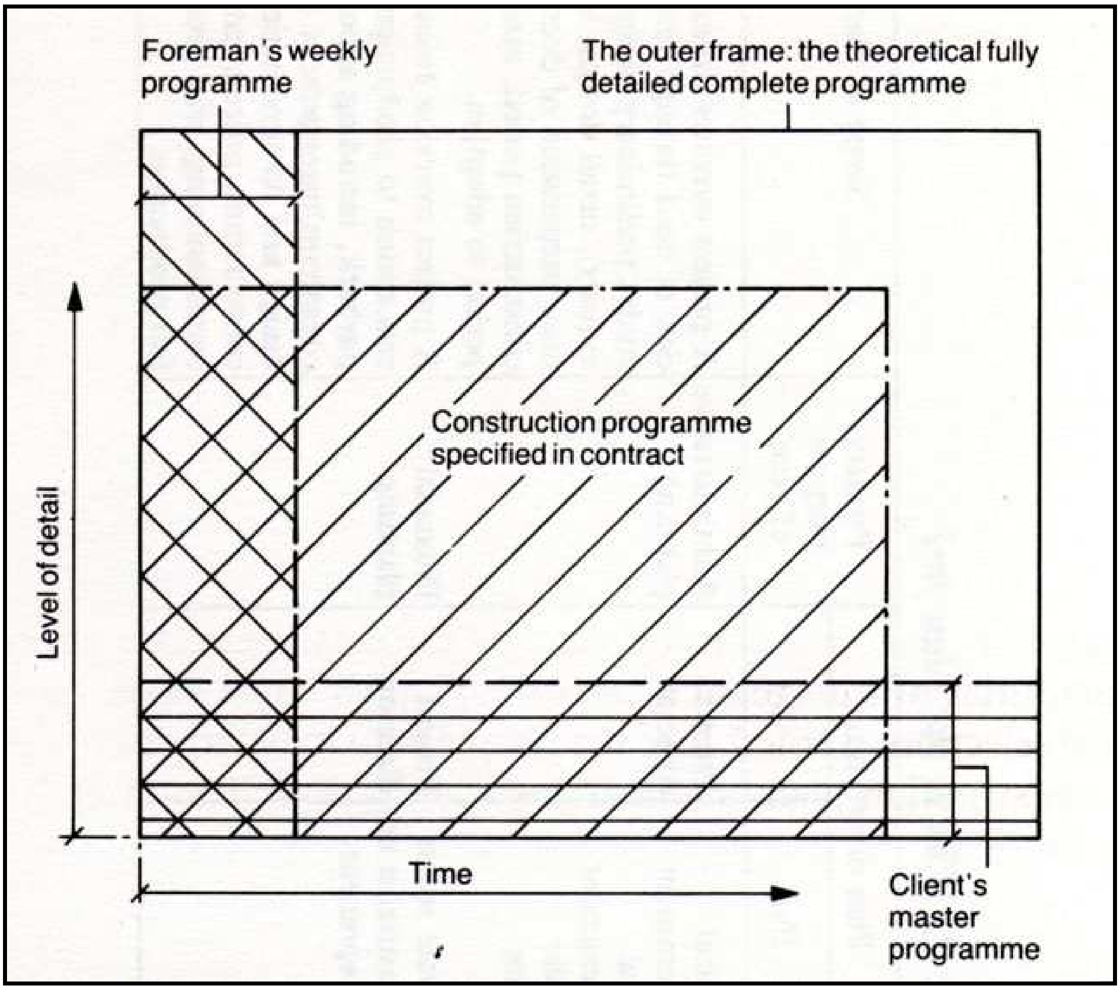
Panel being hoisted into position.

(From CIOB "Prefabricated modules in construction")

Whatever the comparative benefits and problems may have been for these two alternatives, the OS&H assessments would have been dramatically different. In practice, although the prefabricated alternative appears to be more dangerous, the methods used were considered to offer a safer overall solution and the erection team had an excellent safety record.

Level of detail

It is impossible to plan large projects in detail at the outset. The task is too great, the uncertainties considerable and as the project teams' understanding of the project deepens as the work progresses, better solutions may be found. So, planning has to be done in a progressive way, suitable for the time scale and the level of detail required by those who have to implement the plans. This is illustrated in the diagram below.



(From "Construction Planning" by Neale & Neale)

Thus, the OS&H planning philosophy must be to try to assess major hazards and risks at an early stage of the project, so that major decisions can be taken with occupational safety and health in mind, which should aid the detailed hazard and risk analysis at the supervisory level as the construction work is physically undertaken.

3 OS&H BY DESIGN AS A KEY ELEMENT OF PROJECT PLANNING AND CONTROL

The importance of 'early decisions' in the planning of OS&H means that the designers' role in **Construction OS&H** is crucial. Designers can have a substantial influence on the overall safety and health of the employees on a project, but the necessary systematic processes and techniques do not yet exist.

A useful starting point is the USA 'Prevention through design' (PtD) web site:
http://www.designforconstructionsafety.org/concept.shtml

"What PtD is:

- *Explicitly considering the safety of construction workers in the design of a project*
- *Being conscious of and valuing the safety of construction workers when performing design tasks*
- *Making design decisions based in part on how the project's inherent risk to construction workers may be affected*
- *Including worker safety considerations in the constructability review process*

What PtD is not:

- *Having designers take a role in construction safety DURING construction*
- *An endorsement of future legislation mandating that designers design for construction safety*
- *An endorsement of the principle that designers can or should be held partially responsible for construction accidents*
- *Implying that the vast majority of U.S. design professionals are currently equipped to design for construction safety"*

This web site also provides a link to the Australian 'CHAIR' web site:
http://www.workcover.nsw.gov.au/Publications/OHS/SafetyGuides/Pages/chairsafetyindesigntool.aspx

"CHAIR (Construction Hazard Assessment Implication Review) is a tool to assist designers, constructors, clients and other key stakeholders to come together to reduce construction, maintenance, repair and demolition safety risks associated with design."

The USA 'Prevention through design' (PtD) web site also offers a PowerPoint presentation "Design for Construction Safety (DfCS) 2 to 4 Hour Course".

The concept is best illustrated through examples.

Prefabrication or off-site construction

The photos of the prefabricated cladding panels shown in Section 2 above are a good example of how the construction process can be moved from the site to a factory. A second case study from the same research project is shown in the three photos below.

A company in Denmark specialises in the manufacture of off-site bathroom units for hotels and similar applications. The units are absolutely complete when they leave the factory, and are transported by road all over Europe. When they reach the building under construction, they are lifted onto a platform at the appropriate floor by a crane and moved down the corridor on a specially made trolley. This is a well-planned operation and has a very good safety record.

The workers benefit from factory rather than site conditions, and the ergonomic advantages are obvious from the third photo; had it been on site the tiler would be working in cramped conditions on his knees.

Modules nearing completion, with shrink-wrapped covers and doors protected.

(From CIOB "Prefabricated modules in construction")

Modules installed at corridor end of rooms, forming most of the end wall.

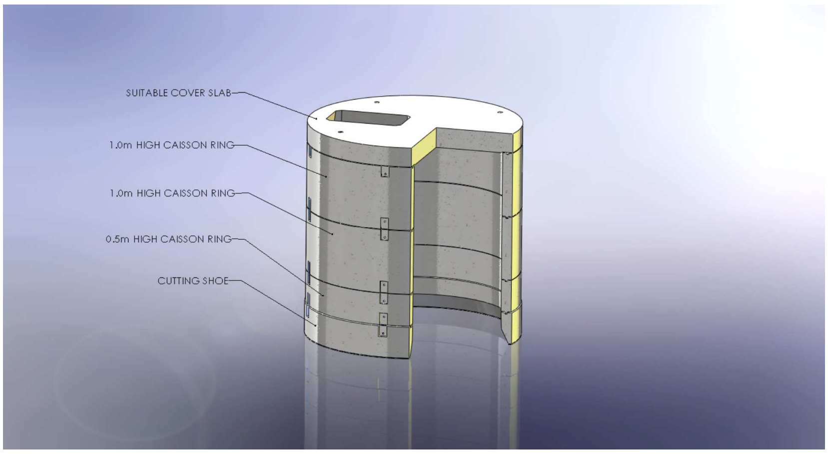
(From CIOB "Prefabricated modules in construction")

Tiling the base, before fitting the walls. Much easier than working on site.

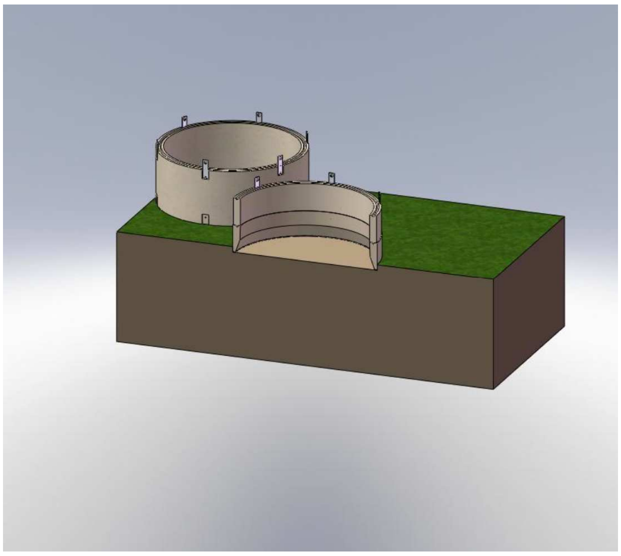
(From CIOB "Prefabricated modules in construction")

Use of caissons for working below ground level

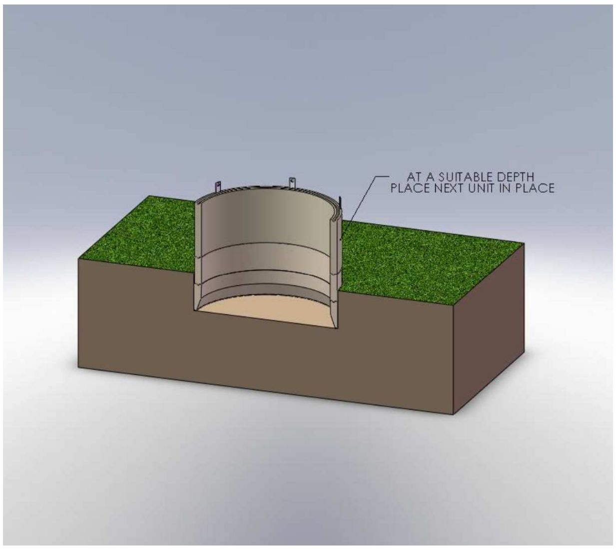
A further example of prefabrication is shown below. In the construction of manholes to give access to drainage systems, the conventional method is to excavate a suitably sized hole then build the manhole upwards from the base with pre-cast concrete rings. The method shown in the box below allows the rings to be pre-assembled on the ground, with the rings sitting on top of a concrete or steel 'cutting shoe' that is slightly bigger than the external diameter of the manhole. The manhole is then excavated relatively safely from the inside, and it slides into the ground under its own weight as the excavation proceeds. Thus the ground is supported throughout by the permanent structure (the concrete rings) so eliminating the need for temporary supports. (Note: this is a good technique but, as the principal author of **Construction OS&H** discovered on one project, it requires skill to execute effectively.



General arrangement of a completed chamber



Starting with the shoe and a ring, excavation can start



Another ring is added as the chamber goes down

An actual installation, showing bulk excavation using a grab on an excavator

Hand excavation at the cutting shoe,
allowing the caisson to sink in a controlled way

The ILO is very grateful to Milton Precast, and especially Linda Curson, for the five images above. They can be contacted at:

Milton Pipes Limited
Cooks Lane
Sittingbourne
Kent ME10 2QF
United Kingdom
www.miltonprecast.com

[The parent company is now CPM Group Ltd: www.cpm-group.com]

‘Trenchless pipelaying’

Laying pipes in the ground usually requires excavating a trench to the required depth and laying the pipes in it. Trench-work is one of the most dangerous construction activities, so methods to eliminate it will be beneficial.

Some excellent literature is available for free download from:
Pipe Jacking Association
10 Greycoat Place
London SW1P 1SB
Telephone +44 (0)845 0705201
Facsimile +44 (0)845 0705202
Email andrew.marshall@pipejacking.org

For example: Guidance For Designers:

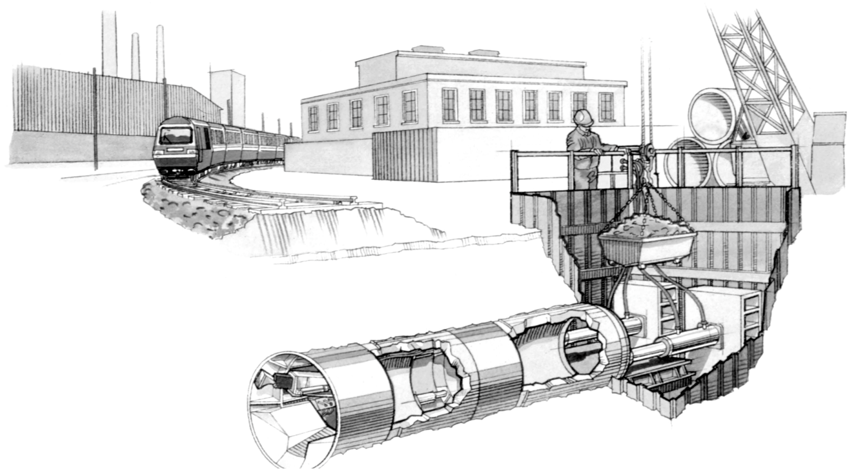
- An introduction to pipe jacking and microtunelling design
- Tunnelling and Pipe Jacking: Guidance for Designers
- Preferred Pipe Sizes
- Guidance on the design of hand excavated pipejacks

Some excellent research papers are also available from this web site.

This is a very helpful organisation and the ILO would like to express its appreciation of the contribution it has made to Construction OS&H.

The following explanation is taken from a section from the Association’s web site entitled “About the technique”

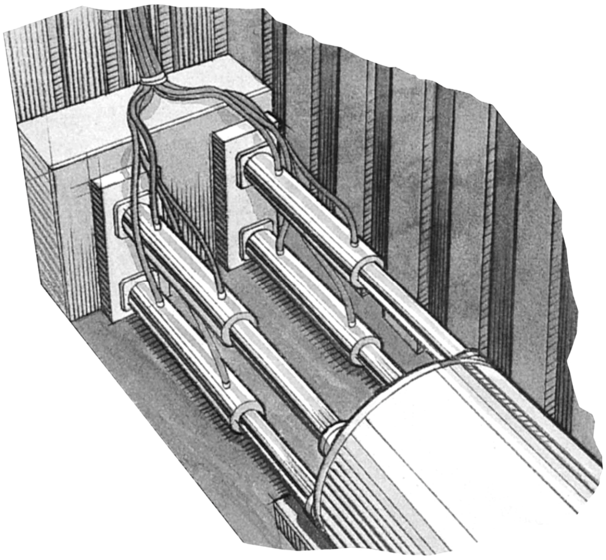
“Pipe jacking, generally referred to in the smaller diameters as micro-tunnelling, is a technique for installing underground pipelines, ducts and culverts. Powerful hydraulic jacks are used to push specially designed pipes through the ground behind a shield at the same time as excavation is taking place within the shield. The method provides a flexible, structural, watertight, finished pipeline as the tunnel is excavated. The pipe jacking technique and its components have been subject to extensive and ongoing research at leading UK universities including both Oxford and Cambridge.



There is no theoretical limit to the length of individual pipe jacks although practical engineering considerations and economics may impose restrictions. Drives of several hundred metres either in a straight line or to a radius or a series of radii are readily achievable. A number of excavation systems are available including manual, mechanical and remote control. Pipes in the range 150mm to 3000mm can be installed by employing the appropriate system. Construction tolerances are comparable with other tunnelling methods, and the pipe jacking method generally requires less overbreak than segmental tunnels and provides ground support and reduces potential ground movement.

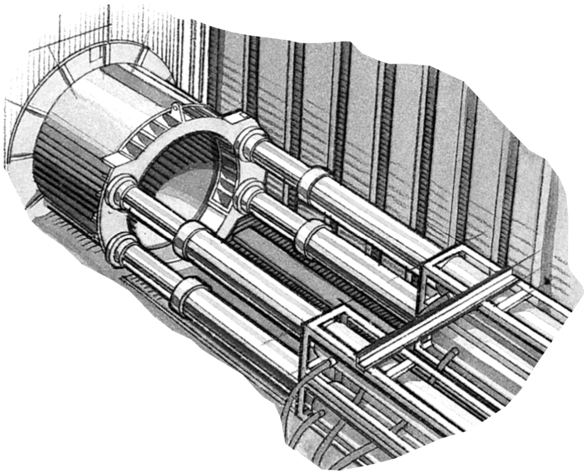
Mechanical excavation methods are similar to those employed in other forms of tunnelling. Shields, excavation and face support can be provided for a wide variety of ground conditions.

In order to install a pipeline using this technique, thrust and reception pits are constructed, usually at manhole positions. The dimensions and construction of a thrust pit vary according to the specific requirements of any drive with economics being a key factor. Pit sizes will vary according to the excavation methods employed, although these can be reduced if required by special circumstances.

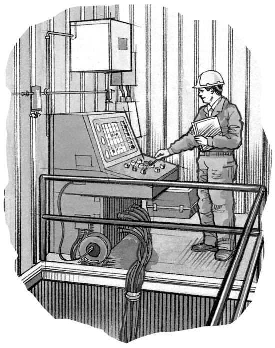


A thrust wall is constructed to provide a reaction against which to jack. In poor ground, piling or other special arrangements may have to be employed to increase the reaction capability of the thrust wall. Where there is insufficient depth to construct a normal thrust wall, for example through embankments, the jacking reaction has to be resisted by means of a structural framework having adequate restraint provided by means of piles, ground anchors or other such methods for transferring horizontal loads.

To ensure that the jacking forces are distributed around the circumference of a pipe being jacked, a thrust ring is used to transfer the loads. The jacks are interconnected hydraulically to ensure that the thrust from each is the same. The number of jacks used may vary because of the pipe size, the strength of the jacking pipes, the length to be installed and the anticipated frictional resistance.



A reception pit of sufficient size for removal of the jacking shield is normally required at the completed end of each drive. The initial alignment of the pipe jack is obtained by accurately positioning guide rails within the thrust pit on which the pipes are laid. To maintain accuracy of alignment during pipe jacking, it is necessary to use a steerable shield, which must be frequently checked for line and level from a fixed reference. For short or simple pipe jacks, these checks can be carried out using traditional surveying equipment. Rapid excavation and remote control techniques require sophisticated electronic guidance systems using a combination of lasers and screen based computer techniques.



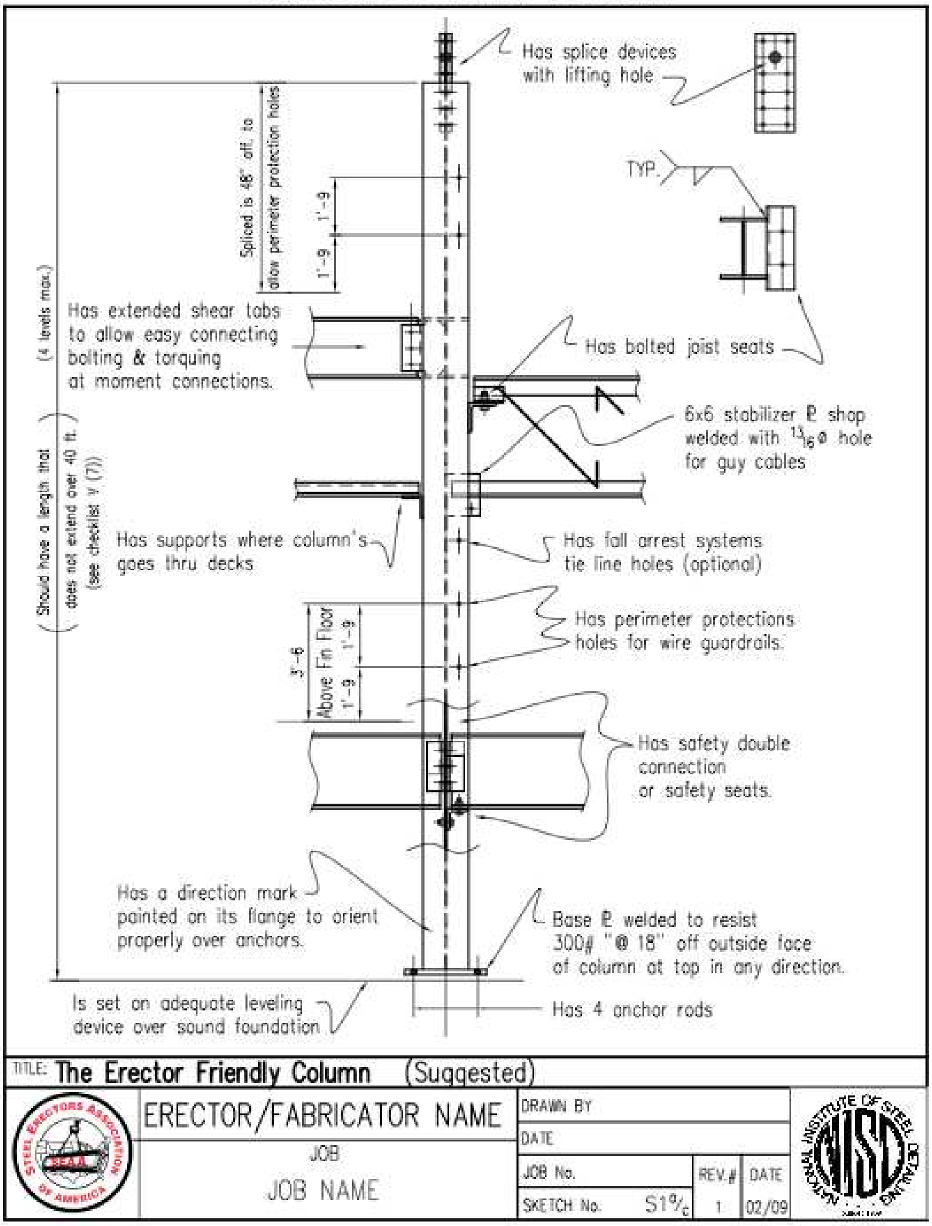
When the pipejack or microtunnel is carried out below the water table it is usual to incorporate a headwall and seal assembly within each thrust and reception pit. The use of these items prevents ingress of ground water and associated ground loss, and retains annular lubricant.”

A good practical example is shown on the web site of the Drainage Services, Department of the Government of Hong Kong Special Administrative Region: (http://www.dsd.gov.hk/EN/Sewerage/Technology_Employed/Pipe_jacking___Microtunneling/index.html). This site also provides some photographs of the technology in action.

The ‘erector friendly column’

The prefabricated and trenchless pipelaying examples showed how some common hazards could be avoided. The erector friendly column shows how a simple steel component can be made in such a way that it becomes easier and safer to erect. These drawings were provided by the National Institute for Steel Detailing [http://www.nisd.org] and the Steel Erectors Association of America [http://www.seaa.net/]. The ILO is very grateful for the enthusiastic support provided by these organisations.

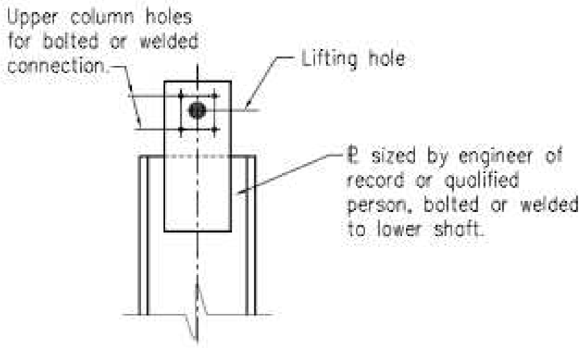
DETAILING FOR ERECTION SAFETY and EFFICIENCY



DETAILING FOR ERECTION SAFETY and EFFICIENCY

COLUMN CHECKLIST:

1) Single shaft when possible (Lengths under 40' preferred)
2) If spliced, 4'-0" above finish floor to accommodate perimeter safety cable. (Also better position to weld or bolt)
3) Bolted splices preferred. (Verify method with erector/fabricator)
4) Prepare upper column for field welding if splice requires welding.
5) All tiered columns shall have lifting device or hole (2"ø min.) for hoisting into place. (See sketch S6 for other suggested details)



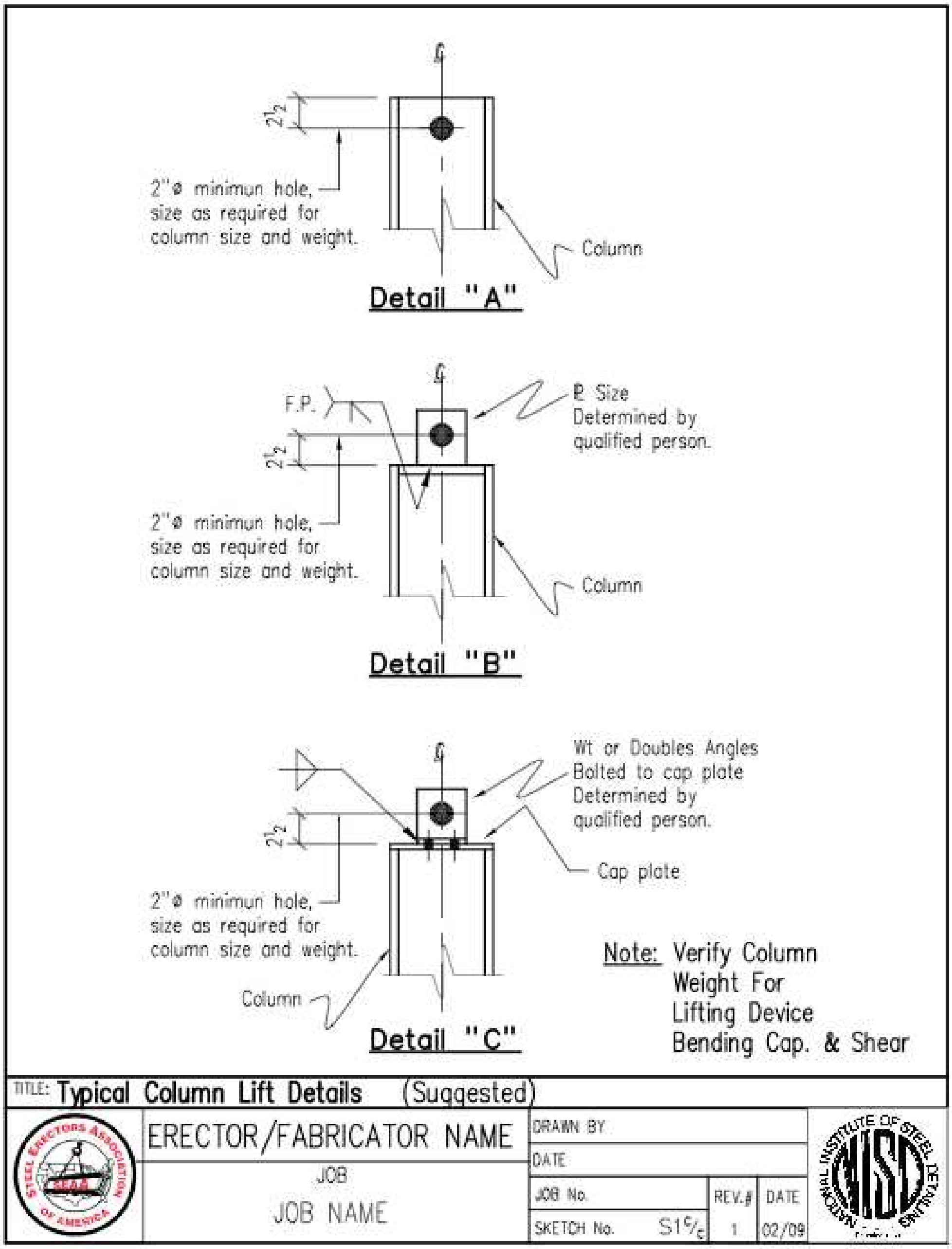
BEAM TO COLUMN CHECKLIST:

1) All double connections at column webs or beam webs over columns must have staggered clip or beam seat for erection.(SEE DETAIL)
2) Utilize permanent bolts at beam webs for moment connections, when possible
3) Minimum (2) bolts req'd at each end of beam for erection.

TITLE: **Column/Beam To Column Checklist** (Suggested)

ERECTOR/FABRICATOR NAME	DRAWN BY		
	DATE		
JOB JOB NAME	JOB No.	REV.#	DATE
	SKETCH No. S1b/c	1	02/09

DETAILING FOR ERECTION SAFETY and EFFICIENCY



Other examples

These examples are taken from an article by John A. Gambatese, Department of Civil, Construction and Environmental Engineering, Oregon State University, which was downloaded from the PtD web site:

- Indicate on the contract drawings the locations of existing underground utilities and mark a clear zone around the utilities. Note on the drawings the source of information and level of certainty on the location of underground utilities.
- Design parapets to be 42 inches (1.07m) tall. A parapet of this height will provide immediate guardrail protection and eliminate the need to construct a guardrail during construction or future roof maintenance.
- Design columns with holes at 21 and 42 inches (0.54 and 1.07m) above the floor level to provide support locations for lifelines and guardrails.
- Design special attachments or holes in members at elevated work areas to provide permanent, stable connections for supports, lifelines, guardrails, and scaffolding.
- Design perimeter beams and beams above floor openings with sufficient strength to support lifelines. Design connection points along the beams for the lifelines, and note on the contract drawings which beams are designed to support lifelines, how many lifelines, and at what locations along the beams.
- Design domed, rather than flat, skylights with shatterproof glass or add strengthening wires.
- Locate rooftop equipment away from the building perimeter to reduce fall hazards while installing the equipment and during future maintenance.

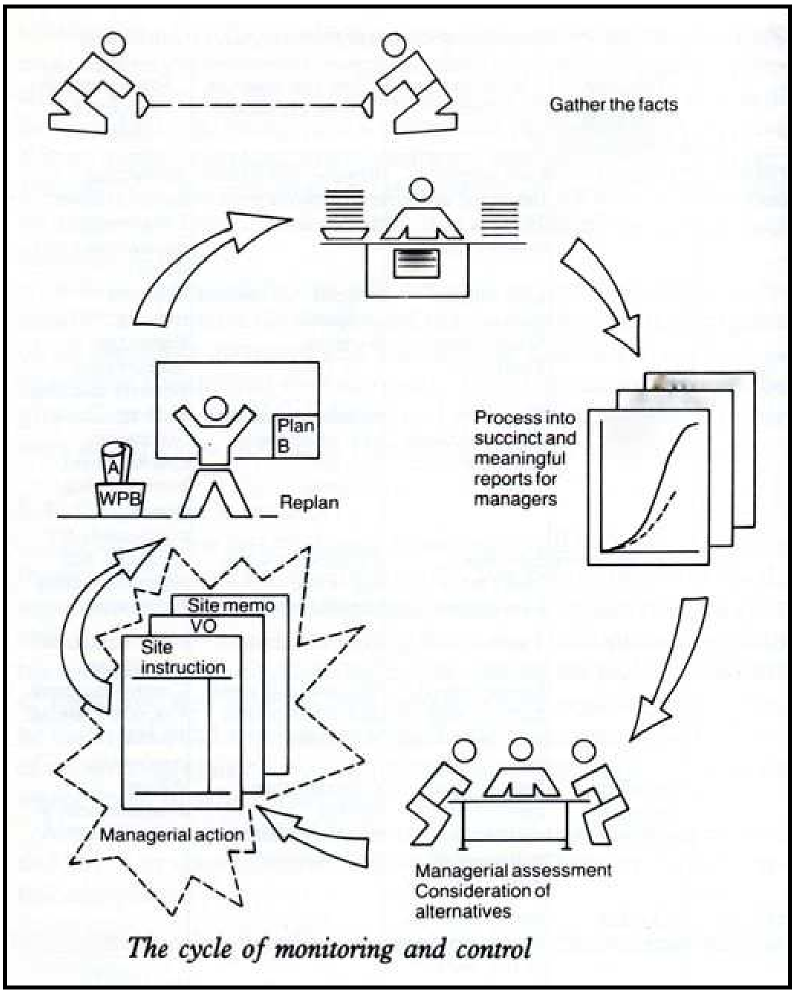
OS&H by design

This is a process, similar in many ways to processes from ‘value engineering’ and ‘buildability’. In fact, OS&H by design should be a central part of the whole process of ‘design development’, through which preliminary designs are refined and improved through a process of review by experts and representatives of all those who will be involved. It must be part of the systematic process of hazard and risk analysis described in **Construction OS&H**, within the cycle of monitoring and control described in the next Section.

4 OS&H PERFORMANCE MEASUREMENT AND MANAGEMENT

The cycle of monitoring and control

The diagram below illustrates the general process of measuring and managing performance – the 'cycle of monitoring and control'. As emphasised in other Module Summaries of **Construction OS&H**, this has to be a continuous and relentless process if improvements are to be made and good OS&H performance is to be achieved.



The cycle of monitoring and control

(From "Construction Planning" by Neale & Neale)

One of the surprising aspects of most plans made during a construction project is that they are – generally – optimistic, so this cycle has the added benefit of bringing more realism into the process.

This cycle relies on making plans based on facts and data, and comparing actual performance against the planned performance in order to keep the project on target. The fundamental basis for the overall management of a project is the 'Project Brief', and the fundamental basis for managing OS&H is the 'Safety and Health Plan'. These two documents are described in the following sections.

The project brief

The project brief should be a clear, comprehensive and succinct statement of the client's requirements of the project, and the context within which it will be provided. It is the result of the client 'doing the job in the mind'. The brief will usually include the following:

- General introduction to the client and the other organisations involved
- General statement of intention (i.e. an outline description of the key characteristics of a building)
- Location and its implications (e.g. topographic, climatic, social)
- Feasibility and cost studies, leading to the cost plan
- Requirements of authorities and permissions (e.g. planning permission, diversion of utilities)
- Safety and health policy
- Contract documents
- Designs, appropriate to the form of contract
- Overall programme for the whole project
- Other important issues (such as the requirements of fund providers)

Briefing is often not done well, and this leads to problems in the implementation phase of a project. Producing a good brief is very challenging because many issues have to be raised and analysed, and it often involves a significant number of people and organisations. Nevertheless, producing the brief is one of the prime functions of the client's project manager, and eliminating some of the problems at source will reward the effort.

A major failing of many otherwise good project briefs is a complete absence of any consideration of safety and health. Many briefs are mainly technical and legal documents that focus on the 'deliverables' of cost, time and functionality. Under the influence of 'triple bottom line' or 'people, planet, profit' initiatives, OS&H is becoming more prevalent, but the philosophy of **Construction OS&H** is that this must be a major consideration in all project briefs, and consequently in all contract and other relevant project documents. It is through the project brief that the client of a construction project can begin to exert pressure to achieve a zero incident project.

The 'ILO Overview' gives guidance on a good project brief as shown in the table below (from Table 5, page 25).

Characteristics of a good project brief

Functions	Attributes
A channel of instruction To convey decisions and information between the client and all the other parties involved	*Clarity* Purposes of the brief should be made clear and carefully distinguished from one another
To stimulate discussion To facilitate the setting of priorities, analyses, problem identification and information flow. It should provide a collective "thinking through"	*Priorities* The degree of importance or firmness of particular items should be shown; which requirements are likely to be necessities, which are no more than wishes
A record To record decisions, information, agreements, etc.	*Consistency* The brief should be consistent within itself, and with any other related projects
A tool for evaluation The brief should provide the yardstick against which the achievements of the designers and project managers can be measured	*Completeness* At any stage in the development of the brief it should be complete as far as the team's understanding and expectations have developed
A basis for estimating resources The brief should include a specific and quantified estimate of all the major resources that will be required, and an overall budget under about 20 headings	*Realism* The brief should be realistic in terms of aims, resources, context and quality to be achieved (clients tend to expect more than they can afford)
A contractual document The brief will form the technical specification for the agreement between the client and designers, project managers and possibly other parties (such as specialist suppliers)	*Relevance* The brief should contain only information and decisions directly relevant to the project
A living document The brief should be developed, in very clearly defined stages, to reflect the progress of the understanding and exploration of the project, and amended to incorporate new knowledge	*Logic* The brief should have a logical structure and presentation. It should distinguish between what the client expects from the project, and how it is intended to achieve these expectations. It should work from the genearl to the particular
	Flexibility The brief should be specific enough for decisions and actions to be taken but flexible enough to encourage exploration of problems, options and uncertainties
	Scope The scope of the project must be carefully defined.

Source: O'Reilly, 1987.

The occupational health and safety plan

This is the crucial document at the centre of the 'cycle of monitoring and control'.

An **OS&H Plan** is an essential platform for the management of OS&H. A search on the Internet will reveal that there are many different interpretations of what is meant by this term, depending on such factors as the project itself, its location, who or what the plan is for, and individual experiences. Considering the 'project matrix', below, it is clear that a number of plans will be required, for those involved and also for the stages of the project.

THOSE INVOLVED	PROJECT STAGES				
	Briefing	Design	Procurement	Construction	Commission
Client	✔	✔	✔	✔	✔
Authorities	?	?	?	?	?
Project managers	✔	✔	✔	✔	✔
Local residents	&	&	&	&	&
Designers		✔			
Contractors			✔	✔	✔
Other consultants	✔	✔	✔	✔	✔
Sub-contractors			✔	✔	✔
Suppliers	✔	✔	✔	✔	✔
Workers	&	&	**&**	**&**	**&**
Users	?	?	?	?	?

A possible range of OS&H Plans could be as follows:

- ✔ **Client**: must have an OS&H Plan which applies throughout the whole project
- ? **Authorities**: must have a project-specific OS&H Plan if directly engaged in the project, for example provision of utilities or supervising the diversion of road-works.
- ✔ **Project managers**: must lead the development and use of OS&H Plans within their areas of responsibility.
- & **Local communities**: may need to be consulted in the development of OS&H Plans.
- ✔ **Designers**: must have their own OS&H Plan and also comply with the Client’s OS&H Plan.
- ✔ **Contractors**: must have detailed OS&H Plans for the whole of their works, and these plans must be consistent with the Client’s and Designers’ OS&H Plans.
- ✔ **Sub-contractors**: must have detailed OS&H Plans for the whole of their works, and these plans must be consistent with the Client’s, Designers’ and Contractors’ OS&H Plans; Contractors have responsibility for the OS&H Plans of their subcontractors.
- ✔ **Early involvement of suppliers**: may have involvement in these stages so must have detailed OS&H Plans for the whole of their materials, components, equipments and works, and these plans must be consistent with the Client’s, Designers’ and Contractors’ OS&H Plans; Contractors usually have responsibility for the OS&H Plans of their suppliers.
- ✔ **Suppliers**: must have detailed OS&H Plans for the whole of their materials, components, equipments and works, and these plans must be consistent with the Client’s, Designers’ and Contractors’ OS&H Plans; Contractors have responsibility for the OS&H Plans of their suppliers.
- & **Early involvement of workers organizations**: this will have a positive effect on all OS&H plans.
- **&** **Worker involvement:** an essential and beneficial part of the development and implementation of all OS&H Plans.

This may seem to be a formidably complicated list, and there is no doubt that on major projects the management of the OS&H processes and procedures becomes a major managerial and administrative activity. Furthermore, in attempting to offer comprehensive guidance, many texts and papers describe very complex systems and procedures. Nevertheless, in the belief that complex systems are difficult to implement in a widespread and effective way, one of the aims of **Construction OS&H** is to offer straightforward and uncomplicated advice on ways to improve OS&H, so a basic list of essential elements of an **OS&H Plan**, which will be applicable to all the plans indicated above, is offered below.

Essential elements of an OS&H Plan

Title page
A clear statement of the project that the plan is prepared for, the organisation it was prepared for and who prepared it.

Authorisations
The plan must be formally approved, authorised and 'signed off' by an authorised person or persons.

Introduction
A brief summary of the parties involved, the project itself, its location, preparatory studies, preliminary programme and any important or exceptional features. Summary of principal OS&H factors. Aims of the OS&H plan and if possible, measurable (i.e. SMART[2]) objectives.

OS&H procedures
All major parties named (e.g. the main contractor's plan would name the client, designers, main contractor and major sub-contractors and suppliers). Responsibilities set out within a specific organisation structure with specific responsibilities for each named position. Compliance statement in regard to legal regulatory framework. Role of OS&H specialist (if designated).

OS&H hazard and risk assessments
Physical, chemical and biological hazards for each element of the project covered by this plan (sometimes called a 'task hazard analysis'). Summary of the assessments and decisions made.

Technical controls
Processes and practices for developing, approving and authorising the technical aspects of the work (for example, for designing, approving and authorising scaffolding, and systems for regular inspections).

---

[2] There are many interpretations of this acronym, but in this case it has been taken to mean Significant, Measurable, Achievable, Results-focussed and Time-based

Working practices
Processes and practices for providing access, egress, safe working conditions, assessment of employees competence and physical suitability; safe use of plant and equipment; personal protective equipment; inspections and performance checks of materials and equipment.

Welfare
Provision of adequate facilities for general welfare, rules of behaviour, accident and first aid, and security.

Training
Summary of training to be provided, derived directly from the above sections (e.g. compliance with the recommendations of the hazard assessments; use of personal equipment; induction).

Consultation and communication
Clear and comprehensive processes and procedures for consulting with all involved in an informed and structured way and for communicating approved methods and precautions.

Review, audit and corrective action
A structured and detailed set of procedures and documents for the 'cycle of monitoring and control'. Must include reporting and recording procedures and the management of this information.

Point to remember

No safety policy or plan is workable without assigning a specific duty:

To a specific person

To be completed at a specific point of time

The safety policy and plan must be transmitted down the line to the workers – it is their safety that the plan is intended to safeguard.

(From: ILO Safety, health and welfare on construction sites: A training manual)

5 ROLE AND RESPONSIBILITIES OF SAFETY SPECIALISTS

Every construction company of any size should appoint a properly qualified person (or persons) whose special and main responsibility is the promotion of safety and health. Whoever is appointed should have direct access to an executive director of the company. His or her duties should include:

- *the organization of information to be passed from management to workers, including those of subcontractors;*
- *the organization and conduct of safety training programmes, including induction training for all workers on the site;*
- *the investigation and review of the circumstances and causes of accidents and occupational diseases so as to advise on preventive measures;*
- *acting as consultant and technical adviser to the safety committee;*
- *participation in pre-site planning.*

To carry out these functions the safety officer should have experience of the industry and should be properly trained and qualified and, where such exists, should be a member of a recognized professional safety and health body.

(From: ILO Safety, health and welfare on construction sites: training manual)

Construction OS&H gives a comprehensive description of OS&H management, demonstrating the extent and complexity of good OS&H practices. From this body of information it will be obvious that large construction projects will benefit from specialist advice and administrative support. The following possible activities have been taken from the Module Summaries:

Advisory role
Briefing
Policy
Organisation
Consultations
Legal and regulatory
Contractual
Hazards and risk
Project planning
Design development
OS&H planning
Emergency and incident response
Project welfare facilities

Administration role
Hazard and risk analysis
Authorisations
Monitoring and reporting
Review
Audit
All OS&H systems (including records and reporting)
ICT applications (including communications systems)

For these reasons, many construction organisations employ specialists, either as direct employees or as specialist consultants. Their position in the organisation varies, but it is generally the case that, in serious circumstances, they have direct access to the Chief Executive, by-passing the normal management structure. This ensures their independence and reinforces senior management commitment. There is an argument that specialist consultants may be more independent than direct employees, but consultants will usually have fixed term but renewable contracts so this argument may not be very robust.

What is fairly clear is that becoming an OS&H specialist presents career opportunities, as the following two examples show.

Example 1

“Employment change. Employment of occupational health and safety specialists and technicians is expected to increase 9 percent during the 2006-16 decade, about as fast as the average for all occupations, reflecting a balance of continuing public demand for a safe and healthy work environment against the desire for smaller government and fewer regulations. Emergency preparedness will continue to increase in importance, creating demand for these workers. More specialists will be needed to cope with technological advances in safety equipment and threats, changing regulations, and increasing public expectations. In private industry, employment growth will reflect overall business growth and continuing self-enforcement of government and company regulations and policies.”

(United States Department of Labor, Bureau of Labor Statistics: http://www.bls.gov/oco/ocos017.htm#emply)

Example 2

The ILO is grateful to the Construction Safety Network for permission to reproduce this advertisement. Note also that there is a very good cartoon on their web site: http://www.safetynetwork.bc.ca/csn_resources/index.cfm

6 BRIEF BIBLIOGRAPHY

Title	Managing construction projects: A guide to processes and procedures
Author(s)	Edited by A D Austen and R H Neale
Type of source	Book, 158 pages
Publication or other source details	International Labour Office, Geneva
Date & ISBN/ISSN	1984. 92-2-103553-0
Summary of contents	Introduction A building project A civil engineering project Organisation and management functions Planning Procurement Control Health and Safety Communication and reporting Planning techniques Appendices: checklists, job description for a project manager, glossary, select bibliography
Comments on relevance	Although now an old book, it provides a clear and straightforward review of the topic in an international context, much of which is still relevant. It forms the basis of the project management element of **Construction OS&H**
Other information	Note that Chapter 8 gives a simple review of OS&H under the following headings: Objectives; participants; principal factors; activities; causes of accidents; project management team functions.

Title	Construction Planning
Author(s)	Richard H Neale and David E Neale
Type of source	Book, 160 pages
Publication or other source details	Engineering management series, Thomas Telford Ltd, Thomas Telford House, 1 Heron Quay, London E14 9XF
Date & ISBN/ISSN	1989. 0 7277 1322 1
Summary of contents	Part 1: Context and strategy 1 Construction planning in context 2 Early decisions Part 2: Techniques, procedures and methods 3 Planning techniques 4 Resources 5 Monitoring and control Part 3: Planning in practice 6 Putting planning into practice 7 Case studies
Comments on relevance	Generally relevant but also the source of the 'Drainage Chamber' assignment.
Other information	A basic planning book, written by a university lecturer and the CEO of a medium size construction company, blending theory and practice.

Title	Managing international construction projects: an overview
Author(s)	R Neale (Ed)
Type of source	Book, 239 pages
Publication or other source details	International Labour Office, Geneva. International construction management series No 7
Date & ISBN/ISSN	1995. 92-2-108751-4 & 4020-0142
Summary of contents	An edited book with contributions from Richard Neale, Williams Sher, Alistair Gibb and Simon Barber Chapters 1: Construction project management 2: Project management organisation 3: System support for projects 4: Control of quality and quality assurance 5: Site layout and facilities 6: Key considerations for site layout and facility planning 7: Construction site safety 8: Planning case studies 9: Cost analysis case study
Comments on relevance	A useful but very general book, apart from the case studies which are quite detailed. This is the last book (No7) in the series so some detailed case studies were seen to be useful. The planning case study has been adapted to provide an integrative project on OS&H for **Construction OS&H**
Other information	See Tutor’s Guide for more on the content of this book.

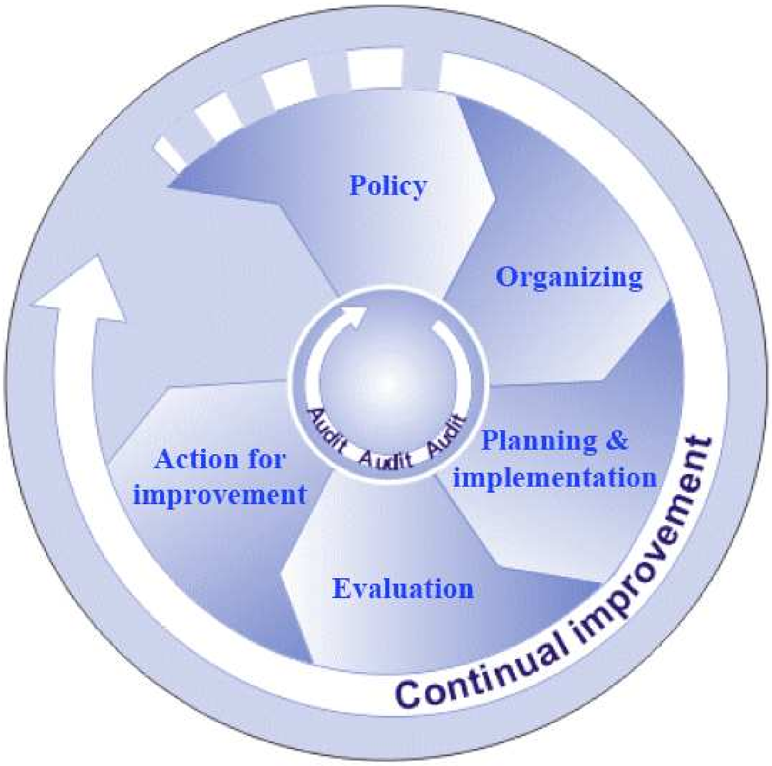
Title	Construction safety management
Type of source	Book and PowerPoint Presentation
Publication or other source details	Tim Howarth, Paul Watson Paperback, 216 pages, Wiley-Blackwell http://eu.wiley.com/WileyCDA
Date & ISBN/ISSN	2008. ISBN: 978-1-4051-8660-5
Summary of contents	An up-to-date textbook on the subject. Very oriented towards being used in an educational course, contains exercises and questions. The web site offers a PowerPoint Presentation on site induction and self-assessment questions. Contents: Introduction: Health and Safety – Overriding Principles. Chapter 1 The Safety Performance of the UK Construction Industry. Chapter 2 The Legal Framework and Enforcement of Construction Health and Safety. Statutory Instruments. Chapter 3 UK Construction Health and Safety Law. Chapter 4 The Construction (Design and Management) Regulations 2007. Chapter 5 Key Site Health and Safety Hazards and Control Measures. Chapter 6 Principles and Practice of Health and Chapter 7 Managing for Health and Wellbeing. Chapter 8 The (Principal) Contractor’s Health and Safety Management System. Chapter 9 Promoting a Positive Health and Safety Culture.
Comments on relevance	Entirely based in a UK context, but contains generally useful materials.

Title	Design for construction safety
Type of source	Web site of the USA OSHA Alliance
Publication or other source details	http://www.designforconstructionsafety.org/
Summary of contents	What DfCS is: • Explicitly considering the safety of construction workers in the design of a project. • Being conscious of and valuing the safety of construction workers when performing design tasks. • Making design decisions based in part on how the project’s inherent risk to construction workers may be affected. • Including worker safety considerations in the constructability review process.
Comments on relevance	This web site is a huge training resource with very useful PowerPoint presentations, documents and good links

Title	Prefabricated modules in construction
Author(s)	Richard Neale, Andrew Price and William Sher
Type of source	Research report in the form of a book, 55 pages
Publication or other source details	Chartered Institute of Building, Ascot, United Kingdom
Date & ISBN/ISSN	1993. ISBN 1 85350 061 9
Summary of contents	This is a research report and the main content is six case studies from actual projects. Executive summary Introduction Research objectives Research methodology Report structure Conclusions and recommendations Summaries of the case studies • Bathroom modules for a hotel • Bathroom modules for student accommodation • Bed/bathroom modules for a military base • Toilet modules for a large building • Cladding panels fro a large building • Boiler house for a retail store, sited on the roof Appendix: transport of large loads
Comments on relevance	Prefabrication is relevant to ‘safety by design’, described in Module Summary 6 ‘Project planning and control for OS&H’
Other information	For a more detailed description of the cladding case study, refer to: A G F Gibb and R H Neale. “Management of prefabrication for complex cladding: case study”. Journal of Architectural Engineering, American Society of Civil Engineers, Vol 3, No 2, June 1997.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

G: PROCESSES AND SYSTEMS



Summary of content	
1.	Preface
2.	Brief review of systems theory and practice; 'systems theory at a glance'
3.	ILO-OSH 2001: Guidelines on Occupational Safety & Health management systems
4.	Hazards and risks
5.	Assessment and management of hazards and risks
6.	The systematic **Construction OS&H** process
7.	Communication systems to improve OS&H
8.	Appendix: an example of an OS&H policy statement by a construction company
9.	Brief bibliography

1 PREFACE

This Module sets up a systematic way of providing for effective OS&H processes, procedures and practices. Good systems are an essential part of preventing incidents and protecting the health of employees, and must be designed and implemented with care and expertise. The content is as shown in the table above.

This Module Summary is largely based on a comprehensive text, the ILO's "Guidelines on occupational safety and health management systems", known as 'ILO-OSH 2001'.

It begins with a simple explanation of systems theory, which leads into an explanation of the ILO's Guidelines. Modern OS&H systems are based on considerations of 'hazards' and 'risks' and these concepts are explained, followed by a description of how they can be assessed and managed. All this is then brought together in the form of a flow chart for a systematic OS&H process. Finally, ways of communicating this process are described, and an example of a contractor's safety and health policy statement is given in the Appendix.

2 BRIEF REVIEW OF SYSTEMS THEORY AND PRACTICE
'Systems theory at a glance'

A huge amount has been written on systems theory applied to management and it can become very complicated, but the essential characteristics are relatively straightforward:

1 It is important to take a broad and comprehensive view of a managerial problem, initiative or process. Individual elements should not be considered in isolation, but within a framework that takes into account the interactions with other parts of the 'system'. This concept is especially important to OS&H in the construction industry, where – as shown in other Module Summaries – construction projects are complex and involve a wide range of organisations and individuals. Lack of care in an apparently minor detail can have catastrophic and widespread effects.
2 A 'system' comprises elements and linkages. In the case of OS&H, the 'elements' include written policies, risk assessments, method statements and communication strategies, which are linked by an agreed set of processes and procedures.
3 The 'system' is 'goal-oriented': that is, it is directed to achieve specific and usually quantified objectives. Methods, processes and procedures are formulated to achieve the desired objectives; the focus is on ends not means. This implies that there may be a number of different ways in which the desired goals can be achieved, and that it is important to examine these alternatives carefully so as to take the most effective decisions and actions.
4 There is an element of what would now be called 'learning' within the system; that is, provision for review and feedback is built in to the processes and procedures. The system is, therefore, 'dynamic' and continually developing and improving.

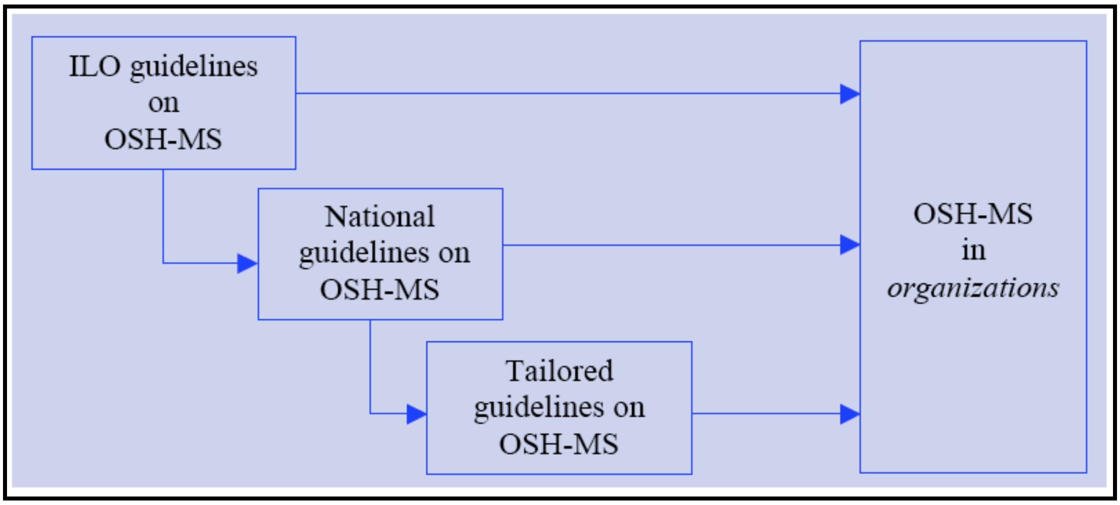
This is 'systems theory at a glance' and so represents a simplification, but is offers a simple framework for further development within **Construction OS&H**.

3 ILO-OSH 2001: GUIDELINES ON OCCUPATIONAL SAFETY & HEALTH MANAGEMENT SYSTEMS

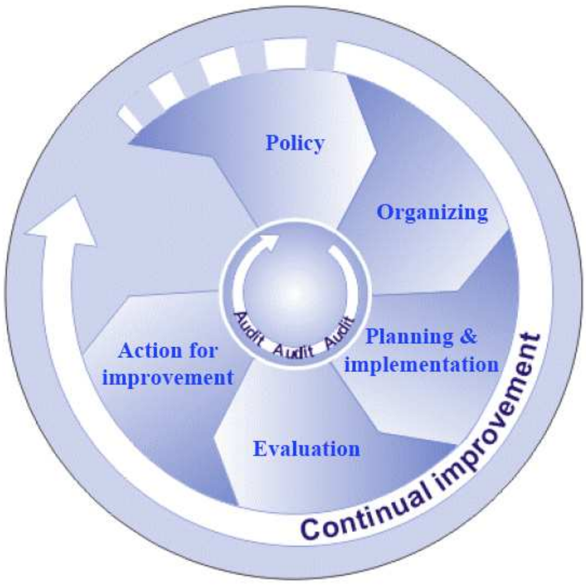
The ILO has published these Guidelines for the following purpose:

"These guidelines should contribute to the protection of workers from hazards and to the elimination of work-related injuries, ill-health, diseases, incidents and deaths."

These Guidelines provide a comprehensive set of recommendations for effective OS&H systems at the levels shown in the diagram below. The overall aim is for the international guidelines to be progressively implemented at national level and then at the level of an organisation.



The system is shown diagrammatically as follows:



ILO-OSH 2001 relates to ‘systems theory at a glance’ as follows:

1. It takes a broad and comprehensive approach
2. The system comprises five main ‘elements’, which are linked within a process
3. The goal is to improve the safety and health of people at work in whatever ways are appropriate
4. ‘Learning’ is through ‘evaluation’ and action for improvement. ‘Continual improvement’ and ‘audit’ are built in to the processes

The five element structure for OS&H systems offered by the Guide has been adopted in **Construction OS&H.** **Since** **Construction OS&H** is intended to be used within organisations (Client, Designers and project managers, Construction companies) and by workers and their organisations, the focus will be on the **organisational level**. The content of each part is summarised briefly below.

Policy

All the organisations involved in the execution of a construction project should have a written and agreed OS&H policy. The policy should be:

- Written specifically by and for the organisation
- Formulated with the participation of employees and their representatives
- Adopted positively at all levels, especially by senior management
- Be clearly stated and effectively communicated to all
- Continually reviewed and up-dated

The policy should include the following:

- A strong commitment to protecting the safety and health of all members of the organisation
- A statement of compliance with all relevant laws, regulations and agreements
- A management structure of organisation and responsibility
- Comprehensive consultation processes and procedures
- Comprehensive review, audit and feedback processes, and a firm commitment to continual improvement
- Must be compatible with other management systems or embedded in them

An example of an OS&H Policy statement by a contractor is given in the Appendix in Section 8.

Organising

Employers have overall responsibility for OS&H and must take the lead in ensuring that employees are adequately protected. Employers and senior managers should set up effective management structures for the practical implementation of the organisation’s OS&H Policy.

These structures should:

- Ensure that the effective management of OS&H is part of the job of all managers and supervisors, and is clearly accepted as such
- Engage the workers in positive and effective participation processes
- Establish clear, easily comprehensible, achievable and measurable aims and objectives for OS&H performance
- Provide adequate resources
- Communicate the aims, objectives, responsibilities, practices and procedures clearly to all
- Promote OS&H in positive ways
- Establish effective ways of identifying, eliminating or controlling hazards and risks

Employers must ensure that all employees are properly trained and competent to undertake the tasks to which they are allocated. Their physical ability (e.g. physique, age, state of health) must also be taken into account.

All of the above must be effectively documented and records kept as follows:

- How the above requirements were implemented, including all communications used
- Details of work-related injuries, ill-health, diseases and incidents, including their causes
- Reports of monitoring and audit processes

Planning and implementation

An effective OS&H plan should comprise:

- Clear, measurable and prioritised objectives
- A plan for achieving each objective
- A process for assessing achievements against the objectives
- Specification of the human, physical, financial and environmental resources required

Hazards and risk should be identified and eliminated or controlled (see Sections 4 and 5 below for further information).

Improving OS&H performance usually requires changes, so it is important to have a plan for ‘managing change’.

Emergency prevention, preparedness and response arrangements should be established and maintained.

Procurement procedures and contracts for contractors, materials and services should ensure that the requirements of the Policy and Plans established by the organisation, as above, are effectively carried through to all elements of the construction project.

Evaluation

Procedures to monitor, measure and record OS&H performance on a regular basis should be developed, established and periodically reviewed. Responsibility, accountability and authority at different levels in the management structure should be allocated.

Accidents, incidents and other non-complying occurrences should be competently investigated and reported, and these reports used within the evaluation.

The purpose of evaluation is to assess the effectiveness of the whole provision of protective measures for all employees and others involved in a construction company or project, and to stimulate improvements.

Action for improvement

These actions should be initiated by comprehensive audits by competent persons, internal to the organisation but independent of the specific project or section of the organisation; or preferably by persons external to the organisation. ILO-OSH 2001 gives a useful set of checklists for audit.

In parallel with audit, ILO-OSH 2001 recommends the use of managerial reviews, which make a strategic and analytical study of the effectiveness of the whole OS&H provision within an organisation. Detailed guidance is given in the ILO-OSH 2001 document.

4 HAZARDS AND RISKS

The following definitions are taken from ILO-OSH 2001:

A **hazard** is the inherent potential to cause injury or damage to people's health

Hazard assessment is a systematic evaluation of hazards

Risk is a combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event

Risk assessment is the process of evaluating the risks to safety and health arising from hazards at work

These definitions provide the basis for a systematic approach to OS&H in organisations. In everyday conversation the terms 'hazard' and 'risk' are often used interchangeably, but in OS&H terminology they have distinct meanings.

OS&H hazards and construction projects

Consideration of the 'project matrix', which is being used as one of the basic structures of **Construction OS&H** and is shown again below, allows a number of categories of hazard to be formulated, as shown in the table.

THOSE INVOLVED	PROJECT STAGES				
	Briefing	Design	Procurement	Construction	Commission
Client					
Authorities					
Project managers					
Local communities					
Designers					
Contractors					
Other consultants					
Sub-contractors					
Suppliers					
Workers					
Users					

CATEGORY OF HAZARD	EXAMPLES
Hazards that may affect the project due to its location	Weather, flooding, active utilities, difficult access, aggressive neighbours
Hazards that may affect the location due to the project	Pollution from site activities, danger to public from site activities and traffic
Hazards that may be caused by project briefing and design (by actions or negligence)	OS&H not considered at the outset, client and designers only consider end result not process of construction
Hazards that may be caused by project management and organisation (by actions or negligence)	Lack of senior management awareness and commitment, failure to implement diligent OS&H practices
Hazards inherent in construction methods ('active hazards')	Safety of workers not considered in the method statement, unsafe equipment
Hazards inherent in construction components and materials ('embedded hazards')	Materials contain injurious chemicals, components need heavy or require excessive force or special techniques
Hazards that may be caused by human behaviour	OS&H not taken seriously by managers, financial pressures on workers and supervisors
Wholly unpredictable or 'latent' hazards *Only such hazards cause 'accidents', all others cause preventable incidents*	Chemical or structural defects which were quite unknown at the briefing or design stage

5 ASSESSMENT AND MANAGEMENT OF HAZARDS AND RISKS

A European Directive provides good guidance on risk assessment, as given below:

Extract from: European Council Directive 89/391/EEC of 12 June 1989 (see http://osha.europa.eu/en/data/legislation/1) on the introduction of measures to encourage improvements in the safety and health of workers at work.

2. The employer shall implement the measures referred to in the first subparagraph of paragraph 1 on the basis of the following general principles of prevention:
(a) avoiding risks;
(b) evaluating the risks which cannot be avoided;
(c) combating the risks at source;
(d) adapting the work to the individual, especially as regards the design of work places, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work-rate and to reducing their effect on health;
(e) adapting to technical progress;
(f) replacing the dangerous by the non-dangerous or the less dangerous;
(g) developing a coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors related to the working environment;
(h) giving collective protective measures priority over individual protective measures;
(i) giving appropriate instructions to the workers.

3. Without prejudice to the other provisions of this Directive, the employer shall, taking into account the nature of the activities of the enterprise and/or establishment:
(a) evaluate the risks to the safety and health of workers, inter alia in the choice of work equipment, the chemical substances or preparations used, and the fitting-out of work places.
Subsequent to this evaluation and as necessary, the preventive measures and the working and production methods implemented by the employer must:
- assure an improvement in the level of protection afforded to workers with regard to safety and health,
- be integrated into all the activities of the undertaking and/or establishment and at all hierarchical levels;
(b) where he entrusts tasks to a worker, take into consideration the worker's capabilities as regards health and safety;
(c) ensure that the planning and introduction of new technologies are the subject of consultation with the workers and/or their representatives, as regards the consequences of the choice of equipment, the working conditions and the working environment for the safety and health of workers;
(d) take appropriate steps to ensure that only workers who have received adequate instructions may have access to areas where there is serious and specific danger.

5. Measures related to safety, hygiene and health at work may in no circumstances involve the workers in financial cost.

(The ILO is grateful to the European Commission for the use of this quotation. It is 375 words long, so has been used under the convention of 'Fair Use' which allows a maximum of 400 words to be used without seeking formal permission.)

Can risks be quantified?

A further, quantified development of risk assessment is described in a large number of publications. The basic concept is derived from the definition of risk given below from ILO-OSH 2001:

***Risk** is a combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event*

The essential principles are given in the table below, which presents a simplification of what can become a complex analysis. The ‘likelihood of an occurrence of a hazardous event’ can be given a numerical value. On some construction projects, this value can be determined from statistical data; for example, if a cofferdam is to be constructed in a river that is liable to flooding, the probability of a cofferdam of a specific height being over-topped can be determined from water level records. But more often such data are not available, so the process is based on probabilities derived from the experience of those involved in making the judgement; quite sophisticated processes are sometimes used to ‘quantify’ these ‘subjective’ judgments. In the case of the table below, these judgements have been made on an integer numerical scale of 1-5.

Similarly, in some cases objective data from statistical records may be available on which to assess the severity of injury or damage, or these values may be assessed by experienced judgement. In the table below, they are shown on a scale of 1-5.

Thus, from the definition of risk as a combination of two factors, multiplying these two values for each cell in the matrix can complete the table.

LIKELIHOOD OF OCCURRENCE		**SEVERITY OF INJURY OR DAMAGE**				
		Very unlikely				Almost certain
		1	2	3	4	5
Low	1	1	2	3	4	5
	2	2	4	4	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
High	5	5	10	15	20	25

5 or below = 20%
6-10 = < or = 40%
12-25 = 60% or >

Even at this simple level, the analysis is informative. The table above illustrates the meaning of ‘risk’ as a ‘combination’ rather than a singular concept and how this combination can have catastrophic results. This is an important concept to be understood when considering hazards and risks, which can help those involved to take a more comprehensive view of their assessments.

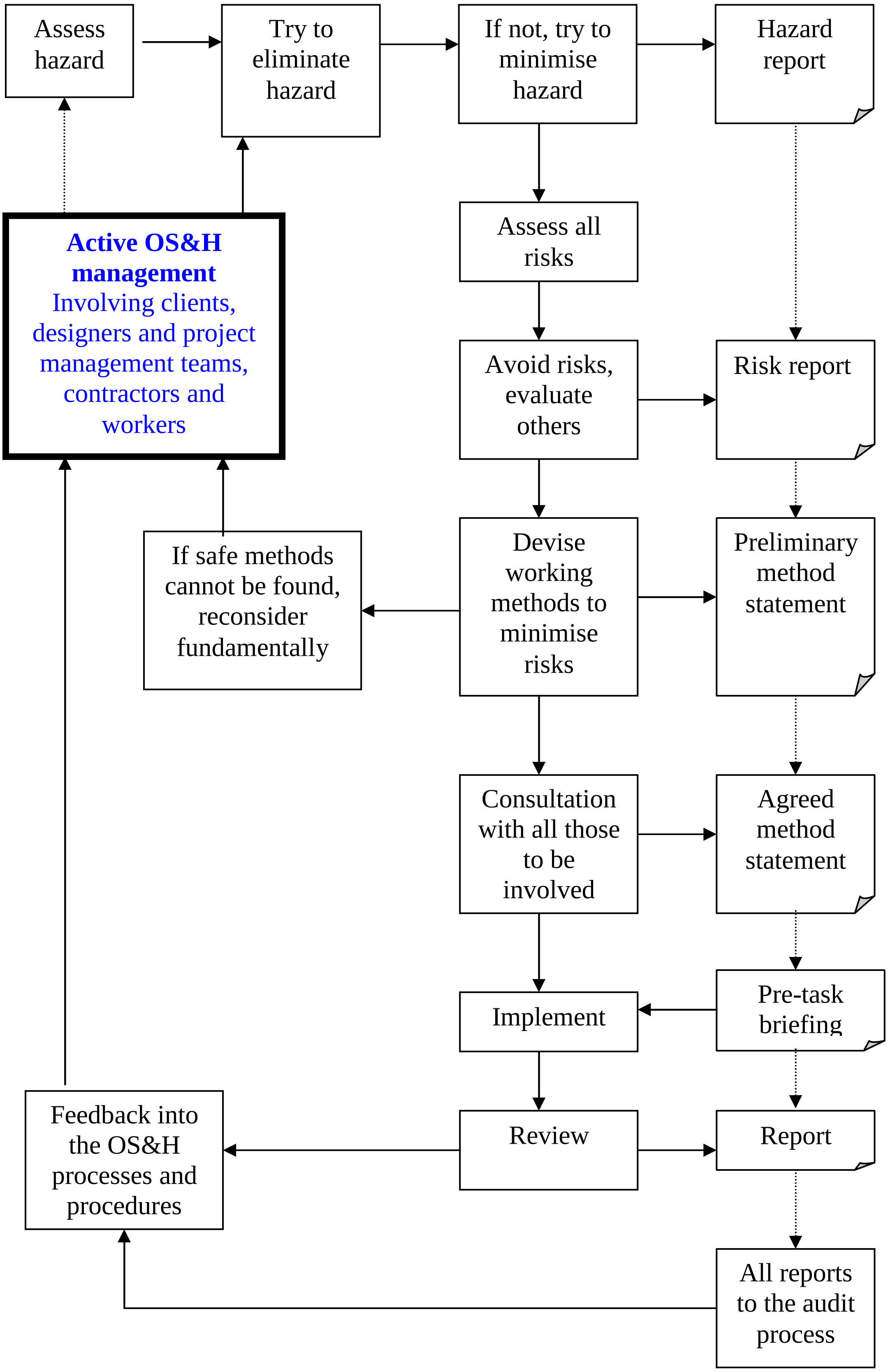
Nevertheless, as a practical tool this type of analysis has two limitations in the context of **Construction OS&H**:

1. The availability of ‘hard data’ is generally very limited, so frequently the analysis has to be based on values derived from personal judgment. Although this is often the case in all risk assessments, the use of ‘subjective data’ can give a false impression of precision, which can be misleading and instil unwarranted feelings of confidence rather than caution.
2. Implicit in the analysis is the acceptance that some level of risk of injury or damage to health is ‘acceptable’, and this is in conflict with the aim of ‘zero incidents’.

6 THE SYSTEMATIC CONSTRUCTION OS&H PROCESS

To put ILO-OSH 2001 and the other parts of this Module into practice requires a more detailed and systematic process. The diagram below, ‘The systematic **Construction OS&H** Process’, brings together the main requirements summarised in the preceding sections into a chart for ‘active OS&H management’.

THE SYSTEMATIC CONSTRUCTION OS&H PROCESS
Elements and linkages



The Method Statement is of crucial importance to this process. This should comprise, as a minimum requirement, a clear, fully documented and agreed statement of the way in which a specific construction element shall be built, taking into account such aspects as:

- The assessment of the hazards and risks inherent in the construction of this element
- The sequence of construction and the plan of work
- The materials and components to be used
- The construction plant and equipment to be used
- Temporary works and their possible effects on the finished element
- Provision of safe access, egress and work places
- The sequence of dismantling, removal and in some cases disposal, of all the plant, equipment, temporary works and waste
- A full statement of compliance with the policy and other requirements of the OS&H plan
- A full statement of all those who will be involved, their roles and confirmation that all have been fully consulted and properly briefed. (Note Module H: “Welfare and project site” explains the necessary requirements for communication, participation, training and other aspects of organising the full involvement of all concerned).

Another crucial aspect of the process is that it is not a linear sequence. ILO-OSH 2001 lays out a comprehensive and systematic approach, but the implications from the way it is presented may give the impression that this is a process that can simply be worked through from start to finish. Although for straightforward and well-understood construction elements this may be the case, in many cases this simple process will be inadequate.

In the process diagram given above, ‘competent persons’ devise the working methods to produce a preliminary Method Statement, which is then discussed with all those involved (or their appointed representatives). This consultation has two possible outcomes; either an agreed, safe and healthy Method Statement or a decision that no acceptable method can be found so the whole process has to be reconsidered fundamentally, starting with an assessment of the inherent hazards. It is through engaging in an iterative processes such as this that difficult problems may be solved.

7 COMMUNICATION SYSTEMS TO IMPROVE OS&H

This topic is only covered briefly in Construction OS&H because it is quite specialised and the information and software available is extensive and varied. Essentially, these systems are available in two forms:

General web-based information for downloading

There are some very useful aids available, many of them free, including;

- Standard forms and detailed guidance for many OS&H functions, such as policies, risk assessments, accident reports and audit reports. These may offer a good starting point for organisations who do not already have these procedures in place.
- Training programmes that may be downloaded, often in the form of PowerPoint presentations. These may also provide a good starting point for an organisation, or may be used selectively to augment other presentations.
- Statistics, case studies, accident reports, government policies and other good general background information.

Software systems for the management of OS&H

Comprehensive software systems are available for managing the OS&H function of an organisation. These will guide the user through all the stages given in ILO-OSH 2001 and much more. Functions include:

- Generating forms for the formulation of policies, procedures and all the systems required
- Prompting for updating these records
- Offering periodic reviews and reports according to an agreed format and timescale
- Holding data on employees
- Operating emergency procedures

The use of these systems should only be considered after careful study and it would be prudent to seek independent expert advice in choosing, installing and implementing such systems.

8 APPENDIX: AN EXAMPLE OF AN OS&H POLICY STATEMENT BY A CONSTRUCTION COMPANY

Taken from http://www.bmcc.ie/policies/safety.html on 22 12 2009. The ILO is very grateful to Brian McCarthy Contractors Ltd for permission to use this statement.

Health and Safety

Brian McCarthy Contractors Ltd. have been awarded SAFE-T-CERT accreditation for our Safety Management System. The SAFE-T-CERT accreditation system was developed jointly by the Construction Industry Federation in Dublin and the Construction Employers Federation in Belfast and takes account of 'best practice' guidelines for health and safety.

Brian McCarthy Contractors Ltd are committed to providing a safe and healthy working environment. All reasonable measures are taken to minimise risks to those directly involved in our activities and also to those who may be indirectly affected by these activities. Our commitment to Health and Safety is set out in our Safety, Health and Welfare Policy statement. Our safety & health procedures are implemented in the form of a Safety Management System which includes the requirement for stringent safety planning, effective communication, site inspections, safety training and review of performance.

Safety Planning

As part of our planning process a Project Safety Manual is prepared by the Contracts Manager in conjunction with our Safety Department for each project where we are appointed as Project Supervisor for the Construction Stage. This is the plan for how safety, health and welfare issues will be managed for each project. Persons with responsibility for safety are identified as part of this planning process and they are made aware of their responsibilities. The Project Safety Manual contains the Preliminary and Construction Stage Health and Safety Plans as well as information such as site rules, site specific risk assessments, method statements, site induction programmes, first aid arrangements, emergency procedures and traffic plans.

Risk assessments are prepared, reviewed and amended both at the planning stage and during the construction phase of each project. We ensure that risk assessments are carried out for all site activities. Over the years we have developed an extensive library of risk assessments which can be referenced and amended to meet the specific requirements of each project / activity.

Communication

We continually strive to ensure effective communication regarding health and safety matters. There are a number of mechanisms we use to communicate safety issues such as discussions with Safety Representatives, toolbox talks, training, site inductions, safety meetings, annual performance reviews and informal discussions.

On each of our sites with more than 20 persons we facilitate the election of a Site Safety Representative who may consult, and make representations regarding safety, health and welfare matters.

Site Inspections

The company employs full time site-based Safety Inspectors on its larger sites and visiting Safety Inspectors on the others. These inspectors carry out regular safety inspections and audits and advise and assist site management in ensuring that the highest safety standards are maintained.

Our Safety Manager co-ordinates the team of Safety Inspectors and is engaged in a process of constantly reviewing safety related matters with a view to continuous improvement in safety standards throughout the Company's operations.

Management Safety Training

All our Contracts Directors, Contracts Managers, Site Supervision and Safety Inspectors have completed the "Managing Safely in Construction" course. This course in construction safety & health management is approved and validated by the Institution of Occupational Safety & Health (IOSH), and run by the Construction Industry Federation with input from the Health and Safety Authority. Site Supervisors are also trained in Management and Inspection of Scaffolding. Other safety training such as Occupational First Aid Training is provided as required.

Occupational Safety Training

All employees must successfully complete the "Safe Pass" course before commencing work on site. A range of courses including Site Inductions, Tool Box Talks, Manual Handling, Abrasive Wheels Instruction and Defensive Driver Training Courses are provided regularly and as required. Toolbox talks are given on subjects which have particular relevance to site activity.

Measuring and Reviewing Performance

The weekly operations management meeting includes a review of site safety inspection reports as well as any incident reports. A review of the effectiveness of the Safety Management System is held on an annual basis. Progress against improvement targets is reviewed as part of this review process.

Company Safety, Health & Welfare Policy Statement

It is the policy of BRIAN MCCARTHY CONTRACTORS LTD to do all that is reasonably practicable to ensure a safe and healthy working environment. All reasonable measures will be taken to minimise risks to those directly involved in our activities and also to those who may be indirectly affected by these activities.

It is the intention of our company to comply with the requirements of the Safety, Health and Welfare at Work Act 2005, the Safety, Health and Welfare (Construction)

Regulations 2006, the Safety, Health and Welfare (General Application) Regulations 2007 and all other legislation.

All employees, subcontractors and others working on our sites are expected to comply with this policy and all other parts of the company's OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM.

In particular, the company will:

- Provide supervisors and managers who will value the health and safety of all personnel, lead by example and respond to all reasonable health and safety concerns.
- Employ people who are competent and capable of carrying out their work safely.
- Provide training, re-training, information, instruction and supervision as necessary to enable employees to work safely, effectively and with the minimum risk to health and safety.
- Prepare risk assessments and safety statements that take account of the general principles of prevention when implementing necessary safety, health and welfare measures.
- Make use of plant and equipment that is as safe as is reasonably practicable.
- Provide and maintain a safe and healthy place of work with proper access and egress to it, supported by a good standard of housekeeping and adequate facilities for health and welfare.
- Make available all necessary safety devices and protective equipment, and to maintain such equipment in good order.
- Ensure safety and minimisation of risk to health and safety, in connection to noise, vibration, radiation and with the use, handling, storage and transport of goods and substances.
- Plan, organise and maintain safe systems of work.
- Prevent improper conduct in the workplace.
- Prepare and revise emergency plans and measures to be taken when there is an emergency or risk of serious or imminent danger.
- Report to the Health & Safety Authority any notifiable accidents, disease and dangerous occurrences.
- Obtain, where necessary, the services of a competent person for the purpose of ensuring the safety, health and welfare of employees.

The company further commits to:

- Communicate this policy to its employees and interested parties.
- To implement and maintain its documented OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM, including this policy.
- To strive to continually improve the OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM.
- To regularly review our OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM, to ensure its continued relevance and effectiveness.

9 BRIEF BIBLIOGRAPHY

Title	Guidelines on occupational safety & health management systems
Author(s)	ILO SafeWork In Focus programme
Type of source	Report
Publication or other source details	ILO-OSH 2001
Date & ISBN/ISSN	2001. ISBN 92-2-111634-4
Summary of contents	The positive impact of introducing occupational safety and health (OSH) management systems at the *organization1* level, both on the reduction of hazards and risks and on productivity, is now recognized by governments, employers and workers. These guidelines on OSH management systems have been developed by the International Labour Organization (ILO) according to internationally agreed principles defined by the ILO's tripartite constituents. This tripartite approach provides the strength, flexibility and appropriate basis for the development of a sustainable safety culture in the *organization.* The ILO has therefore developed voluntary guidelines on OSH management systems which reflect ILO values and instruments relevant to the protection of workers' safety and health. The practical recommendations of these guidelines are intended for use by all those who have responsibility for occupational safety and health management. They are not legally binding and are not intended to replace national laws, regulations or accepted standards. Their application does not require certification. The employer is accountable for and has a duty to organize occupational safety and health. The implementation of an OSH management system is one useful approach to fulfilling this duty. The ILO has designed these guidelines as a practical tool for assisting *organizations* and competent institutions as a means of achieving continual improvement in OSH performance. The Guidelines cover national policy and OS&H systems in the organisation.
Comments on relevance	Very fundamental set of principles

H: WELFARE AND PROJECT SITE

(Photo by Fiona Murie, BWI)

Summary of content
1. Preface
2. General principles of the design of site layout and facilities
3. Site facilities
4. Participative processes and procedures
5. Competence, training and induction
6. Brief bibliography

1 PREFACE

"Those concerned with the design and planning of a construction project shall take into account the safety and health of the construction workers in accordance with national laws, regulations and practice."

"National laws or regulations shall require that employers and self-employed persons have a duty to comply with the prescribed safety and health measures at the workplace."

(ILO C167 Safety and Health in Construction Convention, 1988)

This Module is summarized under the headings given in the table above. No construction project site can be safe unless the layout and facilities are designed carefully and thoroughly, so this Module Summary begins with a review of the factors to be considered and how the site should be planned, which is followed by an assessment of commonly required site facilities. The site will be 'home' to many people during their working hours, so all must have a say in the design and layout, so a section on participation has been included. Finally, the need for all involved to be suitably competent in their jobs is explained, together with some recommendations for training.

This Module Summary is based mainly on the following sources of information:
- ILO C167 Safety and Health in Construction Convention, 1988 ('C167')
- The BWI web site: http://www.bwint.org ('BWI')
- ILO Code of Practice: Safety & health in construction ('ILO Code')
- ILO Safety, health and welfare on construction sites: a training manual ('ILO Manual')
- ILO Managing international construction projects: an overview ('ILO Overview')

A brief bibliography is given at the end of this Module Summary.

2 GENERAL PRINCIPLES OF THE DESIGN OF SITE LAYOUT AND FACILITIES

Careful and thorough design of the construction site layout and facilities lays the foundations for a safe and healthy project.

The following quotation is taken from the 'ILO Overview':

> The construction site is one of the primary resources available to the contractor. In fact the site becomes the "factory" for the production of the building project. The aim in planning site layout and facilities is to produce a working environment that will maximize efficiency and reflect the organization's attitude to the project, its commitment to the safety and well-being of the workforce and its determination to satisfy the needs of its customers. The planning and management of construction site layout and facilities should be given priority throughout the construction period. Concentrating on the efficient organization of the "construction factory" maximizes the benefits of innovative techniques such as prefabrication and automation in construction.
>
> Decisions made in the planning and management of construction site layout and facilities are critical to the successful completion of the project. Incorrect or ill-advised decisions prove costly, and lead to inefficient working, a demoralized workforce and a site that is unlikely to be safe or conducive to producing a high quality product. For example, the wrong choice of type or location for a tower crane may mean that, at worst, certain sections of the project cannot be built, or at least, may result in the necessity of hiring additional mobile craneage, double-handling of materials and so on.

The design of the site layout requires skill and experience and some of the factors that must be taken into account are as follows:

The size of the labour force required throughout the life of the project. This will usually vary significantly from start to finish, growing to a peak during the project before declining towards the finish; usually in the form shown in the diagram below.

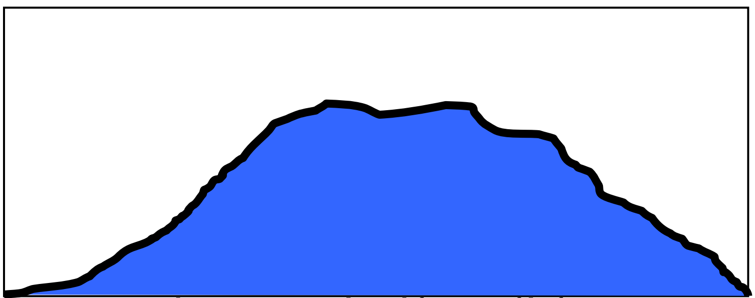


Diagram showing a typical workforce profile for a project

The type of labour force during the project. Consideration must be given to all the needs of the whole workforce: men, women, local residents or migrants requiring accommodation, physical characteristics, etc.

Facilities required by the workforce during the project. This will depend on many factors, including the location, climate, trades and tasks of the workforce, etc.

The changing nature of the work during the project. For example, a typical building project will start with excavation, so there will be a need to control mud and water, and to provide drying rooms for clothing, whereas at the finish most of the work will be inside. In addition, as the work progresses and the permanent works extend across the site, it may be necessary to change the layout and move the facilities.

Access and transport for the workforce. Everyone on site must be able to come on to the site and move about safely.

Delivery and storage of materials and components. This must be carefully planned and executed in a safe way.

Location and use of plant and equipment. The location and use of mechanised plant and equipment has major implications for OS&H. These are explained in other Module Summaries, for example “General plant and equipment”, “Vertical movement” and “Horizontal movement’.

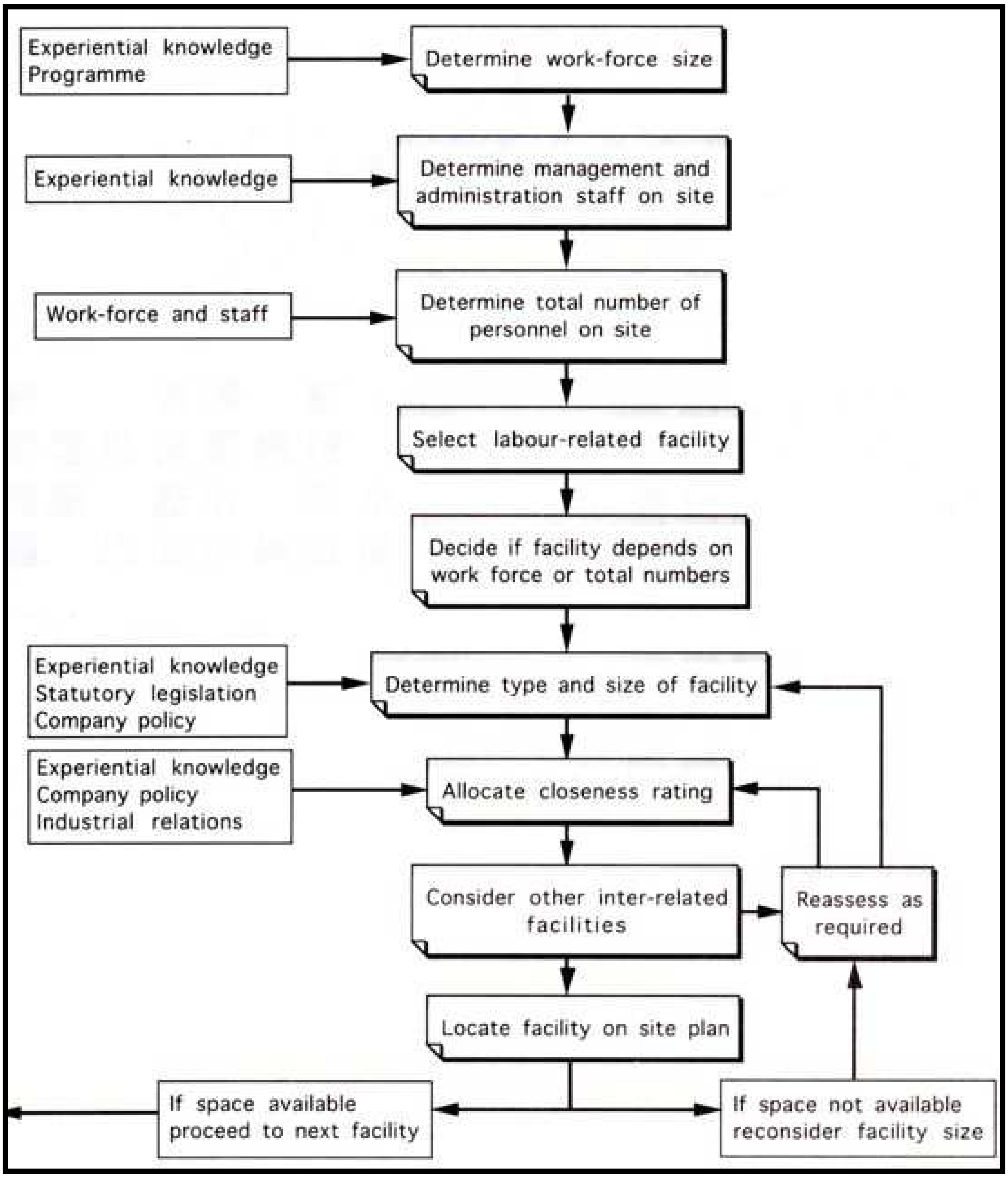
The real challenge in the design and management of site layout and facilities is to consider all these factors together. Construction sites can be very crowded places, with people, materials, components and machines all competing for space around and within the permanent works, which themselves are growing as the work progresses. The following diagrams provide a more detailed description of the facilities and factors to be considered, and provide a useful framework showing their interactions. They are taken from the ILO Overview.

Aspects of site layout and facilities		Primary resources affected		
Main aspect	Related items	Labour	Plant	Material
Safety	Signage			
	First aid			
	Access ways			
	Site cleanliness			
	Lighting			
	Existing services			
	Fire prevention			
Welfare	Canteen/mess rooms			
	Drying/changing rooms			
	Toilets/washrooms			
	Car parking/transport			
	Worker accommodation			
	Time office			
Offices	Major contractor			
	Package contractor			
	Client/design team			
Access	Delivery access			
	Site access roads			
	Pedestrian access			
Storage, etc.	Off-loading areas			
	Long-term storage			
	Workface storage			
	Tool storage			
	Secure stores			
	Hazardous material store			
	Prefabrication areas			
	Batching plants			
Transportation	Hoists			
	Craneage			
	Horizontal transportation			
Rubbish removal	Site cleanliness			
Temporary services	Electricity/gas/water			
	Drainage/surface water			
	Existing services			
Testing	On-site laboratories			
Security	Hoarding/fencing			
	Site access			
	Secure stores			
	Identification passes			
Image	Signage			
	Hoarding/fencing			
	Site cleanliness			
	Public relations			

Facility	Factors affecting sizing of facility							Factors affecting location of facility						
	Statutory requirements	Company policy	Past experience	Size of workforce	No. of package contractors	Site location/Expected usage	Phase of project	Company policy	Past experience	Size of site	Congested/Uncongested site	Location of related facilities	Minimum travel time	Phase of project
Canteen/Mess room	□	□	□	□			□	■	■	■	■	■	■	■
Drying/Changing Room	□	□	□	□			□	■	■	■	■	■	■	■
Toilets/Washroom	□	□	□	□			□	■	■	■	■	■	■	■
Residential accom.		□	□	□		□		■	■	■	■	■		■
Car parking areas		□	□	□		□	□	■	■	■	■	■	■	■
Time office		□	□	□				■	■	■	■	■		■
Site offices		□	□		□			■	■	■	■	■		■
First aid room	□	□	□	□				■	■	■	■	■		■
Personnel hoists		□	□	□			□	■			■	■		■

Facility	Factors affecting sizing of facility						Factors affecting location of facility							
	Company policy	Past experience	Amount of materials	Extent of prefabrication	Size/Weight of materials	Delivery methods	Company policy	Past experience	Site of size	Congested/Uncongested site	Location of related facilities	Location of cranes, etc.	Minimum travel time	Phase of project
Material access		□				□		■		■	■			■
Storage areas	□	□	□	□	□			■	■	■	■	■	■	■
Materials hoists	□	□	□	□	□		■	■		■	■		■	■
Craneage	□	□	□	□	□		■	■	■	■	■	■		■

The process of decision making for the labour aspects of site layout and facilities is illustrated by the following chart and example (ILO Overview).



Example **Sizing and locating the site canteen**

Determine workforce size:
Assume that peak workforce size is 500 and average is 350.

Determine management and administration staff numbers:
Assume a peak of 100 and average of 75.

Determine total number of personnel on site:
600 maximum, 425 average.

Select facility:
Site canteen. At this stage the manager must decide if the facility will cater for peak numbers or average numbers with alternative measures taken for the overflow at peak. Decide if facility size depends on workforce or total numbers: this will depend on whether staff and workforce will use the same canteen; custom varies in different countries.

Determine size of facility:
Plan area determined by seating requirements and allowance for catering, etc. Most countries have statutory legislation which refers to welfare accommodation. Most temporary units can be stacked and so reduce the area of site taken up, however circulation within the canteen area will be a priority and affect decisions to plan a split-level facility. It is also likely that the facility size can be reduced at the start and end of the project.

Allocate closeness rating:
At this stage the manager must decide the importance of this facility being close to the workface. This will obviously have an effect on other facilities and the closeness rating is a method of prioritizing the facilities with regard to location. For instance, the use of dispersed canteens located next to the workface may be considered to minimize workforce travel time at rest breaks. Local practice and industrial relations considerations will be influential here.

Consider other interrelated facilities:
At this stage the manager must relate the canteen to other facilities such as toilets, washrooms and site offices. Decisions on the canteen cannot be made in isolation. The size and closeness rating may need to be reconsidered due to the influence of the other facilities.

Locate facility on site plan:
Allocate the best space to the most important facility. The manager must decide the relative importance of the canteen. The size and closeness rating may need to be reconsidered once more. Avoid moving the canteen during the project unless absolutely essential.

3 SITE FACILITIES

Site layout

Following from the general design principles given in Section 2 above, the ILO Manual provides some good practical advice:

"A badly planned and untidy site is the underlying cause of many accidents resulting from falls of material and collisions between workers and plant or equipment. Space constraints, particularly in urban work sites, are nearly always the biggest limiting factor and a layout which caters best for the safety and health of workers may appear to be difficult to reconcile with productivity. Proper planning by management is an essential part of preparation and budgeting for the safe and efficient running of a construction operation.

Before work even begins on site, thought needs to be given to:

- *The sequence or order in which work will be done and to any especially hazardous operations or processes*

- *Access for workers on and around the site. Routes should be free from obstruction and from exposure to hazards such as falling materials, materials-handling equipment and vehicles. Suitable warning notices should be posted. Routes to and from welfare facilities need equal consideration. Edge protection will be required at the edge of floor openings and stairs, and wherever there is a drop of 2m or more*

- *Routes for vehicular traffic. These should be "one way" as far as practicable. Traffic congestion prejudices the safety of workers, especially when impatient drivers unload goods hurriedly*

- *Storage areas for materials and equipment. Materials need to be stored as close as possible to the appropriate workstation, e.g. sand and gravel close to the cement-batching plant, and timber close to the joinery shop. If this is not practicable, it is important to schedule the arrival of materials*

- *The location of construction machinery. This is usually dependent on operational requirements so that tower cranes are subject to constraints such as their radius of operation, and pick-up and unloading points. The objective should be to avoid the need to slew the load over workers*

- *The location of trade workshops – these are not usually moved after they are built*

- *The location of medical and welfare facilities. On large sites sanitary facilities for both sexes should be provided at several locations*

- *Artificial lighting at places where work continues or workers pass after dark*

- *Site security. The site should be fenced in to keep out unauthorized persons, children in particular, and to protect the public from site hazards. The type of fencing will depend on the location of the site, but in populated areas it should be at least 2m high and without gaps or holes. Overhead protection will be necessary if tower crane loads pass over public thoroughfares*
- *Arrangements to keep the site tidy and for the collection and removal of waste*
- *The need for low-voltage electric power supplies for temporary lighting, portable tools and equipment*
- *Training needs of both workers and supervisors*

Point to remember

The time spent on planning will make for a safer site and save money

Welfare

“Article 32 Welfare

1. At or within reasonable access of every construction site an adequate supply of wholesome drinking water shall be provided.

2. At or within reasonable access of every construction site, the following facilities shall, depending on the number of workers and the duration of the work, be provided and maintained-
(a) sanitary and washing facilities;
(b) facilities for changing and for the storage and drying of clothing;
(c) accommodation for taking meals and for taking shelter during interruption of work due to adverse weather conditions.

3. Men and women workers should be provided with separate sanitary and washing facilities.”
(C167)

The ILO manual covers welfare very comprehensively, and the following is an edited extract. Some of the Articles from C167 are also included.

Work in the construction industry is arduous; it involves much manual or physical activity. It is also hazardous and dirty. Good welfare facilities not only improve workers’ welfare but also enhance efficiency.

Welfare facilities such as the provision of drinking-water, washing, sanitary and changing accommodation, rest-rooms and shelter, facilities for preparing and eating meals, temporary housing, assistance in transport from place of residence to the work site and back, all help to reduce fatigue and improve workers’ health. The facilities may be provided and maintained by one contractor for all workers or by individual contractors.

Point to remember

Welfare facilities improve morale and consequently improve efficiency

Sanitary facilities

National laws usually prescribe the type, number and standard of sanitary facilities which should be provided, but as a general guide the following should be regarded as a practical minimum:

- A sufficient number of water flush-type lavatories for men when this is practicable, including sufficient urinal accommodation; chemical lavatories may be used otherwise
- A sufficient number of separate water flush-type lavatories for women when this is practicable; again, chemical lavatories may be an alternative
- The accommodation should be designed and constructed so as to screen the occupants from view and afford protection against the weather
- The accommodation should be separate from any messroom or rest-room
- A smooth and impermeable floor
- Effective natural and/or artificial lighting and ventilation
- At least 30m from any well
- Constructed for easy maintenance and cleaned out at least daily

(Photo by Fiona Murie, BWI)

Washing facilities

Work in the construction industry is often dusty and dirty; it may also involve handling chemicals and other dangerous substances, so employees need to wash their hands and bodies regularly:

- To prevent chemicals contaminating food and so being eaten during snacks or meals, being absorbed through the skin or being carried home
- To remove dirt and grime, which can also be ingested and cause sickness and disease
- As a basic hygiene measure

When construction work involves the maintenance of or alterations to existing buildings, it is often possible to use the facilities which form part of the building. Otherwise, washing facilities should be provided to the following standards:

- One wash-basin for every 15 workers with a sufficient supply of water and an adequate means of removing waste water.
- Soap, in the form of cake soap, or liquid or powder soap in a special dispenser, to facilitate quick and proper washing, nail-brushes are needed where hazardous substances are used.
- Suitable drying facilities such as paper towels, roller towels (or individual towels for each worker) or electric hand-dryers.
- For facilities likely to be of longer duration, mirrors and shelves at each washing point which will help to keep the place tidy and clean.
- Where workers are exposed to skin contamination by chemical substances or by oil or grease, a sufficient number of showers, which should be disinfected daily.
- Facilities should be covered to provide weather protection, and effectively ventilated and lit.

Facilities for supplying food and drink, and eating meals

(Photo by Fiona Murie, BWI)

Point to remember:

Drink water only from sources clearly marked as “drinking water”

Facilities for supplying food at construction work sites can be particularly important when sites are located in remote areas. Remoteness, together with inadequate temporary housing which lacks cooking facilities, may give rise to considerable problems for workers in the availability and regularity of hygienically prepared and nutritious meals. The problems of shift-workers may be even greater.

To meet the need for proper meals, a choice of facilities should be made available:

- Facilities to boil water and heat food
- Facilities (including provision of space, shelter, water, heating and rubbish bins) for vendors to sell hot and cold food and drink
- A canteen supplying cooked meals or serving packed meals, snacks and beverages
- Arrangements with a restaurant or canteen near the work site to supply packaged meals

There should be accommodation with tables and seats, protected from the weather, where workers can eat in comfort food brought from home or bought from vendors. It should be situated away from workstations to minimize contact with dirt, dust or dangerous substances.

Point to remember

Construction work is physically exhausting, and you need hygienically prepared and nutritious meals at regular times

Facilities for changing, storing and drying clothes

Secure facilities at the work site for changing from street clothes into work clothes, and for airing and drying the latter, greatly assist workers with their personal hygiene and tidiness and relieve them of anxiety over the security of their possessions.

(Photo by Fiona Murie, BWI)

Changing-rooms are particularly important when workers change from street clothes into protective clothing and when working clothes become wet or dirty. The facilities should include provision for drying wet clothes, whether it is street or working clothing. Separate changing facilities for men and women workers should be provided.

The provision of adequate seats, mirrors and rubbish bins in the changing rooms or close to the lockers will assist workers in paying attention to personal appearance and cleanliness.

(Photo by Fiona Murie, BWI)

Rest breaks

Construction workers begin work early. They start their day alert and productive but their activity level decreases as the day passes. Fatigue develops gradually before it begins to have marked effects. If they rest before they show signs of being really tired, recovery is much faster. Short breaks taken frequently are much better than infrequent long breaks. Productivity improves with frequent rest breaks.

National law may prescribe the length of a working day which includes a period or periods for rest breaks. At least one ten-minute break in the morning and one in the afternoon, in addition to a longer break for lunch, are essential.

Workers are not just idle during rest breaks, but are recovering from fatigue and preparing for continued productive work. Getting away from a noisy or polluted workplace helps workers to relax and recover from fatigue, and an area with seating and out of direct sunlight should be set aside for rest breaks.

Point to remember

Breaks which are short and taken often are better than long breaks taken infrequently

Child-care facilities

Working mothers employed at construction sites often need help with the special difficulties of caring for their children while they are at work. Basic provisions are summarised below.

A clean and well-ventilated room, preferably with access to an enclosed space, is the main facility needed. A few items of simple furniture are necessary for the children to sit or lie down, and some toys help. There should be provision for feeding the children with nutritious meals at regular times and, for this, there should also be access to cooking facilities or a canteen.

It is essential for someone to care for the children while their mothers are at work, prepare their meals and feed them regularly. It may be possible for mothers themselves to take turns to look after the children. Mothers, especially nursing mothers, should be able to visit their children during recognized breaks from work.

It is essential to watch the children's movements. Each year there are many tragic deaths of children on construction sites. Children should never be allowed to wander into or play on sites. There are excavations to fall into, scaffolding to fall from and hazardous equipment.

Welfare facilities and women workers

The following extract is taken from a study in the USA by the Occupational Safety and Health Administration (OSHA) (osha.gov): Women in the Construction Workplace: Providing Equitable Safety and Health Protection. It tells a story of a fundamental problem that could be found on construction sites in many countries in the world, and must be resolved by international action.

Access to sanitary facilities is frequently a problem on a new construction site. Temporary facilities are usually unisex, often without privacy, and generally not very well maintained. Sometimes there are no sanitary facilities available for women to use. Due to the lack of facilities, women report that they avoid drinking water on the job, risking heat stress and other health problems. Courts have found that the lack of appropriate sanitary facilities is discriminatory and violates OSHA standards.

Unclean facilities can result in disease as well as urinary tract infection (for those who delay urinating rather than using such facilities). The availability and cleanliness of restroom facilities are major concerns for tradeswomen. Thirty-five percent of the women in the second NIOSH survey answered "false" to the statement, "There are clean toilets at most jobsites."

Inadequate, unsanitary toilet facilities were the subject of a 1987 U.S. Appeals Court decision. Eileen Lynch, a female carpenter apprentice with the Tennessee Valley Authority (TVA), was fired for using the large, clean, fully-equipped restrooms in the main building of the plant, which was off limits to construction personnel. She used these restrooms occasionally after her doctor diagnosed her with a bladder infection. Some of the men she worked with used them regularly and were not disciplined. The construction site contained two portable toilets for women, one at each end of the work area, and 21 other portable toilets not designated by sex, but primarily used by men.

The portable toilets were dirty, often had no toilet paper or paper that was soiled, and were not equipped with running water or sanitary napkins. In addition, those designated for women had no locks or bolts on the doors and one of them had a hole punched in the side. To avoid using the toilets, Ms. Lynch began holding her urine until she left work. Within three days after starting work she experienced pain and was advised that the practice she had adopted, as well as using contaminated toilet paper, frequently caused bladder infections.

The Appeals Court ruled that the condition of the toilets limited female Construction Service Branch employees in a way that adversely affected their status as employees based solely on their sex. It held that any employment practice that adversely affects the health of female employees, while leaving male employees unaffected, has a significantly discriminatory impact.

(The ILO is grateful to OSHA for the use of this quotation. It is 390 words long, so has been used under the convention of ‘Fair Use’ which allows a maximum of 400 words to be used without seeking formal permission.)

For the full report see: http://www.osha.gov/doc/accsh/haswicformal.html

First aid and general medical facilities

The following extract is from ILO C167.

Article 31 First aid
The employer shall be responsible for ensuring that first aid, including trained personnel, is available at all times. Arrangements shall be made for ensuring the removal for medical attention of workers who have suffered an accident or sudden illness.

Construction sites are dangerous places, and first-aid and rescue equipment should always be available. What is needed will depend on the size of the site and the numbers employed, but there should be at least a stocked first-aid box and a stretcher and blanket – the stretcher should be of a type which can be raised and lowered to and from upper floors. On large sites, and always where more than 200 people are employed, there should be a properly equipped first-aid room or hut. Ideally, large sites would have a well-stocked medical facility and properly trained staff. These would support general welfare as well as providing an emergency service. On any construction site of any size, at least one person on every shift should have been trained in first aid to a nationally recognized standard.

(Photo by Fiona Murie, BWI)

Fire precautions

Fires on construction sites arise from the misuse of compressed gases and highly flammable liquids, from the ignition of waste material, wood shavings and cellular plastic materials, and from the failure to recognize that adhesives and some floor and wall coatings are highly flammable.

Every individual on site should be aware of fire risks, and should know the precautions to prevent a fire and the action to be taken if fire does break out.

4 PARTICIPATIVE PROCESSES AND PROCEDURES

"Article 6
Measures shall be taken to ensure that there is co-operation between employers and workers, in accordance with arrangements to be defined by national laws or regulations, in order to promote safety and health at construction sites."

"Article 10
National laws or regulations shall provide that workers shall have the right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on the working procedures adopted as they may affect safety and health."
(C167)

Safety committees

An active safety committee is a great spur to safety. Its primary purpose is to enable management and workers to work together to monitor the site safety plan so as to prevent accidents and improve working conditions on site. Its size and membership will depend on the size and nature of the site and upon differing legal and social conditions in the countries concerned, but it should always be an action-oriented group of people in which both management and workers are represented. The safety committee carrying out a site inspection together raises the level of safety consciousness at the site. The duties carried out by an active safety committee will include:

- Regular and frequent meetings to discuss the safety and health programme on site and to make recommendations to management
- Consideration of reports of safety personnel
- Discussion of accident and illness reports in order to make recommendations for prevention
- Evaluating improvements made
- Examination of suggestions made by workers, particularly by safety representatives
- Planning and taking part in educational and training programmes, and information sessions

(ILO Manual)

Safety representatives

These are appointed by workers, sometimes in accordance with national legislation, to represent them in dealing with safety and health matters on site. They should be experienced workers well able to recognize construction site hazards, although they are likely to require training to acquire new skills in inspection and in using information. Their functions are to:

- Make representations to management about matters of concern regarding the safety and health of workers
- Attend meetings of the safety committee
- Carry out regular and systematic inspections on site
- Investigate accidents in conjunction with management to determine their causes and to propose remedies
- Investigate complaints by fellow workers
- Represent workers in discussions with government inspectors at their site visits

(ILO Manual)

5 COMPETENCE, TRAINING AND INDUCTION

Article 3 Information and training
Workers shall be adequately and suitably-
(a) informed of potential safety and health hazards to which they may be exposed at their workplace;
(b) instructed and trained in the measures available for the prevention and control of, and protection against, those hazards.
(C167)

20.2. No person should be employed in any work at a construction site unless that person has received the necessary information, instruction and training so as to be able to do the work competently and safely. The competent authority should, in collaboration with employers, promote training programmes to enable all the workers to read and understand the information and instructions related to safety and health matters.

20.3. The information, instruction and training should be given in a language understood by the worker and written, oral, visual and participative approaches should be used to ensure that the worker has assimilated the material.

20.4. National laws or regulations should prescribe:
(a) the nature and length of training or retraining required for various categories of workers employed in construction projects;
(b) that the employer has the duty to set up appropriate training schemes or arrange to train or retrain various categories of workers.

20.5. Every worker should receive instruction and training regarding the general safety and health measures common to the construction site, which should include:
(a) general rights and duties of workers at the construction site;
(b) means of access and egress both during normal working and in an emergency;
(c) measures for good housekeeping;
(d) location and proper use of welfare amenities and first-aid facilities provided in

pursuance of the relevant provisions of this code;
(e) proper use and care of the items of personal protective equipment and protective clothing provided to the worker;
(f) general measures for personal hygiene and health protection;
(g) fire precautions to be taken;
(h) action to be taken in case of an emergency;
(i) requirements of relevant safety and health rules and regulations.

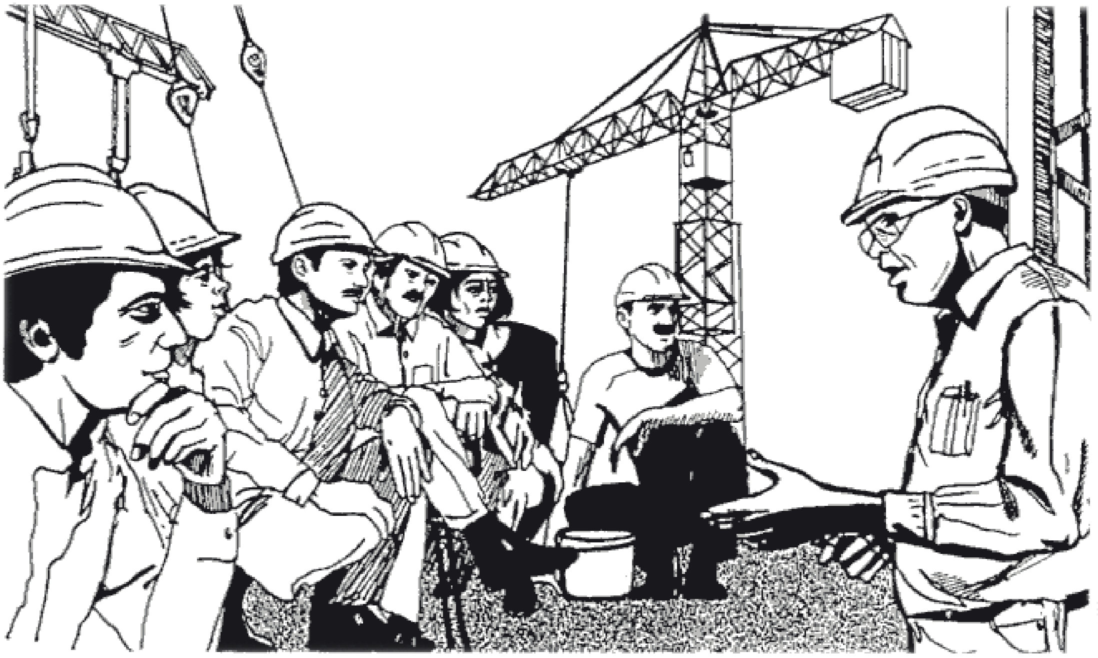
20.6. Copies of the relevant safety and health rules, regulations and procedures should be available to workers upon the commencement of and upon any change of employment.

20.7. Specialised instruction and training should be given to:
(a) drivers and operators of lifting appliances, transport vehicles, earth-moving and materials-handling equipment and plant, and machinery or equipment of a specialised or dangerous nature;
(b) workers engaged in the erection or dismantling of scaffolds;
(c) workers engaged in excavations deep enough to cause danger, or shafts, earthworks, underground works or tunnels;
(d) workers handling explosives or engaged in blasting operations;
(e) workers engaged in pile-driving;
(f) workers working in compressed air, cofferdams and caissons;
(g) workers engaged in the erection of prefabricated parts or steel structural frames and tall chimneys, and in concrete work, formwork and such other work;
(h) workers handling hazardous substances;
(i) workers working as signallers;
(j) other specialised categories of workers.

20.8. Wherever required by national laws and regulations, only drivers, operators or attendants holding a certificate of proficiency or licence should be employed to operate particular vehicles, lifting appliances, boilers or other equipment.

(C167)

"Tool-box briefing" should be carried out regularly



(ILO Manual)

Induction

Induction to the project site and the way it operates is of crucial importance to those who work on the site, but also to visitors – who will include the Client's representatives and also many of the others involved in the project.

No person should be allowed onto the construction site unless they have completed the induction training or they are accompanied at all times by a 'competent' person', who will of course have been through the induction training.

An excellent PowerPoint Presentation is provided with **Construct OS&H**. It is taken from "Construction safety management" by Howarth and Watson.

6 BRIEF BIBLIOGRAPHY

Title	C167 Safety and Health in Construction Convention, 1988
Author(s)	The General Conference of the International Labour Organisation
Type of source	ILO Convention concerning Safety and Health in Construction
Publication or other source details	Convention: C167 Place: Geneva Session of the Conference: 75
Date & ISBN/ISSN	Date of adoption: 20:06:1988 Date of coming into force: 11:01:1991
Summary of contents	XI. Scope and definitions XII. General provisions XIII. Preventive and protective measures XIV. Implementation XV. Final provisions There are also some useful cross-references at the end.
Comments on relevance	The core document for **Construction OS&H**, containing fundamental general provisions and much detailed guidance.
Other information	This Convention has very similar detailed content to the ILO's Code of Practice, 1992, which is also summarised in this Knowledge Base.

Title	BWI web site
Type of source	Web site
Publication or other source details	http://www.bwint.org and refer to the 'Building and Construction' button on the left
Date & ISBN/ISSN	Accessed December 2008
Summary of contents	The first page in the Building and Construction section has a very good summary of the characteristics and employment issues of these industries, and sets out BWI's views: "For the BWI, the most effective way to ensure that worker's interests are protected in the work place is through legislation and regulation. In this connection, we work with the International Labour Organization (ILO) to lobby for the implementation of ILO standards and their respect in World Bank agreements. We promote the social dimension of sustainable development in economic growth, environmental conservation and society since it will not make construction more expensive. For example, a good working environment reduces the risks of heavy physically demanding work, leads to fewer accidents at work, fewer sick days and thus shorter times and lower costs for the total construction." There are many interesting and relevant articles, especially concerned with women workers with some excellent photos of women at work.
Comments on relevance	There is much in this site of general relevance, and the photos can be downloaded and used in training materials.
Other information	See other BWI source summaries

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

Title	Managing international construction projects: an overview
Author(s)	R Neale (Ed)
Type of source	Book, 239 pages
Publication or other source details	International Labour Office, Geneva. International construction management series No 7
Date & ISBN/ISSN	1995. 92-2-108751-4 & 4020-0142
Summary of contents	An edited book with contributions from Richard Neale, Williams Sher, Alistair Gibb and Simon Barber Chapters 1: Construction project management 2: Project management organisation 3: System support for projects 4: Control of quality and quality assurance 5: Site layout and facilities 6: Key considerations for site layout and facility planning 7: Construction site safety 8: Planning case studies 9: Cost analysis case study
Comments on relevance	A useful but very general book, apart from the case studies which are quite detailed. This is the last book (No7) in the series so some detailed case studies were seen to be useful. The planning case study has been adapted to provide an integrative project on OS&H for **Construction OS&H**
Other information	See Tutor's Guide for more on the content of this book.

Title	Construction safety management
Type of source	Book and PowerPoint Presentation
Publication or other source details	Tim Howarth, Paul Watson Paperback, 216 pages, Wiley-Blackwell http://eu.wiley.com/WileyCDA
Date & ISBN/ISSN	2008. ISBN: 978-1-4051-8660-5
Summary of contents	An up-to-date textbook on the subject. Very oriented towards being used in an educational course, contains exercises and questions. The web site offers a PowerPoint Presentation on site induction and self-assessment questions. Contents: Introduction: Health and Safety – Overriding Principles. Chapter 1 The Safety Performance of the UK Construction Industry. Chapter 2 The Legal Framework and Enforcement of Construction Health and Safety. Statutory Instruments. Chapter 3 UK Construction Health and Safety Law. Chapter 4 The Construction (Design and Management) Regulations 2007. Chapter 5 Key Site Health and Safety Hazards and Control Measures. Chapter 6 Principles and Practice of Health and Chapter 7 Managing for Health and Wellbeing. Chapter 8 The (Principal) Contractor's Health and Safety Management System. Chapter 9 Promoting a Positive Health and Safety Culture.
Comments on relevance	Entirely based in a UK context, but contains generally useful materials.

Title	Women in the Construction Workplace: Providing Equitable Safety and Health Protection
Author(s)	Advisory Committee on Construction Safety and Health (ACCSH), Department of Labor, US Government
Type of source	Report on web site
Publication or other source details	Health and Safety of Women in Construction (HASWIC) workgroup Occupational Safety & Health Administration 200 Constitution Avenue, NW Washington, DC 20210 www.osha.gov
Date & ISBN/ISSN	March 13, 1997
Summary of contents	As increasing numbers of women enter the construction trades, concerns about their health and safety are growing. In addition to the primary safety and health hazards faced by all construction workers, there are safety and health issues specific to female construction workers. The small percentage of females within the construction trades and the serious health and safety problems unique to female construction workers have a circular effect. Safety and health problems in construction create barriers to women entering and remaining in this field. In turn, the small numbers of women workers on construction worksites foster an environment in which these safety and health problems arise or continue. Sources of information for this report include a survey of tradeswomen conducted by CWIT and two research studies by NIOSH. The key findings and recommendations are organized into seven categories: Workplace Culture; Sanitary Facilities; Personal Protective Equipment; Ergonomics; Reproductive Hazards; Health and Safety Training; and Injury and Illness Data and Research. Similar concerns surfaced in all three studies. The prevalence of a hostile workplace, restricted access to sanitary toilets, protective clothing and equipment in the wrong sizes, and poor on-the-job training; these were significant issues that adversely impacted women's ability to perform their jobs safely. Many of the identified problems are amenable to change through engineering, behavioral, or administrative intervention. The recommendations in this report are directed at employers, labor unions, manufacturers, training programs, supervisors, and workers. Improving the work conditions for women in the construction trades will not only ensure their health and safety, it will also serve to attract and retain women as workers during a critical time of labor shortages in this industry.
Comments on relevance	Particularly relevant to Modules 3, 7, 8 & 14

I: PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT (PPE)

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

Summary of content	
1.	Preface
2.	The need for personal protective clothing and equipment (PPE)
3.	General review of personal protective clothing and equipment
4.	Clothing
5.	Harnesses and similar devices
6.	Lifting and handling devices
7.	Specific characteristics of individuals
8.	Summary photos of safe working
9.	Brief bibliography

1 PREFACE

This Module Summary follows the relevant structure and content of the “ILO Code of Practice: Safety & health in construction” (the “Code”). The following passage is taken from this Code:

“1. General provisions

1.1. Objective

1.1.1. The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

> *(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;*
>
> *(b) ensuring appropriate design and implementation of construction projects;*
>
> *(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.*

1.1.2. This code also provides guidance in the implementation of the provisions of the Safety and Health in Construction Convention, 1988 (No. 167), and the Safety and Health in Construction Recommendation, 1988 (No. 175).”

Other passages from this Code are included in this Module Summary, and they are shown in the same format as above.

This Module Summary also includes extracts from the ILO’s “Safety, health and welfare on construction sites: A training manual” (the “Manual”).

A brief bibliography is given at the end of this Module Summary.

This Module Summary follows the sections shown in the table above.

2 THE NEED FOR PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT (PPE)

General provisions of the Code

18.1.1. Where adequate protection against the risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means, suitable personal protective equipment and protective clothing, having regard to the type of work and risks, should be provided and maintained by the employer, without cost to the workers, as may be prescribed by national laws or regulations.

18.1.2. Personal protective equipment and protective clothing should comply with standards set by the competent authority, taking into account as far as possible ergonomic principles.

18.1.3. Employers should provide the workers with the appropriate means to enable them to use the individual protective equipment and should require and ensure its proper use.

18.1.4. A competent person having a full understanding of the nature of the hazard and the type, range and performance of the protection required should:

> *(a) select suitable items of personal protective equipment and protective clothing;*
>
> *(b) arrange that they are properly stored, maintained, cleaned and, if necessary for health reasons, disinfected or sterilised at suitable intervals.*

18.1.5. Workers should be required to make proper use of and to take good care of the personal protective equipment and protective clothing provided for their use.

18.1.6. Workers should be instructed in the use of personal protective equipment and protective clothing.

18.1.7. Workers working alone on construction sites in confined spaces, enclosed premises or in remote or inaccessible places should be provided with an appropriate alarm and the means of rapidly summoning assistance in an emergency.

Extracts from the Manual

Point to remember

It is safer and in most cases cheaper to eliminate hazards
than to provide personal protective equipment

“The working conditions in construction are in most cases such that, despite all preventive measures in project planning and work design, some personal protective equipment (PPE), such as a helmet, hearing and eye protection, boots and gloves, is needed to protect workers.

However, there are disadvantages in using PPE:

- *Wearing some forms of PPE may involve discomfort to the user and slow down their work*
- *Extra supervision is called for to see that PPE is worn*
- *PPE costs money*

Wherever possible, it is better to try to eliminate the hazard rather than providing PPE to guard against it.

However, some PPE such as safety helmets and footwear should be used on all construction sites. The need for other PPE will depend on the sort of work being done. Remember, too, that proper work clothes will provide protection for the skin."

The Construction OSH view of PPE

PPE has developed and improved remarkably during the past few decades. When first introduced, many items were uncomfortable to wear and got in the way of the work and their use was often resisted. Various factors have led to a general acceptance and use of PPE in many countries, including:

- Legislation which requires the use of appropriate PPE
- Trade Union pressure
- An acceptance of the need by employers
- Improved design of PPE

In many countries it is now quite rare not to see everyone on a construction project site wearing helmets, safety boots and a 'hi-viz' jacket. In addition, many employers insist that workers also wear proper overalls and other work gear, rather than their own clothes, and provide changing and secure locker rooms. This is to be commended.

3 GENERAL REVIEW OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

General provisions of the Code

18.2.1. Where necessary, workers should be provided with and wear the following personal protective equipment and protective clothing:

> *(a) safety helmets or hard hats to protect the head from injury due to falling or flying objects, or due to striking against objects or structures;*
>
> *(b) clear or coloured goggles, a screen, a face shield or other suitable device when likely to be exposed to eye or face injury from airborne dust or flying particles, dangerous substances, harmful heat, light or other radiation, and in particular during welding, flame cutting, rock drilling, concrete mixing or other hazardous work;*
>
> *(c) protective gloves or gauntlets, appropriate barrier creams and suitable protective clothing to protect hands or the whole body as required when exposed to heat radiation or while handling hot, hazardous or other substances which might cause injury to the skin;*
>
> *(d) footwear of an appropriate type when employed at places where there is the likelihood of exposure to adverse conditions or of injury from falling or crushing objects, hot or hazardous substances, sharp-edged tools or nails and slippery or ice covered surfaces;*

(e) respiratory protective equipment, suitable for the particular environment, when workers cannot be protected against airborne dust, fumes, vapours or gases by ventilation or other means;

(f) a suitable air line or self-contained breathing apparatus when employed in places likely to have an oxygen deficiency;

(g) respirators, overalls, head coverings, gloves, tight-fitting boiler suits, impermeable footwear and aprons appropriate to the risks of radioactive contamination in areas where unsealed radioactive sources are prepared or used;

(h) waterproof clothing and head coverings when working in adverse weather conditions;

(i) safety harnesses with independently secured lifelines where protection against falls cannot be provided by other appropriate means;

(j) life vests and life preservers where there is a danger of falling into water;

(k) distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure to danger from moving vehicles.

4 CLOTHING

Safety helmets

From the Manual

"Falling objects, overhead loads and sharp projections are to be found everywhere on construction sites. A small tool or bolt falling from 10 or 20m high can cause serious injuries or even death if it strikes an unprotected head. Head injuries often occur when moving and working in a bent position, or when arising from such a position."

"Safety helmets protect the head effectively against most of these hazards, and you should wear a helmet whenever you are on site and particularly when you are in an area where overhead work is going on. These areas, known as "hard-hat areas", should be clearly marked with safety signs at entrances and other suitable places. The same rule applies to managers, supervisors and visitors. Only safety helmets which have been tested to national or international standards should be used. A chin-strap on the helmet prevents it from failing off and should be used when appropriate."

"Hard-hat" areas – all or most parts of construction sites should be marked by signs as "hard-hat" areas

Point to remember

Your safety helmet protects you only if you have it on

(Photo: Fiona Murie, BWI)

The Construction OSH view of helmets

Safety helmets are easy to obtain and relatively cheap. The example below is a typical design.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

It has reinforced ribs on top for impact strength, a rain gutter round the side and rear to guide water away, and can be fitted with a chin-strap. This helmet also has a built-in safety visor, which can be easily pushed up out of the way if required. The whole helmet is light and quite comfortable.

There are many different designs available, made for specific purposes. For example, many trades - such as scaffolders - find that helmets with a very short peak are easier to wear because they do not get in the way. Some helmets contain Kevlar fibres giving them great resilience and resistance to impact.

Eye and face protection

From the Manual

“In industry many eye injuries occur as a result of flying material, dust or radiation when the following jobs are being carried out:

- *Breaking, cutting, drilling, dressing or laying of stone, concrete and brickwork with hand or power tools;*
- *Chipping and dressing painted or corroded surfaces;*
- *Cutting off or cutting out cold rivets and bolts;*
- *Dry grinding of surfaces with power grinders;*
- *Welding and cutting of metals.*

In some industrial processes there may also be a risk from the spillage, leakage or splashing of hot or corrosive liquids.

Some of these hazards can be removed permanently by proper machine guarding, exhaust ventilation or work design. For many hazards, for example, stone cutting or dressing, personal eye protection (goggles, safety glasses or shields) is the only practical solution. Sometimes workers are aware of the danger they run and the consequences if their eyes are damaged, but do not wear eye protection. This is because the type chosen interferes with vision or is uncomfortable to wear, or is not immediately at hand when needed.”

Eye protection must be suitable, comfortable and available to encourage workers to wear it

Point to remember

Ninety per cent of all eye injuries can be prevented
by suitable eye protection

From the United States Department of Labour
Occupational Safety and Health Administration
(http://www.osha.gov/SLTC/etools/eyeandface/ppe/selection.html)

“Personal protective equipment (PPE) for the eyes and face is designed to prevent or lessen the severity of injuries to workers. The employer must assess the workplace and determine if hazards that necessitate the use of eye and face protection are present or are likely to be present before assigning PPE to workers.

A hazard assessment should determine the risk of exposure to eye and face hazards, including those which may be encountered in an emergency. Employers should be aware of the possibility of multiple and simultaneous hazard exposures and be prepared to protect against the highest level of each hazard.”

An example of an assessment

Hazard Assessment		
Hazard type	**Examples of Hazard**	**Common Related Tasks**
Impact	Flying objects such as large chips, fragments, particles, sand, and dirt.	Chipping, grinding, machining, masonry work, wood working, sawing, drilling, chiseling, powered fastening, riveting, and sanding.
Heat	Anything emitting extreme heat.	Furnace operations, pouring, casting, hot dipping, and welding.
Chemicals	Splash, fumes, vapors, and irritating mists.	Acid and chemical handling, degreasing, plating.
Dust	Harmful Dust.	Woodworking, buffing, and general dusty conditions.
Optical Radiation	Radiant energy, glare, and intense light	Welding, torch-cutting, brazing, soldering, and laser work.

(The ILO is grateful to OSHA for the use of this quotation. It is 193 words long, so has been used under the convention of 'Fair Use' which allows a maximum of 400 words to be used without seeking formal permission.)

The following is a useful classification of eye and face protection equipment taken for the web site: http://www.ataltus.com/ppe/ppe-eyes-and-face.asp.

"Safety spectacles – can protect eyes from low energy impacts and depending on the lens characteristics glare, UV and IR radiation. The lenses are usually made of toughened glass or polycarbonate. They are available in a range of styles and most frames have possibilities for adjustment, so that they can be matched to the wearer. Most manufacturers can supply safety spectacles with prescription lenses, and some designs can be worn over prescription spectacles."

The spectacles below are light, adjustable and comfortable to wear.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

"Goggles – can protect eyes against medium impacts and depending on design and marking against droplets and coarse dust, as they form a seal around the entire periphery of the face. The lenses are usually made of anti-fog coated polycarbonate or toughened glass."

Photo: Richard Neale

"Face shields – Depending on design and markings they can protect eyes and face against medium or even high-energy impacts, liquid splash and hazards like molten metal splash or electric arcs etc. They usually have an adjustable headband or harness fitted with either a one-piece ear shield protecting the entire face, a metal mesh screen or an opaque shield into which lenses are fitted. There is a number of designs that integrate head, eye and respiratory protection in one unit.

The Construction OSH view of eye and face protection

Eyesight is an absolutely prime human sensory ability. Loss of sight can destroy the quality of a person's life, so all measures must be taken to protect it. As the examples above and below show, there is a range of reasonably priced items available and modern materials and design make them comfortable to wear, so there can be no reason for employers not to provide them and for employees to wear them.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

Protection for the eyes but not the ears
(Photo: Fiona Murie, BWI)

Protection against noise

From the Manual

If you are working at or near a noisy machine:

- *Ask if noise levels have been measured, and what those measurements are;*
- *Remember that noise which is continuous at a level of 85-90 decibels (dB(A)) or more is injurious to hearing;*
- *Ask for appropriate earmuffs or ear plugs if you work with or near a noisy machine and make sure they fit properly and are comfortable;*
- *Wear them all the time you are in a noisy part of the site;*
- *Keep your hearing protection clean and in a safe place when you are not using it;*
- *Insert ear plugs with clean hands;*
- *Look out for damage: if the earmuffs no longer fit properly or the seals have become hard or damaged, ask for a replacement.*

It is not true that ear protectors make it more difficult to understand speech or hear warning signals, as they reduce both unwanted noise and alarm signals equally; the signal can actually be heard more easily.

Point to remember

If you have to shout to make yourself heard by someone about 1m away there is a noise problem requiring action”

The Construction OSH view of protection against noise

Hearing is another vital human sense, so all efforts must be made to prevent noise form damaging the hearing of all those who are involved in a construction project. Furthermore, since many warnings from moving machinery are audible as well as visual, good hearing is necessary for people to heed the warning. Nevertheless, excessive noise from other machinery will drown out these warnings even for those with good hearing. So, both the level of noise and the effect on people within earshot must be considered.

Photo by Richard Neale

The photograph above shows good eye, ear and respiratory protection, but also illustrates the difficulty of wearing a safety helmet at the same time. Fortunately, some safety helmets have ear and eye protection built in, or are provided with additional fittings to allow them to be added, so providing the wearer with comprehensive protection in one item of PPE.

A good example of “all-in” design is shown below. This is a very strong helmet, the Kevlar fibes giving it great resilience and resistance to impact. The addition of the ear and eye protection provides the wearer with comprehensive protection for one item of PPE.

(Source: http://wesspur.com/safety/helmets.html. The ILO is grateful for permission to use these images and text)

Pacific Kevlar Helmet with Brim
Pacific kevlar helmets are made from hard resin with injected Kevlar fibers. 6 point webbing suspension and a ratchet adjustment at the back give it a customizable fit. This helmet is the most durable and long lasting helmet we have found. Available with attached face shield and/or ear muffs. Weighs approximately 1.2 lb.

Face Shield/ Ear Muff Kit
This kit offers ear and eye protection that snaps into standard hard hat and helmet attachment slots. Works with Vertex and Pacific helmets, and aluminum and plastic hard hats. Includes ear muffs, wire mesh visor, and visor sealer to keep out dust and rain.

Hand protection

From the Manual

"Hands are extremely vulnerable to accidental injury, and in construction more injuries are caused to hands and wrists than to any other part of the body. Open wounds, abrasions, fractures, dislocations, strains, amputations and burns occur. They are largely preventable by better manual handling techniques and equipment, and by wearing suitable hand protection such as protective gloves and gauntlets.

Among the common hazardous tasks where hand protection should be provided are:

- *Operations involving contact with rough, sharp or jagged surfaces;*
- *Contact with or splashes from hot, corrosive or toxic substances such as bitumen and resins;*
- *Working with vibratory machines such as pneumatic drills where some cushioning of the vibrations is desirable;*
- *Electrical work in humid and cold weather.*

Skin trouble is common in the construction industry. Contact dermatitis is the commonest type of skin disease. It feels itchy and looks red, scaly and cracked, and can become so bad that it affects your ability to continue working. Wet cement is one of the main skin hazards, but other substances include tar and pitch, which can cause skin cancer after prolonged exposure, paint thinners, acids for masonry cleaning and epoxy resins. In addition to gloves, use barrier creams and wear long-sleeved shirts, full-length trousers and rubber boots."

The Construction OSH view of hand protection

Gloves are one of the cheapest and most obvious items of PPE yet they can serve an important function in OS&H. Nevertheless, many workers are not supplied with gloves so they have to work with their bare hands.

The photograph below shows a worker making concrete blocks in a simple manual process. He is in close and continual contact with concrete and cement, a highly corrosive material to human skin. He should be wearing waterproof gloves. In addition, although his face has been obscured so that he cannot be recognised, he was not wearing safety glasses, which would have protected his eyes from the cement.

(Photo: Richard Neale. "Professional development for the field staff of UNRWA". International Labour Office, Geneva, 1993. ISBN 92-2-108972-X.)

Some examples of protective gloves are shown below:

1 Lightweight fabric gloves with hard-wearing plastic palms. They can be used even for work that requires dexterity, such as bricklaying.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

2 Heavier fabric gloves with plastic palms for more rugged use.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

3 Fully coated, waterproof gloves for rugged use in wet conditions or with materials such as concrete.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

4 Heavy duty leather gloves for steel fixing and similar work

(Photo: Fiona Murie, BWI)

Further examples can be seen on the web site of "Protec":
http://www.protecdirect.co.uk/Hand-Protection/Builders-Grip-Gloves.htm

Footwear

From the Manual

"Foot injuries fall into two broad types: those due to penetration of the sole by nails which have not been knocked down or removed, and those due to crushing by falling materials, which can be minimized by wearing protective footwear. The type of safety shoes or boots to be used will depend on the nature of the work (e.g. the presence of ground water on construction sites), but all safety footwear should have an impenetrable sole and uppers with a steel toe-cap.

There are many types of safety footwear now available such as:

- *lightweight, low-cut leather safety shoes for climbing jobs;*
- *normal safety shoes or boots for heavy-duty work;*
- *rubber or plastic safety wellingtons or gumboots which provide protection against corrosive substances, chemicals and water."*

The Construction OSH view of footwear

(Photo: Richard Neale. "Professional development for the field staff of UNRWA". International Labour Office, Geneva, 1993. ISBN 92-2-108972-X.)

The photo above shows how necessary it is to wear protective footwear even for simple tasks. The column cramps are quite heavy and could cause broken bones in the feet if dropped on them.

(Photo: Fiona Murie, BWI)

A lovely photograph of a hod carrier but she is wearing footwear that is totally unsuitable for working on a construction site. But can she get safety footwear in her size? And if she could, would she be happy to wear footwear that has essentially been designed for men?

The photograph below shows three examples of safety boots. There are two main requirements of a safety boot: resistant to crushing and penetration through the sole. They may also be resistant to heat and/or chemicals. Boots should have labels to identify their specification.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

Waterproof and conspicuously visible clothing ('hi-viz')

Clause 18.2.1 of the ILO Code requires:

(h) waterproof clothing and head coverings when working in adverse weather conditions;

and

(k) distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure to danger from moving vehicles

Provision of waterproof clothing makes economic sense to the employer because it allows work to continue in wet conditions (assuming of course that workers are not forced to work in these conditions without protective clothing). Modern fabrics 'breathe' so allowing moisture to escape and avoid condensation. Modern fabrics are also light and strong, so they are much easier to work in than those available a couple of decades ago.

Modern waterproof clothing is also usually high visibility ('hi-viz). An example is shown below. This is a very comfortable, warm and weatherproof jacket. It is in hi-viz yellow with additional hi-viz reflective bands. It is also relatively cheap.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

The example below shows a lightweight hi-viz waistcoat for use in warm weather.

Photo: Richard Neale.
PPE provided by S&M, Cardiff, UK; www.sandmdecorating.co.uk

Happy to be visible!
(Photo: Fiona Murie, BWI)

Respiratory equipment

From the Manual

"On construction sites there are often tasks where harmful dust, mist or gas may be present, such as:

- *rock crushing and handling;*
- *sandblasting;*
- *dismantling buildings containing asbestos insulation;*
- *welding or cutting materials with coatings containing zinc, lead, nickel or cadmium;*
- *paint spraying;*
- *blasting*

Whenever there is doubt about the presence of toxic substances in the atmosphere, a respirator must be worn. The correct type of respirator will depend upon the hazard and the work conditions, and you need to be trained in its use, cleaning and maintenance. Advice on suitable types of respirator and filter should be sought from appropriate safety and health authorities.

The simplest masks are disposable paper types. Remember that these are only effective against nuisance dusts.

There are three types of half-face masks with filters:

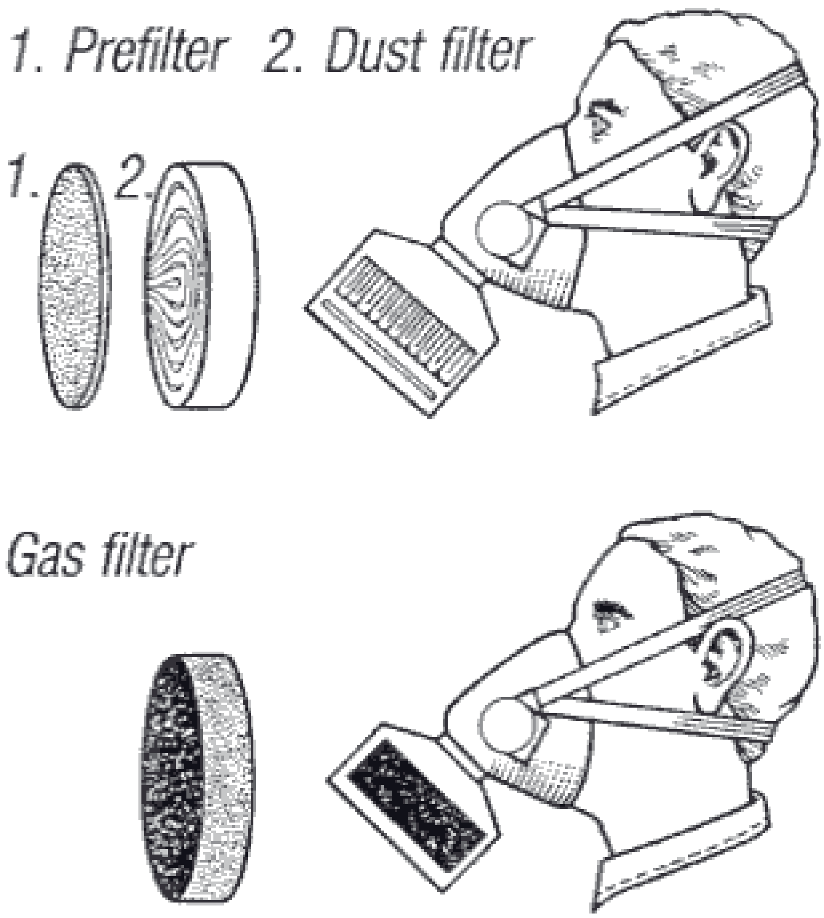
- *for protection against airborne particles, e.g. stone dust, with a coarse filter fitted in the cartridge (note, these filters have a specific lifetime and should be changed as necessary);*

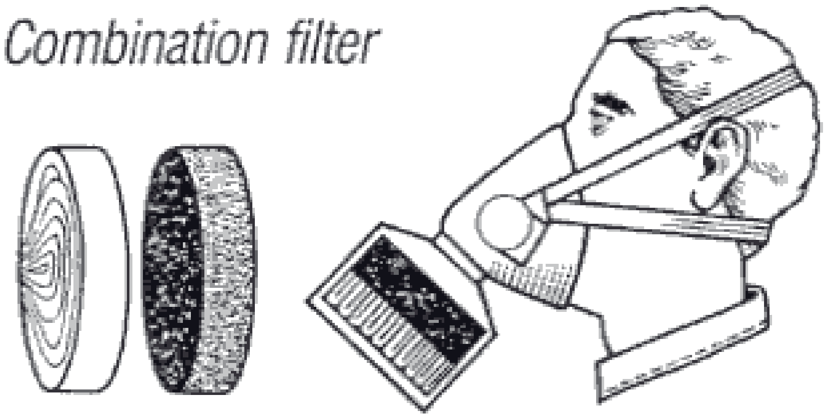
- *for protection against gases and fumes, e.g. when using paints containing solvents, with a filter containing activated carbon;*

- *a combination filter containing both a dust and a gas filter. Cartridges must be replaced regularly.*

A full-face mask can be fitted with the same types of filter, and it also protects the eyes and face."

Three types of half-face mask with filters





Eye and respiratory protection, but no hearing or hand protection
(Photo: Fiona Murie, BWI)

5 HARNESSES AND SIMILAR DEVICES

From the Manual

"The majority of fatal accidents in construction are due to falls from heights. Where work cannot be done from a scaffold or ladder, or from a mobile access platform, the wearing of a safety harness may be the only way to prevent serious injury or death.

Another common situation in which a safety harness may be used – sometimes supplemented by the use of a safety net – is maintenance work on steel structures such as bridges and pylons.

There are many types of safety belt and safety harness available. The manufacturer or supplier should be asked for advice on suitable types for the intended purpose and for instructions on use and maintenance. A full safety harness should always be used in preference to a safety belt.

A safety harness and its lanyard must:

- *limit your fall to a drop of not more than 2m by means of an inertia device;*
- *be strong enough to support your weight;*
- *be attached to a strong structure through a firm anchorage point above the place at which you are working."*

Point to remember

Make a habit of using the safety harness provided"

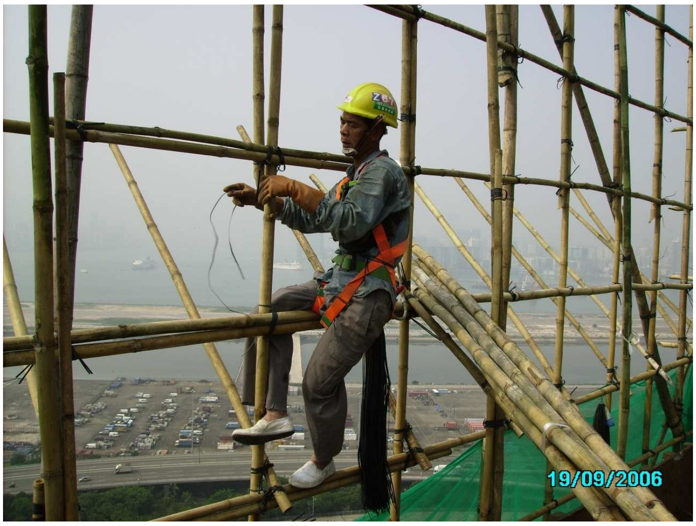
From the Code

18.2.1. Where necessary, workers should be provided with and wear the following personal protective equipment and protective clothing:

(i) safety harnesses with independently secured lifelines where protection against falls cannot be provided by other appropriate means;

The Construction OSH view of safety harnesses

An example of the use of a harness is shown below, although this remains a highly dangerous operation. Note also: helmet with chin-strap and gloves.



"Hong Kong's bamboo scaffolders continue to work at ever-increasing heights – but they now have to follow government safety codes and design guidelines"

[From the paper "Hong Kong-bastion of bamboo scaffolding", by M Ramanathan, Proceedings of ICE-Civil Engineering, Volume: 161, Issue: 4, November 2008.

Photograph by the author of the paper, Muthukaruppan Ramanathan}

A huge range of safety harnesses (sometimes called 'fall arresters') is available and expert advice is required to select the most suitable. A typical example is shown in the photographs below.

(Photo: Fiona Murie, BWI)

(Photo: Fiona Murie, BWI)

6 LIFTING AND HANDLING DEVICES

From the Manual

"Almost one-quarter of work injuries occur during manual handling, most of which are strains to the hands, legs, feet and back. Much construction work involves heavy manual labour and workers not in good physical condition tire easily and are more susceptible to injury."

The Manual provides very good detailed advice on lifting and carrying.

Point to remember

Correct lifting and carrying calls for training and practice

There is also a good example of a lifting and carrying device in Module Summary 8: "Welfare and project site".

7 SPECIFIC CHARACTERISTICS OF INDIVIDUALS

One of the most significant impediments to the widespread use of PPE is that it is not generally available in a sufficiently large range of sizes and is not generally adapted to fit women's bodies. Most of it seems to have been designed for quite sturdy males, whereas in many countries of the world males can be quite lightly built. Women have special difficulties, as is shown in the following passage from a study by OSHA (osha.gov) in the USA: Women in the Construction Workplace: Providing Equitable Safety and Health Protection.

Many women in non-traditional jobs, such as the construction trades, complain of ill-fitting personal protective clothing (PPC) and equipment (PPE). Clothing or equipment that is not sized, or does not fit properly can compromise personal safety. It may also not function effectively in the manner for which it was designed.

Poor fit compromises the protection offered by the garment or equipment. The lack of appropriate PPC and PPE can cause serious safety and health risks for women, and men of smaller sizes, who rely on protective clothing and equipment to help them keep safe. Having inadequate or ill-fitting clothing, boots, gloves, or safety equipment presents a safety hazard for any worker.

Studies by NIOSH and the U.S. Department of the Army found that most tools, equipment, and clothing are not designed for a women's physique. When asked if they could easily find protective clothing to fit, 46% of women in the second NIOSH study said "no" with respect to work shoes and 41% with respect to finding work gloves. One survey of manufacturers of protective equipment, taken at a National Safety Council Annual meeting, found that only 14% offered ear, head, and face protection in women's sizes. The highest percentage, 59%, was manufacturers who offered foot protection in women's sizes.

Ill-fitting personal protective equipment may be due to unavailability (i.e., manufacturers don't make or distributors don't stock), limited availability, or lack of knowledge among employers and workers about where equipment designed for a woman's body structure can be obtained. Personal protective equipment intended for use by women workers should be based upon female anthropometric (body measurement) data.

A recent NIOSH review found that few tools, equipment, or clothing are designed for a woman's physique. A recent study commissioned for the U.S. Army had similar findings.

"Most of the personal protective equipment and tools used worldwide are designed based on male populations from Germany and the United States. Significant variability exists among these two working populations and those from other countries; this means that many workers cannot perform their duties adequately. Women workers and those workers who are not in the upper levels of height and weight, as for example Asian workers, are therefore not properly equipped for their protection."

Source: Information Note on Women Workers and Gender Issues on Occupational Safety and Health (http://www.ilo.org/public/english/protection/safework/gender/womenwk.htm#intro)

(The ILO is grateful to OSHA for the use of this quotation. It is 369 words long, so has been used under the convention of 'Fair Use' which allows a maximum of 400 words to be used without seeking formal permission.)

This quotation illustrates that a major problem with currently available PPE is that most of it seems to have been designed for quite strongly built males. Smaller people are not well provided for; to give an example, safety boots size Eu 36 are difficult to obtain, and available safety clothing and especially safety harnesses are often unsuitable for women's physique.

8 SUMMARY PHOTOS OF SAFE WORKING

The picture below shows a worker properly provided with PPE: helmet, boots, gloves and hi-viz waterproof clothes, using handling equipment to move a heavy concrete paving slab. The public and workforce are separated by a substantial fence.

Worker paving a street in Cardiff UK
(Photo: Richard Neale. Skanska is the contractor)

A group of well-equipped workers
(Photo: Fiona Murie, BWI)

Must wear PPE!
(Photo: Fiona Murie, BWI)

9 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

J: GENERAL PLANT & EQUIPMENT

(Photo: Richard Neale, permission given by operators)

Summary of content	
1.	Preface
2.	Common hazards with general plant and equipment
3.	General construction plant and equipment
4.	Hand tools
5.	Scaffolding materials and equipment
6.	Temporary works for concrete and steel
7.	Trench support and excavation equipment
8.	Fire prevention and control equipment
9.	Electricity
10.	Brief bibliography

1 PREFACE

Most of this Module is relevant to those who purchase, install, maintain and inspect plant and equipment, rather than those who use it in the construction process. The use of the plant and equipment is described in Module Summaries: K "Vertical movement", L Horizontal movement", M "Working at or below ground level" and N "Working at height".

OS&H and construction plant and equipment has to be considered within the overall context of a construction project. The following is a good example, taken from a project in Australia, the Pacific Highway, Karuah to Bulahdelah sections 2 and 3 (http://www.k2b.abigroup.com.au/html/safety_b.html). The ILO is very grateful to the RTA for permission to use this example.

"The Pacific Highway Upgrade Program is one of the largest infrastructure projects in New South Wales (NSW) history. From the F3 Freeway to the Queensland border, the NSW State and Federal governments are working together to build a safer and better highway. Accident-prone sections are being replaced with median-separated dual carriageways, and sections with major traffic congestion are gradually being improved. The RTA is managing the program with a view to achieving a balance between social, ecological, engineering and cost factors, while providing adequately for the future transport needs of highway users and NSW central coast communities.

Occupational health and safety is a primary consideration in the planning and organisation of the project's operations.

The project involves many different activities from earthworks to bridges and encompasses road users, workers and residents. By identifying the potential major hazards associated with the different activities on site, it is possible to reduce the risk of injury to employees, public and damage to equipment. Strategies include:

- *To plan each stage of the project with safe working as one of the primary objectives.*
- *To ensure the appropriate equipment is used for each operation including the provision of protective clothing.*
- *To encourage everyone to work together in developing and maintaining safety.*
- *To provide adequate training and instruction.*
- *To ensure adequate supervision.*
- *To maintain adequate records and undertake full accident investigations.*
- *To provide full feedback information to all participants.*

Hazards identified for the project include:

- *Construction plant (large machines and continuous activity).*
- *Existing services (high voltage, fibre optic cable, etc).*
- *Piling (large cranes, heavy materials).*
- *Bridge construction.*
- *Terrain (steep slopes).*
- *Adjacent traffic on public roads, including intersections.*
- *The mixing of construction plant and traffic.*
- *Working at heights.*

Risk management is integral to the project and its evaluation and assessment play a significant role. Detailed processes require each major activity and sub-activity associated with the works to be given a risk rating. This is the catalyst for the subsequent development of safe work procedures which are documented on job hazard analysis (JHA) worksheets. Regular training is provided to give work crews and supervisors help in the development and understanding of these worksheets and risk management.”

This Module Summary follows the relevant structure and content of the “ILO Code of Practice: Safety & health in construction” (the “Code”). The following passage is taken from this Code:

“1. General provisions

1.1. Objective

1.1.1. The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

> *(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;*
>
> *(b) ensuring appropriate design and implementation of construction projects;*
>
> *(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.*

1.1.2. This code also provides guidance in the implementation of the provisions of the Safety and Health in Construction Convention, 1988 (No. 167), and the Safety and Health in Construction Recommendation, 1988 (No. 175).”

Other passages from this Code are included in this Module Summary, and they are shown in the same format as above.

This Module Summary also includes extracts from the ILO’s “Safety, health and welfare on construction sites: A training manual” (“The Manual”).

A brief bibliography is given at the end of this Module Summary.

This Module Summary follows the sections shown in the table above.

2 COMMON HAZARDS WITH GENERAL PLANT AND EQUIPMENT

Modern construction plant and equipment should create no hazards for anyone on a construction project. Many of the hazards which do arise have the following causes:

- Poor mechanical design (breaks in use, not powerful enough, components fracture or malfunction)
- Poor functional design (not properly designed for the stated purpose)
- Misuse (not used as designed)
- Used in the wrong circumstances (e.g. ground collapses under a crane)
- Poor maintenance (breaks or emits noxious gases)

These can cause the following hazards:

- Falling machinery or parts of machinery
- Crushing due to impact of moving or toppling plant and equipment
- Falling from plant and equipment
- Limbs or bodies caught in machinery
- Physiological damage through vibration
- Poor ergonomics
- Physiological and psychological damage through repetitive work
- Stress caused by poor environment (noise, heat, poor ventilation, chemicals, noxious gases)

These are, of course, just some of the main hazards; there are many more which are specific to particular projects.

3 GENERAL CONSTRUCTION PLANT AND EQUIPMENT

Moving plant and equipment

6.1.1. All vehicles and earth-moving or materials-handling equipment should:

> *(a) be of good design and construction taking into account as far as possible ergonomic principles, particularly with reference to the seat;*

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

(b) be maintained in good working order;

6.1.9. Where appropriate, earth-moving or materials-handling equipment should be fitted with structures designed to protect the operator from being crushed, should the machine overturn, or from falling material.

"Roll Over Protection System or ROPS are designed and fitted to machinery which on overturning would reduce the possibility of an operator from being crushed, provided the operator was wearing a seat belt. The following points must be taken into account when operating plant with a Roll Over Protection System.

Ensure that seat belts are worn in conjunction with ROPS protection; otherwise there is a risk that the driver may be crushed by the ROPS bar as he or she is thrown from the vehicle."

(Photo and text from "Use of Mobile Machinery on Construction Sites" Published June 2008 by Health and Safety Authority, James Joyce Street, Dublin 1, Ireland. http://www.hsa.ie. The ILO is very grateful for permission to use this information)

6.1.10. All vehicles and earth-moving or materials-handling equipment should be provided with a plate or the like indicating:

(a) the gross laden weight;

(b) the maximum axle weight or, in the case of caterpillar equipment, ground pressure;

(c) the tare weight.

6.1.11. All vehicles and earth-moving or materials-handling equipment should be equipped with:

(a) an electrically operated acoustic signalling device;

(b) searchlights for forward and backward movement;

(c) power and hand brakes;

(d) tail lights;

(e) silencers;

(f) a reversing alarm.

The following table is taken from “Use of Mobile Machinery on Construction Sites” Published June 2008 by Health and Safety Authority, James Joyce Street, Dublin 1, Ireland. The ILO is grateful for permission to use this table and other quotations from this Authority.

The Authority’s web site http://www.hsa.ie/eng/Publications_and_Forms/Publications provides some excellent information and much of it can be downloaded freely.

Safety Devices

Auxiliary Devices / Visual Aids

Where an operator's view is restricted from his position in the driver's seat auxiliary devices / visual aids (as listed below) must be installed unless a risk assessment shows that they are not required. The purpose of these auxiliary devices and visual aids is to allow vision from the driver's seat of all points more than 1 meter high and 1 meter from the machine at each side and at the rear of the driver. Auxiliary devices also give warning to persons who maybe in the vicinity of mobile plant & machinery.

Table 2-Abbreviated Schedule 6

Machine type	Reversing & visual aids required	Machine type	Reversing & visual aids required
Off-road dump trucks (Trailer to rear of driver) > 7 tonnes	Reversing alarm and flashing beacon with CCTV or convex mirrors or a combination of both	Scrapers	Reversing alarm and flashing beacon with CCTV or convex mirrors or a combination of both
Dumpers (front tip) no cab	Reversing alarm and flashing beacon	All tracked type tractors (bulldozers)	Reversing alarm and flashing beacon with CCTV or convex mirrors or a combination of both
Dumpers (front tip) with cab	Convex mirrors; reversing alarm and flashing beacon	Graders	CCTV, convex mirrors, reversing alarm and flashing beacon
Wheel Loaders (loading shovels), including skid steer loaders	Reversing alarm and flashing beacon with CCTV or convex mirrors or a combination of both	Telescopic Handlers	Reversing alarm and flashing beacon with CCTV or convex mirrors or a combination of both
Backhoe Loaders	Convex mirrors; reversing alarm and flashing beacon	Compactors / rollers without cab and seat to rear	Reversing alarm & flashing beacon
All 360° excavators	Movement alarm and flashing beacon with CCTV or convex mirrors or a combination of both to allow vision from drivers seat (without slewing)	Compactors / rollers with cab and seat to rear	Convex mirrors; reversing alarm and flashing beacon

6.1.12. Operators of vehicles and earth-moving or materials-handling equipment should be adequately protected against the weather or accidents due to impact, crushing or contact with a moving load by a cab:

(a) which is designed and constructed in accordance with ergonomic principles and provides full protection from adverse weather conditions;

(b) which is fully enclosed where dusty conditions are likely to be encountered;

(c) which provides the driver with a clear and unrestricted view of the area of operation;

(d) which is equipped with a direction indicator and a rear-view mirror on both sides.

6.1.13. The cab of vehicles and earth-moving or materials-handling equipment should be kept at least 1m from a face being excavated.

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

6.1.15. On earth-moving and materials-handling equipment, motors, brakes, steering gear, chassis, blades, blade-holders, tracks, wire ropes, sheaves, hydraulic mechanisms, transmissions, bolts and other parts on which safety depends should be inspected daily.

6.1.17. Deck plates and steps of vehicles and equipment should be kept free from oil, grease, mud or other slippery substances.

Power shovels and excavators

6.2.2. Brake pedals for all motions on power shovels should have two independent locking devices.

6.2.3. Power shovels should be equipped with an emergency quick-acting stop device independent of the controls.

6.2.4. Excavators that are equipped with a unit for deep digging should either be so designed that the bucket teeth cannot come nearer the boom than 40cm or be provided with a reliable stop that prevents this from happening.

6.2.5. Excavators that are designed to be used for lifting with lifting gear should be provided with a plate in the cabin and on the boom bearing a clearly legible and durable text giving the maximum safe working load of the lifting gear fitted.

6.2.6. Excavators that are equipped for use as mobile cranes should:

> *(a) be examined and tested in accordance with national laws and regulations for mobile cranes;*
>
> *(b) be fitted with an automatic safe working load indicator, when practicable.*

(Image: http://www.cpa.uk.net/data/uploads/public/CIG%200801%20Excavators%20Used%20as%20Cranes-Rev%202-%20March%202009.pdf)

Note that great care must be taken when using excavators as mobile cranes. They have, generally, not been designed as cranes and have very different operating characteristics. For a full explanation see “UK CPA Guidance on Lifting Operations in Construction When Using Excavators”, available from the cpa web site given above. Under no circumstances should they be used for lifting people, their operating characteristics make this extremely dangerous. The ILO is very grateful to the CPA for permission to use the image above.

6.2.18. While work is being done on hydraulically operated buckets the piston should be fully drawn back in the hydraulic cylinder, and where necessary props provided.

Pavers

Pavers are very complex items of machinery and require great skill to maintain safely. All those involved must be properly and thoroughly trained.

(Photo: Richard Neale. Permission given by the operator)

6.6.1. Pavers should be equipped with guards that prevent workers from walking under the skip.

Note also that health hazards may occur from breathing the fumes from the asphalt, to which operators are especially exposed because they sit over the hot asphalt. Their health should be monitored regularly and carefully.

Lifting appliances and gear

(Image: http://www.cpa.uk.net. The ILO is very grateful to the cpa for permission to use this image)

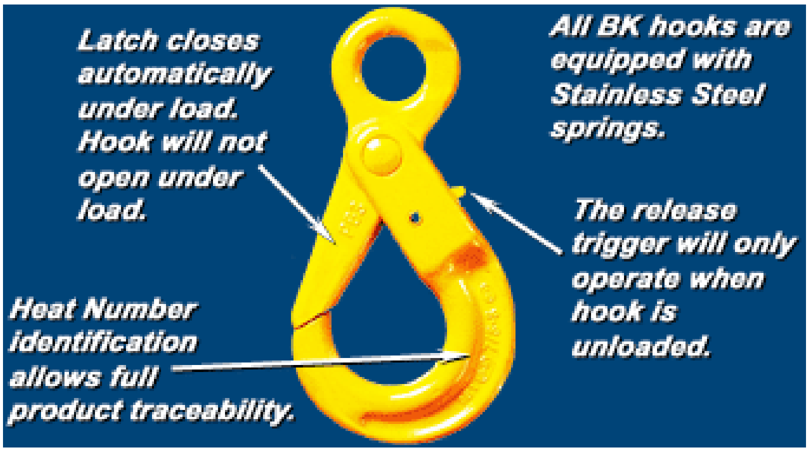
5.1.1. Employers should have a well-planned safety programme to ensure that all the lifting appliances and lifting gear are selected, installed, examined, tested, maintained, operated and dismantled:

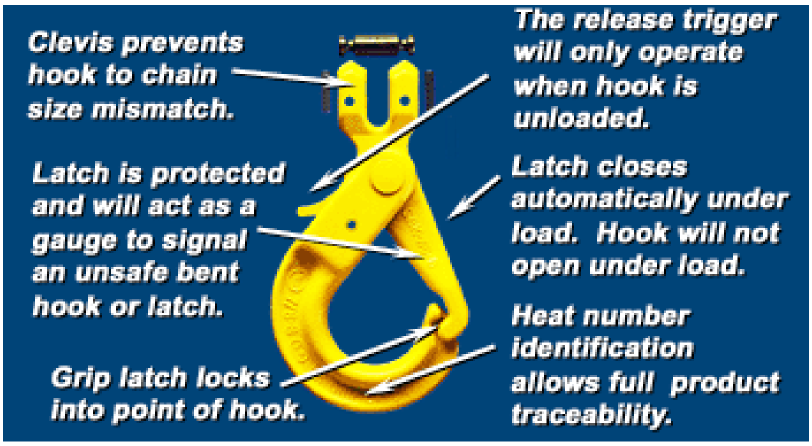
(a) with a view to preventing the occurrence of any accident;

(b) in accordance with the requirements laid down in the national laws, regulations and standards.

5.1.2. Every lifting appliance, including its constituent elements, attachments, anchorages and supports should be of good design and construction, of sound material and have adequate strength for the purpose for which it is used.

All cranes should be fitted with a safety hook designed to prevent accidental dislodgement of the load if it fouls something or meets an obstruction during the lift. There is a range of different safety hooks, each with its specific characteristics.





[Images from http://meerholz.ca. The ILO is very grateful to Meerholz for permission to use these images.]

5.1.3. Every lifting appliance and every item of lifting gear should be accompanied at the time of purchase with instructions for use and with a test certificate from a competent person or a guarantee of conformity with national laws and regulations concerning:

> *(a) the maximum safe working load;*
>
> *(b) safe working loads at different radii if the lifting appliance has a variable radius;*
>
> *(c) the conditions of use under which the maximum or variable safe working loads can be lifted or lowered.*

5.1.4. Every lifting appliance and every item of lifting gear having a single safe working load should be clearly marked at a conspicuous place with the maximum safe working load in accordance with national laws and regulations.

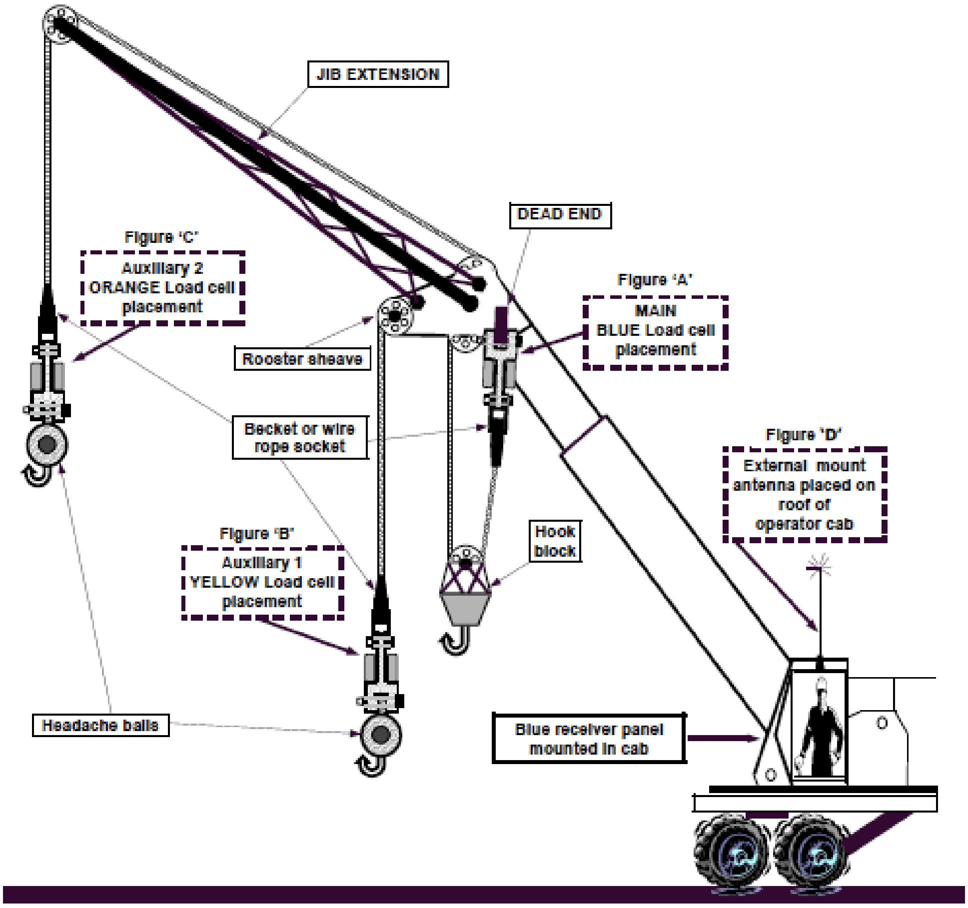
5.1.5. Every lifting appliance having a variable safe working load should be fitted with a load indicator or other effective means to indicate clearly to the driver each maximum safe working load and the conditions under which it is applicable.

Modern load sensors provide a very good and reliable means of informing the user of the weight about to be lifted and provide clear warning when the safe load is about to be exceeded. The most modern are wireless, so eliminating the work of wiring the indicators into the lifting appliance, and also eliminating subsequent risks of damage and corrosion. There is no excuse therefore for 'accidents' when lifting excessive loads.

An example of a modern load monitoring system, by Cranesmart (http://www.cranesmart.com) is shown below. This is a very helpful company and their web site provides some very useful information.

777 Multi-line load cell installation and placement guide for load cell links

Figure 'A' - Pin the **BLUE** load cell between the wire rope socket (becket) and the dead end on the main boom of the crane. **>MAIN<**
Figure 'B'- Pin the **YELLOW** load cell between the wire rope socket (becket) and the headache ball on the auxiliary sheave (rooster) on the cranes boom tip. **>AUX 1<** (Note: for two line load systems only)
Figure 'C'- Pin the **ORANGE** load cell between the wire rope socket (becket) and the headache ball on the jib extension. **>AUX 2<** (Note: for three line load systems only)
Figure 'D' - Location of external magnetic mount antenna on operator cab of crane.



All the information from the load cells comes to the driver on one device, giving clear and useful information:

5.1.6. All lifting appliances should be adequately and securely supported; the weight-bearing characteristics of the ground on which the lifting appliance is to operate should be surveyed in advance of use.

5.1.7. Fixed lifting appliances should be installed:

(a) by competent persons;

(b) so that they cannot be displaced by the load, vibration or other influences;

(c) so that the operator is not exposed to danger from loads, ropes or drums;

(d) so that the operator can either see over the zone of operations or communicate with all loading and unloading points by telephone, signals or other adequate means.

5.1.9. The strength and stability of lifting appliances should take into account the effect of any wind forces to which they may be exposed.

5.1.10. No structural alterations or repairs should be made to any part of a lifting appliance which may affect the safety of the appliance without the permission and supervision of the competent person.

5.1.11. Lifting appliances and items of lifting gear, as prescribed by national laws or regulations, should be examined and tested by a competent person:

(a) before being taken into use for the first time;

(b) after erection on a site;

(c) subsequently at intervals prescribed by national laws and regulations;

(d) after any substantial alteration or repair.

5.1.12. The manner in which the examinations and tests are to be carried out by the competent person and the test loads to be applied for different types of lifting appliances and lifting gear should be in accordance with national laws and regulations.

5.1.13. The results of the examinations and tests on lifting appliances and lifting gear should be recorded in prescribed forms and, in conformity with national laws and regulations, made available to the competent authority and to employers and workers or their representatives.

5.1.14. Controls of lifting appliances should be:

(a) designed and constructed as far as possible in accordance with ergonomic principles;

(b) conveniently situated with ample room for operation and an unrestricted view for the operator;

(c) provided, where necessary, with a suitable locking device to prevent accidental movement or displacement;

(d) in a position free from danger from the passage of the load;

(e) clearly marked to show their purpose and method of operation.

5.1.15. Lifting appliances should be equipped with devices that would prevent the load from over-running and prevent the load from moving if power fails.

5.1.16. The operator of every lifting appliance used outdoors except those used for short periods should be provided with:

(a) a safe cabin with full protection from weather and adverse climatic conditions, and designed and constructed in accordance with ergonomic principles;

(b) a clear and unrestricted view of the area of operation;

(c) safe access to and egress from the cabin, including situations where the operator is taken ill.

An example is shown below.

(Photo: Robert Carr. http://myconstructionphotos.smugmug.com)

Concrete work equipment

7.9.1. Concrete mixers should be protected by side railings to prevent workers from passing under the skip while it is raised.

7.9.2. Hoppers into which a person could fall, and revolving blades of trough or batch-type mixers, should be adequately guarded by grating.

7.9.3. In addition to the operating brake, skips of concrete mixers should be provided with a device or devices by which they can be securely blocked when raised.

7.9.4. While the drum of a concrete mixer is being cleaned, adequate precautions should be taken to protect the workers inside by locking switches open, removing fuses or otherwise cutting off the power.

(Photo: Richard Neale. Project in Dar es Salaam)

7.9.5. Concrete buckets for use with cranes and aerial cableways should be free as far as practicable from projections from which accumulations of concrete could fall.

[Source of image: www.elcosh.org/images. The ILO is grateful for the use of this image]

"No fall protection, no tag line on cement hopper"

7.9.9. Concrete bucket towers and masts with pouring gutters or conveyor belts should:

(a) be erected by competent persons;

(b) be inspected daily.

7.9.12. Guides for the bucket should be correctly aligned and so maintained as to prevent the bucket from jamming in the tower.

Pressure plant

Hazards from pressure plant are powerfully illustrated by the incident reported on the following web page:
http://www.nytimes.com/1988/04/27/nyregion/4-hurt-in-air-compressor-explosion-at-manhattan-construction-site.html

****

“Four Hurt in Air Compressor Explosion at Manhattan Construction Site

Three pedestrians and a construction worker were injured yesterday when an air compressor hose exploded at a construction site on the Avenue of the Americas, hurling debris into the street and starting a small fire.

New York City officials said the accident was the second one involving such a compressor in less than a month, and they ordered an immediate inspection of all similar machines in use throughout the city. The trailer-like compressors, which power pneumatic tools through a network of air hoses, are typically parked at curbside near city construction sites, placing them close to sidewalk crowds.

''The machinery is a type commonly used during excavation and other foundation work,'' said the city's Commissioner of Buildings, Charles M. Smith Jr. ''Starting tomorrow, we're going to inventory all of the construction sites in the foundation and excavation stage where this kind of heavy compressor would be used, and ask the construction company or their lessors to inspect the equipment.''

Mr. Smith said a hose carrying air from the compressor burst about 10 feet from the diesel-powered compressor.

''The rupture of the hose sent out a concussion wave that spread to the other side of the street, knocking down pedestrians,'' Mr. Smith said. ''The hose itself was blown to pieces, and one of the fragments struck a pedestrian.''

A police spokesman, Detective Vincent Jones, said the explosion had ignited some nearby diesel fuel, causing a fire.

Although city investigators had not yet completed an examination of the machine, Mr. Smith said the rupture had apparently resulted from a sudden increase in pressure or a flaw in the hose, which was made of a hard composition rubber lining reinforced by wire strands and covered by a fiber shell.

City investigators found no safety violations in the operation of the machine, and no summonses were issued, Mr. Smith said.”

****

(The extract above is 316 words long, which is less than 400 words and so it is reproduced under the convention of “fair use”)

7.10.1. Pressure plant and equipment should be examined, tested and issued with a certificate by a competent person in cases and at times prescribed by national laws or regulations.

7.10.2. National laws or regulations should be laid down and enforced as regards the materials, design, construction, installation, inspection, testing, maintenance and operation of steam boilers and other pressure plant as necessary.

[Source of image: www.elcosh.org/images. The ILO is grateful for the use of this image]

“Workers are using respiratory protection. Exposure levels would be reduced if they were using jackhammers and compressors that reduced noise and silica dust levels.”

7.10.4. Compressors should be equipped with:

(a) automatic devices that will prevent the maximum safe discharge pressure from being exceeded;

(b) a quick-release valve;

(c) suitable arrangements for preventing contamination where persons are working in confined spaces.

7.10.5. Compressors in which explosive mixtures of gas may form should be protected against sparking.

7.10.6. Where compressor cylinders are equipped with water-cooling jackets it should be possible to observe the water flow.

7.10.7. Intercoolers and aftercoolers should be able to withstand safely the maximum pressure in the air-discharge piping.

7.10.8. Where necessary to prevent danger, air-discharge piping of compressors should be provided with:

(a) a fusible plug;

(b) insulating covers to protect workers against burns, and to prevent fire risks.

7.10.9. Where necessary to prevent danger, an oil separator should be provided between the compressor and the air receiver.

7.10.10. Where stop valves are installed in air-discharge piping:

(a) they should be easily accessible for inspection and cleaning;

(b) one or more safety valves should be installed between the compressor and the stop valve.

7.10.11. All working parts, including speed governors, safety valves and oil separators, should be inspected and cleaned at suitable intervals.

7.10.12. Air receivers should be equipped with:

(a) a safety valve;

(b) a pressure gauge;

(c) a drain cock.

7.10.13. Air receivers should be provided with suitable openings for inspection and cleaning.

7.10.14. Air receivers should be examined and tested at appropriate intervals by a competent person.

7.10.15. The safe working pressure should be marked in a distinctive colour on the pressure gauge.

7.10.16. Where necessary to prevent danger, a pressure-reducing valve or a stop valve, or both, should be inserted in the piping between the air receiver and the compressor.

7.10.17. Between the receiver and each consuming appliance there should be a stop valve.

7.10.18. Cylinders for compressed, dissolved or liquefied gases should be properly constructed with sound material, fitted with appropriate safety devices in accordance with national laws or regulations, inspected and tested by a competent person as prescribed and stored, transported, handled and used in conformity with the prescribed safety measures.

Power generators

7.13.1. Power generators should meet national laws and regulations for safe and reliable operation.

7.13.2. Power generators should be rated to meet the maximum anticipated load.

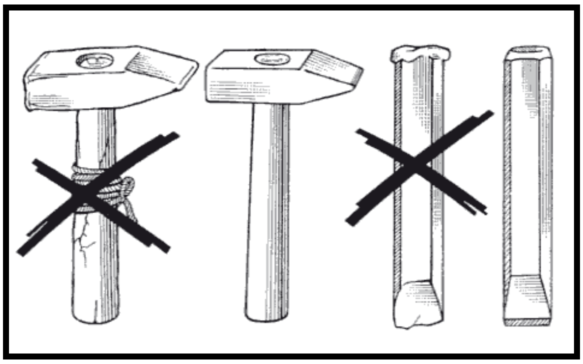
7.13.3. Power generators should be located in enclosed and properly ventilated areas.

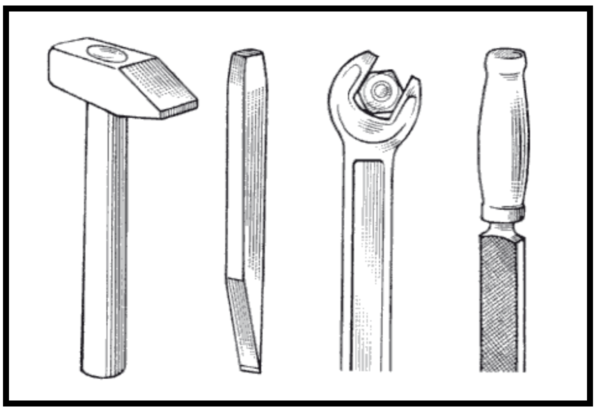
7.13.4. Power generators should be provided with an overriding power switch to avoid accidental remote starting during maintenance.

7.13.5. Power generators should be provided with adequate silencers and exhaust piping.

7.13.6. When located near workers' accommodation, power generators should be housed in a concrete room or properly insulated area in accordance with national laws and regulations to minimise noise disturbance

4 HAND TOOLS





The following organisation offers a downloadable information sheet which provides an excellent introduction to the choice and use of hand tools:

The Center for Construction Research and Training (www.cpwr): "Choosing Safer Hand Tools in Construction". Also on this web site are some excellent images, which can be freely downloaded: see http://www.elcosh.org/images/

Small tools

7.2.1. Hand tools and implements should be tempered, dressed and repaired by competent persons.

7.2.2. The cutting edges of cutting tools should be kept sharp.

7.2.3. Heads of hammers and other shock tools should be dressed or ground to a suitable radius on the edge as soon as they begin to mushroom or crack.

7.2.4. When not in use and while being carried or transported sharp tools should be kept in sheaths, shields, chests or other suitable containers.

7.2.5. Only insulated or non-conducting tools should be used on or near live electrical installations if there is any risk of electrical shock.

7.2.6. Only non-sparking tools should be used near or in the presence of flammable or explosive dusts or vapours.

Pneumatic tools

7.3.1. Operating triggers on portable pneumatic tools should be:

> *(a) so placed as to minimise the risk of accidental starting of the machine;*
>
> *(b) so arranged as to close the air inlet valve automatically when the pressure of the operator's hand is removed.*

7.3.2. Hose and hose connections for compressed-air supply to portable pneumatic tools should be:

> *(a) designed for the pressure and service for which they are intended;*
>
> *(b) fastened securely to the pipe outlet and equipped with a safety chain, as appropriate.*

7.3.3. Pneumatic shock tools should be equipped with safety clips or retainers to prevent dies and tools from being accidentally expelled from the barrel.

7.3.4. Pneumatic tools should be disconnected from power and the pressure in hose lines released before any adjustments or repairs are made.

Cartridge-operated tools

7.4.1. Whenever practicable, a low-velocity tool should be used.

7.4.2. Cartridge-operated tools should have:

> *(a) a guard or protective shield that cannot be removed without rendering the tool inoperative;*
>
> *(b) a device that prevents the tool from firing inadvertently, for example if it is dropped or while it is being loaded;*
>
> *(c) a device that prevents the tool from firing if it is not approximately perpendicular to the working surface;*
>
> *(d) a device that prevents the tool from firing if the muzzle is not pressed against the working surface.*

7.4.3. The recoil of a cartridge-operated tool should not be capable of injuring the user.

7.4.4. The noise of the detonation should not be such as to damage hearing.

7.4.5. A cartridge-operated tool, before each occasion of use, should be inspected to ensure that it is safe to use, and in particular:

> *(a) that the safety devices are in proper working order;*
>
> *(b) that the tool is clean;*
>
> *(c) that all moving parts work easily;*
>
> *(d) that the barrel is unobstructed.*

7.4.6. At intervals recommended by the manufacturer the tool should be completely dismantled and inspected for wear on the safety devices by a competent person.

7.4.7. Cartridge-operated tools should only be repaired by the manufacturer or by competent persons.

7.4.8. Cartridges should not be stored nor cartridge tools operated:

> *(a) in a place or environment where they could explode accidentally;*
>
> *(b) in an explosive atmosphere.*

7.4.9. When not required for use, inspection or other purpose, cartridge-operated tools should be kept in a suitable container that:

(a) is made of suitable material;

(b) is clearly marked to indicate its contents;

(c) is kept locked when not in use;

(d) contains nothing except the tools and cartridges.

7.4.10. No cartridge-operated tool should be stored or transported loaded, or left loaded when not in use.

7.4.11. Cartridge-operated tools should be accompanied by instructions for their maintenance and use and should only be operated by persons trained in their safe use.

Electrical tools

[Photo: Richard Neale. Permission granted by the operator (Diane Neale)]

7.5.1. Portable electrical tools should generally be used on reduced voltage to avoid as far as possible the risk of a lethal shock.

7.5.2. All electrical tools should be earthed, unless they are "all insulated" or "double insulated" tools which do not require an earth. Earthing should be incorporated in metallic cases, and as a safeguard against damaged cables where wires enter the tool.

7.5.3. All electrical tools should receive inspection and maintenance on a regular basis by a competent electrician, and complete records kept.

Woodworking machines

7.6.1. Shavings, sawdust, etc, should not be removed by hand from woodworking machines or in their vicinity while the machines are working.

7.6.2. Where provided, chip and sawdust extraction systems should be maintained in efficient working order.

7.6.3. Mechanical feeding devices should be used whenever practicable.

7.6.4. All cutters and saw blades should be enclosed as far as practicable.

7.6.5. Circular saws should be provided with strong, rigid and easily adjustable hood guards for the saw blades and with riving knives of suitable design matched to the saw blade in use. The width of the opening in the table for the saw blade should be as small as practicable.

7.6.6. Portable circular saws should be so designed that when the blade is running idle it is automatically covered.

7.6.7. On band saws all the blade, except the operating portion, should be enclosed. Band wheels should be enclosed with stout guards.

7.6.8. Band saws should be provided with automatic tension regulators.

7.6.9. Planing machines should be provided with bridge guards covering the full length and breadth of the cutting block and easily adjustable in both horizontal and vertical directions.

7.6.10. Thicknessing machines should be provided with sectional feed rollers or a kick-back preventer which should be kept as free as possible.

7.6.11. Woodworking machines should be properly spaced to avoid accidental injury when handling large boards or long planks.

5 SCAFFOLDING MATERIALS AND EQUIPMENT

4.2.1. Sufficient suitable and sound material should be provided and used in the construction of scaffolds.

Photo: Richard Neale

A good example is the scaffolding above, which is a patented system which can be erected more quickly and cheaply than conventional 'tube and fittings' when used in straightforward applications (such as rectangular scaffolds on firm and level foundations). The whole scaffold is enclosed in sheeting to protect the workforce from weather and the public from falling objects, dust and debris.

The photographs below show how the system is built up from yellow plastic base plates to prevent damage to the pavement surface. The screwed base members are necessary to adjust for irregularities in the level of the pavement because the joints in the uprights are at fixed intervals. The scaffold bracing is part of the patented system. The uprights are encased in highly visible plastic foam to prevent damage to passing pedestrians.

As shown below, a beam is necessary over shop doorways and this is attached by conventional tube and fittings.

4.2.2. Timber used in the construction of scaffolds should be straight-grained, sound, and free from large knots, dry rot, worm holes and other defects likely to affect its strength.

4.2.3. No rope which is defective whether through contact with acids or other corrosive substances or otherwise should be used on scaffolds.

4.2.4. Where necessary, boards and planks used for scaffolds should be protected against splitting.

This is important to preserve the strength of the board and also to prevent injury from jagged ends

(Photo: Richard Neale)

4.2.5. Ladders, boards and planks used in scaffolds should not be painted so that any defects are visible.

4.2.6. Materials used in the construction of scaffolds should be stored under good conditions and apart from any material unsuitable for scaffolds.

4.2.7. Fastenings on wooden scaffolds should conform with the national laws and regulations or be approved by the competent authority.

4.2.8. All tubes, couplers and fittings used in metal tubular scaffolding should be of a standard and type approved by the competent authority. All couplers and fittings should be free from damage and distortion, and should be maintained in an oiled condition.

4.2.9. Couplers should not cause deformation in tubes. Couplers should be made of drop forged steel or equivalent material.

4.2.10. Tubes should be free from cracks, splits and excessive corrosion and be straight to the eye, and tube ends cut cleanly square with the tube axis.

4.2.11. Alloy and steel tubing should not be intermixed on the same scaffold.

Useful guidance from the State of Montana, USA:

(http://erd.dli.mt.gov/safetyhealth/brochures/scaffold.pdf)

“B. Inspections and Testing of Planks

Wood scaffolds should not be proof tested. This may result in concealed or unrecognized damage that may cause failure later. Wood planks bear a mark, stamp, seal, or other indication of the referenced standard on usage.

Examine the plank for large knots, excessive grain slopes, shakes, decay, and other defects that may render it unfit.

Do not use a scaffold if the planks are bowing more than 1/60 of their span.

Discard the plank upon visible or audible evidence of failure, or if it has an obvious defection.

Determine the safe load for a plank on its size and species.

Do not use rusty or corroded scaffold equipment, its strength is unknown.

Check for cracks around welds, joints, and circumference.

Check castors for damaged brakes, axles, or stems.

Check manufactured planking for missing hooks, locks, missing rivets, bent side rails, and damaged walking surfaces. If the surface is plywood, check for rotten areas.”

(The extract above is 159 words long, which is less than 400 words and so it is reproduced under the convention of “fair use”. The ILO is grateful to the State of Montana for the use of this extract.)

6 TEMPORARY WORKS FOR CONCRETE AND STEEL

Design and supervision of such works has to be done by qualified engineers and this is beyond the scope of **Construction OS&H**.

7 TRENCH SUPPORT AND EXCAVATION EQUIPMENT

Shafts

9.3.2.5. All shafts over 30m in depth should have an adequate head frame strong enough to withstand safely the maximum load that it will have to carry and preferably be of open steelwork construction.

9.3.2.6. If head frames are of timber, they should be treated to make them fire-resistant.

9.3.2.7. Head frames should be earthed or otherwise adequately protected against lightning.

9.3.2.8. All landings in shafts should be provided with gates that effectively close the opening to a height of at least 2m.

9.3.2.9. Shafts should be equipped with a signalling system that warns the hoisting engineer when a conveyance passes beyond the safe limit of travel.

9.3.2.10. Before tunnelling operations are begun from a shaft, two separate signalling or communications systems of different types should be installed.

9.3.2.11. The signal code should be posted in the hoisting machine room and at each landing.

9.3.2.12. Hoisting machines should be equipped:

> *(a) with an adequate brake that will automatically stop and hold the conveyance if the hoisting power fails;*
>
> *(b) with a reliable depth indicator.*

9.3.2.13. All hoisting machines should be inspected at least once a day by the hoisting engineer.

9.3.2.14. Shafts exceeding 30m in depth should have an installation for conveying persons.

9.3.2.15. Cages or cars for conveying persons should be equipped with safety gear that automatically holds the cage or car when fully loaded if the suspension rope breaks or becomes slack.

9.3.2.16. There should be adequate means of blocking the cage or car at every landing.

9.3.2.17. Buckets used for conveying persons in shafts should:

(a) have no projections on the outside that could catch in an obstruction;

(b) be not less than 1 m deep;

(c) be provided with adequate means to prevent them from inadvertently tipping and spinning;

(d) not be self-opening.

9.3.2.18. Notices should be posted at conspicuous places at the hoisting installation stating:

(a) the maximum speed for transporting persons in the shaft;

(b) the maximum number of persons and the maximum weight of material that may be safely carried in each conveyance.

9.3.2.19. Hoisting operations in shafts should be governed by suitable signals.

Support of excavations

The excavation below has been supported in a very makeshift way and does not inspire confidence. The use of modern trenching equipment would make it much safer.

Photo: Richard Neale

An excellent web site on support of excavations is provided by www.mabeyhire.co.uk. This site has a wide range of very safety-conscious equipment, explained clearly with good illustrations. A visit is highly recommended.

Large or deep excavations are aspect of construction that requires qualified engineers and it is essential that unqualified people do not try to design, erect or maintain such equipment. A very good paper on the subject emphasises this point: "Earth retaining systems for the shaft excavation of smart tunnel" by Siow Meng, Tan; Chee Siong, Lim and Toong Woh, Chang. Ssp Geotechnics Sdn Bhd (sspg@sspsb.com.my). International conference and exhibition on trenchless technology and tunneling, 7th – 9th March 2006, Hotel Sheraton, Subang, Subang Jaya, Malaysia. See: http://www.sspsb.com.my/images/GEOWEB/Publications/SMART-Earth%20Retaining%20Systems.pdf.

8 FIRE PREVENTION AND CONTROL EQUIPMENT

Wikipedia provides a good introduction to fire extinguishers:

*"A **fire extinguisher** is an active fire protection device used to extinguish or control small fires, often in emergency situations. It is not intended for use on an out-of-control fire, such as one which has reached the ceiling, endangers the user (i.e. no escape route, smoke, explosion hazard, etc.), or otherwise requires the expertise of a fire department. Typically, a fire extinguisher consists of a hand-held cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.*

There are two main types of fire extinguishers: stored pressure and generated pressure. In stored pressure units, the expellant is stored in the same chamber as the firefighting agent itself. Depending on the agent used, different propellants are used. With dry chemical extinguishers, nitrogen is typically used; water and foam extinguishers typically use air. Stored pressure fire extinguishers are the most common type. Cartridge-operated extinguishers contain the expellant gas in a separate cartridge that is punctured prior to discharge, exposing the propellant to the extinguishing agent. This type is not as common, used primarily in areas such as industrial facilities, where they receive higher-than-average use. They have the advantage of simple and prompt recharge, allowing an operator to discharge the extinguisher, recharge it, and return to the fire in a reasonable amount of time. Unlike stored pressure types, these extinguishers utilize compressed carbon dioxide instead of nitrogen, although nitrogen cartridges are used on low temperature (-60F rated) models. Cartridge operated extinguishers are available in dry chemical and dry powder types in the US and in water, wetting agent, foam, and dry powder (ABC, BC, or D) types in the rest of the world.

Fire extinguishers are further divided into handheld and cart-mounted, also called wheeled extinguishers. Handheld extinguishers weigh from 0.5 to 14 kilograms (1 to 30 pounds), and are hence easily portable by hand. Cart-mounted units typically weigh 23+ kilograms (50+ pounds). These wheeled models are most commonly found at construction sites, airport runways, heliports, as well as docks and marinas."

(332 words, so 'fair use')

(Photo: Richard Neale. The ILO is grateful to the Chair of the Board of Management of Cadwyn Housing Association for permission to use this photo.)

Two types of extinguisher, guidance on their use and also actions to take in case of fire

From the ILO Manual:

Type of fire extinguisher	Action	Suitability and dangers
Pressurized water	Cools fuels rapidly - for fires in ordinary combustible building materials	Conducts electricity - not to be used for live electrical equipment or oil fires
Carbon dioxide	Excludes oxygen	Displaces oxygen when used in confined spaces Re-ignition may occur in overheated liquids such as hot bitumen
Dry chemical powder	Interferes with the combustion process	Use in confined areas may lead to a reduction in visibility Non-conductor of electricity and may be used on live electrical equipment Re-ignition may occur in overheated liquids
Foam	Excludes oxygen, limited cooling	Conducts electricity - not to be used for live electrical components
	Forms blanket over flammable liquids	Gives better control over re-ignition than carbon dioxide and dry powder Better suited to extinguish fire in overheated liquids such as bitumen boilers and oil tanks

9 ELECTRICITY

General provisions

15.1.1. All electrical equipment and installations should be constructed, installed and maintained by a competent person, and so used as to guard against danger.

15.1.2. Before construction is commenced and during the progress thereof, adequate steps should be taken to ascertain the presence of and to guard against danger to workers from any live electrical cable or apparatus which is under, over or on the site.

15.1.3. The laying and maintenance of electrical cables and apparatus on construction sites should be governed by national laws and regulations.

15.1.4. All parts of electrical installations should be of adequate size and characteristics for the power requirements and work they may be called upon to do and in particular they should:

(a) be of adequate mechanical strength to withstand working conditions in construction operations;

(b) not be liable to damage by water, dust or electrical, thermal or chemical action to which they may be subjected in construction operations.

15.1.5. All parts of electrical installations should be so constructed, installed and maintained as to prevent danger of electric shock, fire and external explosion.

15.1.6. The electrical distribution at each site should be via an isolator which cuts off current from all conductors, is readily accessible and can be locked in the "off" position but not locked in the "on" position.

15.1.7. The power supply to all electrical equipment should be provided with means of cutting off current from all conductors in an emergency.

15.1.8. All electrical appliances and outlets should be clearly marked to indicate their purpose and voltage.

15.1.9. When the layout of an installation cannot be clearly recognised, the circuits and appliances should be identified by labels or other effective means.

15.1.10. Circuits and appliances carrying different voltages in the same installation should be clearly distinguished by conspicuous means such as coloured markings.

15.1.11. Adequate precautions should be taken to prevent installations from receiving current at a higher voltage from other installations.

15.1.12. Where necessary to prevent danger, installations should be protected against lightning.

15.1.13. Lines for signalling and telecommunication systems should not be laid on the same supports as medium- and high-voltage lines.

15.1.14. Only flameproof equipment and conductors should be installed in explosive atmospheres or in storeplaces for explosives or flammable liquids.

15.1.15. A notice or notices should be kept exhibited at suitable places:

(a) prohibiting unauthorised persons from entering electrical equipment rooms or from handling or interfering with electrical apparatus;

(b) containing directions as to procedures in case of fire, rescue of persons in contact with live conductors and the restoration of persons suffering from electric shock;

(c) specifying the person to be notified in case of electrical accident or dangerous occurrence, and indicating how to communicate with him.

15.1.16. Suitable warnings should be displayed at all places where contact with or proximity to electrical equipment can cause danger.

15.1.17. Persons having to operate electrical equipment should be fully instructed as to any possible dangers of the equipment concerned.

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

The worker is standing on the cab of a crawler crane and pushing an electric cable above the crane as it passes underneath

Inspection and maintenance

15.2.1. All electrical equipment should be inspected before it is taken into use to ensure that it is suitable for its proposed use.

15.2.2. At the beginning of every shift, the person using the electrical equipment should make a careful external examination of the equipment and conductors, especially the flexible cables.

15.2.3. Apart from some exceptional cases, work on or near live parts of electrical equipment should be forbidden.

15.2.4. Before any work is begun on conductors or equipment that do not have to remain live:

> *(a) the current should be switched off by a responsible person;*
>
> *(b) adequate precautions should be taken to prevent the current from being switched on again;*
>
> *(c) the conductors or the equipment should be tested to ascertain that they are dead;*
>
> *(d) the conductors and equipment should be earthed and short-circuited;*
>
> *(e) neighbouring live parts should be adequately protected against accidental contact.*

15.2.5. After work has been done on conductors and equipment, the current should only be switched on again on the orders of a competent person after the earthing and short-circuiting have been removed and the workplace reported safe.

15.2.6. Electricians should be supplied with sufficient adequate tools, and personal protective equipment such as rubber gloves, mats and blankets.

15.2.7. All conductors and equipment should be considered to be live unless there is certain proof of the contrary.

15.2.8. When work has to be done in dangerous proximity to live parts the current should be cut off. If for operational reasons this is not possible, the live parts should be fenced off or enclosed by qualified staff from the power station concerned.

Testing

15.3.1. Electrical installations should be inspected and tested and the results recorded in accordance with national laws or regulations.

15.3.2. Periodic testing of the efficiency of the earth leakage protective devices should be carried out.

15.3.3. Particular attention should be paid to the earthing of apparatus, the continuity of protective conductors, polarity and insulation resistance, protection against mechanical damage and condition of connections at points of entry.

10 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

K: VERTICAL MOVMENT

(Photo: Richard Neale. St David’s 2, Cardiff, UK)

Summary of content	
1.	Preface
2.	Common hazards with vertical movement
3.	Cranes
4.	Hoists
5.	Vertical distribution of concrete
6.	Falls of materials
7.	Brief bibliography

1 PREFACE

This Module Summary describes the processes of moving materials, components, plant, equipment, people and all other items that have to be moved vertically within a construction site. The design, maintenance and inspection of the plant and equipment in these processes are described in the Module Summary J: “General plant and equipment”.

This Module Summary follows the relevant structure and content of the “ILO Code of Practice: Safety & health in construction” (the “Code”). The following passage is taken from this Code:

1.1. Objective

1.1.1. The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

> *(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;*
>
> *(b) ensuring appropriate design and implementation of construction projects;*
>
> *(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.*

1.1.2. This code also provides guidance in the implementation of the provisions of the Safety and Health in Construction Convention, 1988 (No. 167), and the Safety and Health in Construction Recommendation, 1988 (No. 175).”

Other passages from this Code are included in this Module Summary, and they are shown in the same format as above.

This Module Summary also includes extracts from the ILO’s “Safety, health and welfare on construction sites: A training manual” (“The Manual”).

A brief bibliography is given at the end of this Module Summary.

This Module Summary follows the sections shown in the table above.

2 COMMON HAZARDS WITH VERTICAL MOVEMENT

Moving materials, components and items of plant and equipment vertically should create no hazards for anyone on a construction project. Many of the hazards that do arise have the following causes:

- Poor mechanical design (breaks in use, not powerful enough, components fracture or malfunction)
- Poor functional design (not properly designed for the stated purpose)
- Incorrectly erected or installed
- Poor workplace design
- Signalling systems (manual, mechanical, electronic) malfunction
- Misuse (not used as designed)
- Used in the wrong circumstances (e.g. ground collapses under a crane)
- Loads insecurely attached
- Release of pressure (concrete pumps)
- Poor maintenance (breaks or emits noxious gases)

These cause the following hazards:

- Falling machinery or parts of machinery
- Falling loads
- Crushing due to impact of moving or toppling plant and equipment
- Impact from release of pressure (e.g. concrete exploding from concrete pump hose failure)
- Falling from plant and equipment
- Falls caused by swinging loads, plant and equipment
- Limbs or bodies caught in machinery
- Electrocution
- Physiological damage through vibration
- Poor ergonomics
- Physiological and psychological damage through repetitive work
- Stress caused by poor environment (noise, heat, poor ventilation, chemicals, noxious gases)

These are, of course, just some of the main hazards; there are many more which are specific to particular projects.

3 CRANES

Before a crane is used on site, management should consider all the factors that could affect its safe use, such as:

- The weight, size and type of load it will have to lift

- The maximum reach or radius required of it; restrictions on use such as overhead power lines, the state of the site and the type of ground

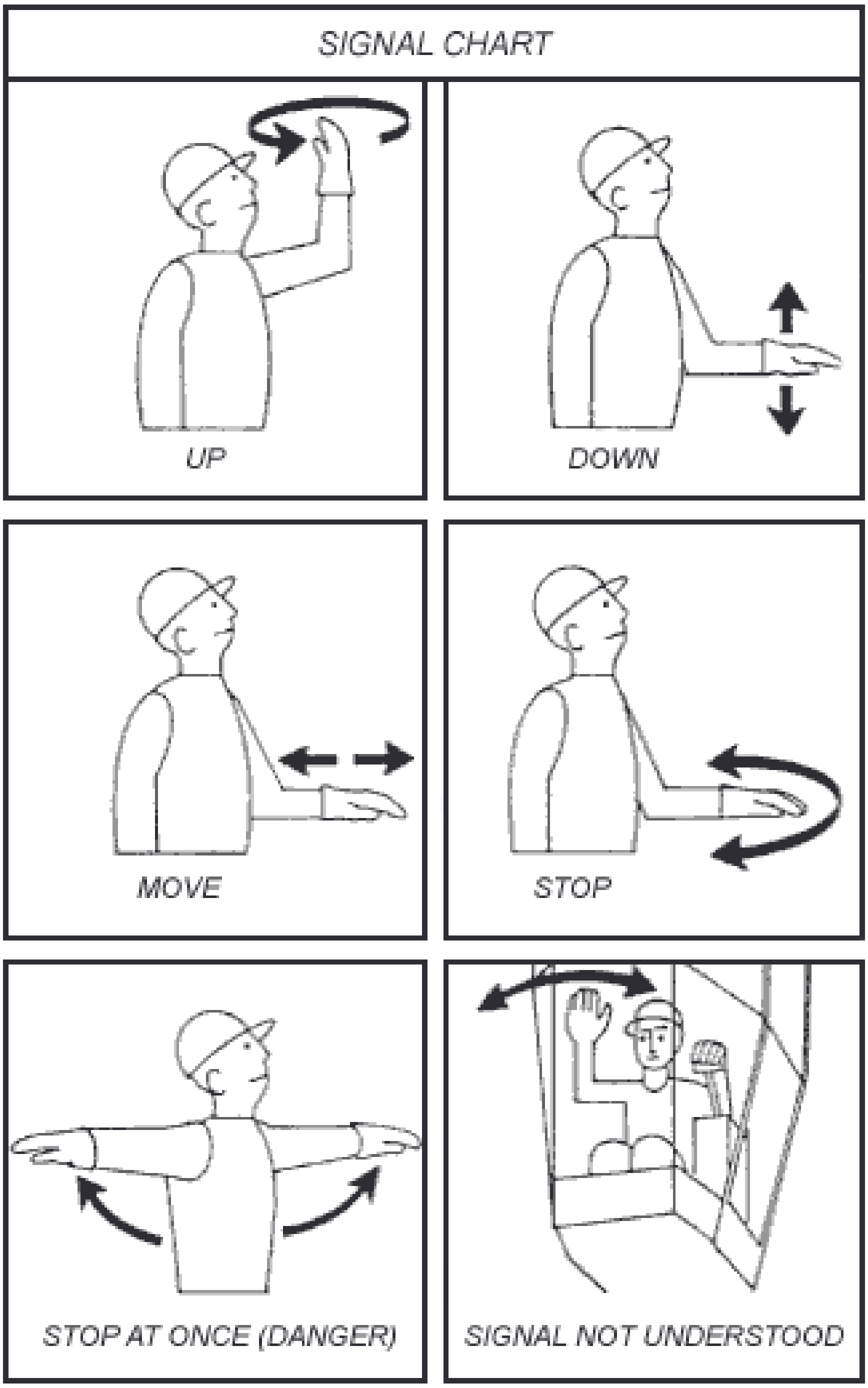
- Crane operators and signallers must be over the age of 18, and trained and sufficiently experienced.

Erection

Skilled workers under the immediate direction of a competent and experienced supervisor should do both the erection and dismantling of cranes. The manufacturers’ instructions should be closely followed.

Signalling

There should always be a signaller, or a signalling system such as a telephone, if the crane operator cannot see the load throughout the lift. Hand signals should be clear and distinct, and should follow a recognized code or system.



Safe load indicators

All jib cranes should have an automatic safe load indicator which alerts the operator, just before the safe load is reached and warns both the operator and others nearby if the safe load is exceeded.

The safe load indicator is an aid to safe crane operation, but does not guarantee it. For example, it does not take into account the effect of wind or soft ground conditions.

If you are lifting a load that you know or believe to be close to the safe working load, do not proceed immediately to a full lift. Rather raise the load a short distance and stop to check the stability of the crane before continuing with the lift. Remember that if a load is allowed to swing or is lowered rapidly, the radius of the jib may be increased unintentionally by flexing of the jib. Some indicators operate also as an overload cut-out.

Never bypass the indicator in order to lift an overload.

Never drag a load with a crane because the friction may cause the safe load to be exceeded.

Site inspection and maintenance

Cranes are subject to wear and tear which may not be easily detected; for example, bolts and similar parts may be subject to metal fatigue. Cranes should be tested and examined by a competent person before they are used on a construction site, and subsequently inspected at regular intervals in accordance with government requirements. The manufacturer's recommended programmes of operator checks and maintenance should be followed and any damage or defect should be reported to the supervisor. Never use a crane if you think it is unsafe.

Particularly susceptible components are wire ropes, brakes and safety devices. The constant contact of wire ropes with the sheaves on the jib accelerates wear. Brakes are in constant use and need to be checked, adjusted or renewed regularly. Safe load indicators and other safety devices such as overload cut-outs and limit switches are often susceptible to breakdown under site conditions and are sometimes deliberately disconnected.

Overloading

Overloading, causing vital parts to be stressed beyond rated capacities, can easily occur when neither the operator nor the supervisor is able to estimate the weight of material to be lifted, which is likely in the case of odd-shaped items.

An operator who is not properly trained may then lower a load at too high a speed so that when the brake is abruptly applied the jib snaps.

All cranes should be marked with their safe working load which must not be exceeded during the use of the crane. In the case of cranes with a derricking jib; that is, with a variable operating radius, the safe working load should be shown for every increment of radius of the jib. Winches and pulley blocks should be similarly marked.

Points to remember

If you cannot see the load all the time, you need a signaller

Beware of exceeding the safe working load when trying to free a stuck load

Mobile cranes

There is a huge range of mobile cranes available, but in terms of their safe use they all give rise to similar hazards.

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

A mobile crane works on the basis of balancing overturning forces so it is potentially unstable and is liable to overturn if used on un-compacted ground or on a slope. Remember that rain can soften the ground, and sites which are not level impose strains on the crane which may lead to unintentional overloading.

The training of a crane operator should provide an understanding of the advantages and limitations of outrigger settings and an awareness of the dangers of failing to use them.

Lifting is made more difficult or hazardous by the wind. Make sure that there is adequate clearance for the crane’s jib or boom and counterweight from traffic and fixed structures such as buildings, and that no part of the crane or the crane load will be closer than 4m to live overhead power lines.

It is not good practice to travel with a load but if this has to be done it must be controlled very carefully. If the movement is up-hill the load will become closer to the crane body, which increases the risk of impact. If the crane is to travel downhill, the effective radius may be increased, so making the effective load heavier.

Excellent advice on the safety of mobile cranes is provided by The California State Compensation Insurance Fund, at http://www.statefundca.com/safety/safetymeeting/.

“Mobile cranes are responsible for the most accidents, injuries, and fatalities of all of the crane types. Be aware of the hazards if you operate or work around mobile cranes. Get proper training on crane operation and load preparation and securing. Wear hard hats, safety boots, and high visibility clothing when operating or working around cranes.

Falling loads from mobile cranes pose a severe hazard to operators and nearby workers. Never exceed the load capacity of the mobile crane. If you are unsure about the load size and weight, calculate the weight to ensure that it meets your crane’s capacity. Load indicating devices, called load moment devices, can prevent an accidental overload. Properly secure the loads that you will be lifting. Inspect all slings, chains, and hooks that will be used to lift and secure the load.

Rotate, raise, and lower the crane boom slowly. Avoid sudden stops or accelerations that could jar the load. When rotating the load, you can use taglines or guidelines to control the arc and swing. Try to avoid lifting loads over workers or over the cab of the crane. If this type of lifting is necessary, use safety hooks or other approved devices. If two cranes are required to lift a load, a qualified person should be in charge of planning and directing the lift.

Cranes can accidentally come in contact with electrical lines. Before you start work, survey the site for potential electric hazards. Consider all lines energized unless they are certified by the owner/operator and visibly grounded at the site. Always maintain the required clearances from electrical lines and sources.

Tip-overs and instability are another mobile crane hazard. Soft or unlevel ground can cause a crane to tip. Use outriggers to stabilize the crane when the ground surface or the load requires it. Never operate a crane if the load or slope lifts the wheels off the ground. For stability when traveling, keep the boom steady in the direction of the movement. Boomstops should be used if there is a danger of the boom falling backward.

Workers near mobile cranes can get run over if they do not pay attention or if the operator loses sight of them. Operators should use an audible warning and operating signal device to notify workers of movement. Workers should stay out of the way of the *load, the crane wheels, and outrigger wheels. If the operator has a limited view, a qualified signals person should direct and communicate the operations. Never ride a load on a crane. Always lash or secure empty hooks when moving the crane so they do not swing.*

Lack of training is the leading cause of accidents. Certification as a crane operator is required unless you are operating a mobile crane with a boom length of less than 25 feet or a maximum rated load capacity of less than 15,000 pounds."

Fixed cranes

By far the most common fixed crane nowadays is the tower crane, so only this type of fixed crane will be considered in **Construction OS&H**.

Tower cranes are very sophisticated items of plant and there is a wide range of types and sizes available.

(Photo: Richard Neale. Project site in Dar es Salaam)

The photo shows a type of crane commonly in use worldwide

An example of an incident:

“Eurolift (Tower Cranes) Ltd of Aldershot, Hampshire has been fined £50,000 plus £1,000 costs at Chichester Crown Court for breaches of health and safety legislation following the collapse of the tower crane in Worthing that killed two people.

Gary Miles, 37, and Steven Boatman, 45, both from Reading, Berkshire, died when the 36m crane collapsed at Durrington High School in Worthing on 11 February 2005. The accident happened when an unsupervised colleague mistakenly loosened the bolts of the crane they were working on.

Judge William Wood said he believed the breach was serious enough to attract a fine in the region of £100,000 to £200,000. However taking into account the current financial state of the company he imposed a fine of £50,000 and ordered it to pay costs of £1,000.”

[http://www.contractjournal.com/Articles/2009/06/19/68976/50000-fine-for-tower-crane-collapse-that-killed-two.html]

(130 words so ‘fair use)

Use of cranes

To prevent overturning, a tower crane must either be anchored to the ground or securely counterweighted or ballasted. If the crane is rail mounted, remember that the rail tracks cannot be used as an anchor.

Ballast material may be moved so a diagram of the counterweight or ballast should be fixed to the crane, and the ballast should be checked against this whenever the crane is erected, and after bad weather.

Equipment such as slings and chains used with the crane must not clutter access-ways or ladders and must be well clear of any machinery in which it may become entangled.

Loads must be lifted vertically, as any out-of-vertical lifting may result in crane collapse.

Crane manufacturers specify the maximum wind speed at which tower cranes may be safely used.

Loads having a large surface area should not be lifted in windy conditions.

The crane must be positioned to ensure that the crane jib or boom is free to wind-vane (rotate through 360° degrees) around the tower, so that there are no horizontal wind forces on it when it is not in use.

When the crane is not in use, the hook should be raised to its highest position; the crane should be allowed to wind-vane and the power should be turned off.

When more than one tower crane is used on a site, care must be taken when designing the site layout to ensure that collisions between booms, loads or lifting ropes are avoided. If physical separation cannot be arranged, effective electronic warning devices have to be used.

Tower cranes should not be used for magnet, or demolition ball service, piling operations or other duties which could impose excessive loadings on the crane structure.

4 HOISTS

(Photo: Richard Neale. St David's 2, Cardiff, UK)

Goods hoists

The goods, or platform, hoist used to raise materials and equipment vertically to successive levels as construction proceeds is probably the most widely used item of mechanical handling equipment. It consists of a platform which is driven either from a rope winch or by a rack and pinion with the motor and gearbox mounted on the platform

The principal hazards are of falling down the hoistway from a landing on the platform, being struck by the platform or other moving parts, and being hit by materials falling down the hoistway.

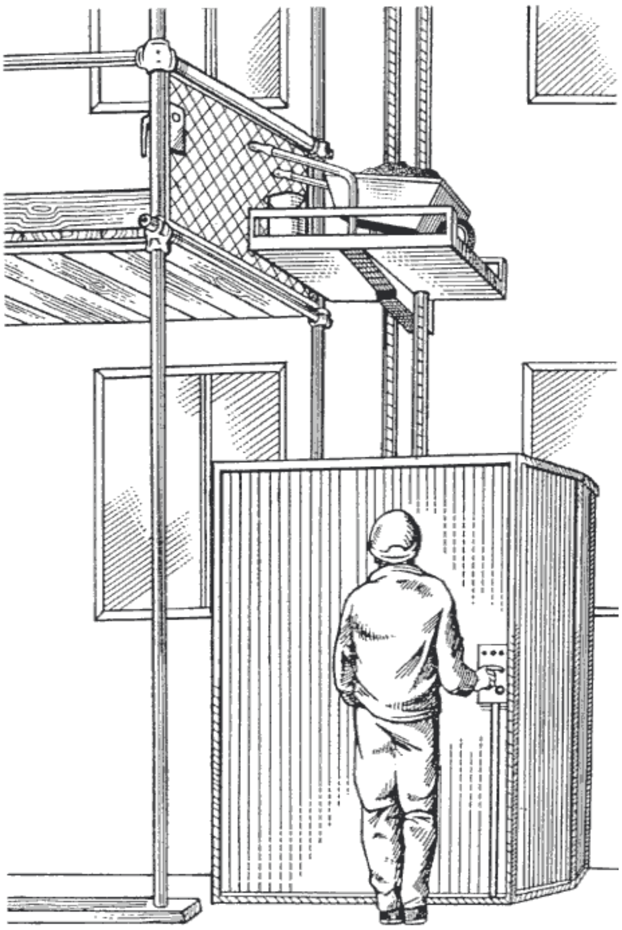
Passenger hoists

Lifts for the carriage of persons need to be especially constructed and installed for the purpose, with such features as mechanical and electrical interlocking devices on the cage and landing gates. They must be fully enclosed.

Enclosure

A substantial enclosure should be erected at ground level around the hoist-way to a height of at least 2m. It should have suitable gates giving access to the platform. The remainder of the hoist-way should be enclosed (e.g. with wire mesh) throughout its height sufficiently to contain falling material within the enclosure.

Gates should be fitted at every landing level where access to the platform is needed, and the gates must be closed except during loading and unloading at that level.



The diagram above shows the cage of a passenger hoist entering the access enclosure at ground level.

Safety devices

An overrun device should be fitted just above the highest platform position required, or near the top of the mast. An arrestor device should be fitted to support the platform, fully loaded, in the event of failure of the hoist rope or driving gear. There should be at least three turns of rope on the winch-drum when the platform is in its lowest position.

Operation

To prevent the hoist operator, who should be trained and aged at least 18 years old, from moving the platform while someone is trying to load or unload materials, the controls need to be set up so that the hoist can be operated from one position only. From this position the operator can see all landing levels clearly. If this is not possible, a signalling system must be used during loading and unloading.

There should be overhead protection for the operator if, as is usually the case, he or she is at ground level.

Loads

The platform should be clearly marked with its safe working load and the platform should not be overloaded. Barrows should not be overfilled, and their wheels should be chocked or secured so that they cannot move about on the hoist platform while it is moving. Loose bricks or other materials should never be carried on an open hoist platform. No one should be allowed to ride on the platform and there should be a notice on the platform forbidding riding.

Testing and examination

Every hoist should be tested and examined after installation, and checks made on the arrester and overrun devices. Weekly recorded checks should be made by a competent person.

(Photo: Richard Neale. Construction project in Gaza)

The photo above shows a hoist by a public road. There is no enclosure at all, which is extremely dangerous. Note that the lifting cable is very close to overhead power lines. This hoist is on the side of a road, so the lack of an enclosure is a hazard for the public as well as those who work on the project site.

5 VERTICAL DISTRIBUTION OF CONCRETE

The main means of transporting concrete vertically are by means of a crane and skip or by concrete pumps. Cranes (which use 'skips' or 'concrete buckets') have been explained in Section 3 above, so this section is mainly about concrete pumps.

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

Concrete pump providing concrete in a deep excavation

(Photo: Richard Neale. Project site in Dar es Salaam)
A static pump installed on the project on a long-term basis

7.9.13. Scaffolding carrying a pipe for pumped concrete should be strong enough to support the pipe when filled and all the workers who may be on the scaffold at the same time, with a safety factor of at least 4.

Examples of incidents (‘accidents)

This is a good example, from: WorkCover New South Wales: Concrete Placing Pumps. Safety Alert No 4024, 22 November 1994
http://www.cfmeu-construction-nsw.com/pdf/saconcreteplacingpumps.pdf

“Two serious accidents, one fatal, in Sydney in June 1994 involving concrete placing boom pumps, highlighted the need to follow the safety recommendations in the WorkCover Authority's Codes of Practice on Pumping Concrete and Construction and Testing of Concrete Pumps.

The first accident occurred when a boom pump operator stood on the hopper grate of his machine and his leg slipped through the grate. His leg became entangled in the auger of the pump and his left leg was severed below the knee.

Investigation revealed the hopper grate bars at each end of the grate were wider than the 70mm recommended by WorkCover Codes of Practice.

WorkCover recommends that all pump operators should:

- *Never stand on the hopper grate of concrete placing pumps.*
- *Always ensure the grate complies with the recommendations of the WorkCover Authority.*
- *Always ensure that grates are in good condition and not unduly worn or damaged.*

The second accident involved the collapse of the boom of a concrete placing boom pump, which hit the pump line operator on the head and inflicted fatal injuries.

Investigation revealed that a failure of the pedestal-to-hydraulic ram connection caused the boom to collapse.

Recommendations

- *A regular and thorough maintenance program be undertaken by pump owners and operators in accordance with WorkCover’s codes of practice.*
- *Operators and concreters should avoid standing or working under the elevated boom as much as possible.*
- *When working on a construction site, workers should always remember to wear head protection.”*

(250 words, so ‘fair use’)

Despite the specialised nature of concrete pumping, basic safe operation can be achieved by applying the general processes and procedures of **Construction OS&H**: for example, working with the pumping specialist to identify hazards, develop a safe working method, and briefing everyone involved carefully.

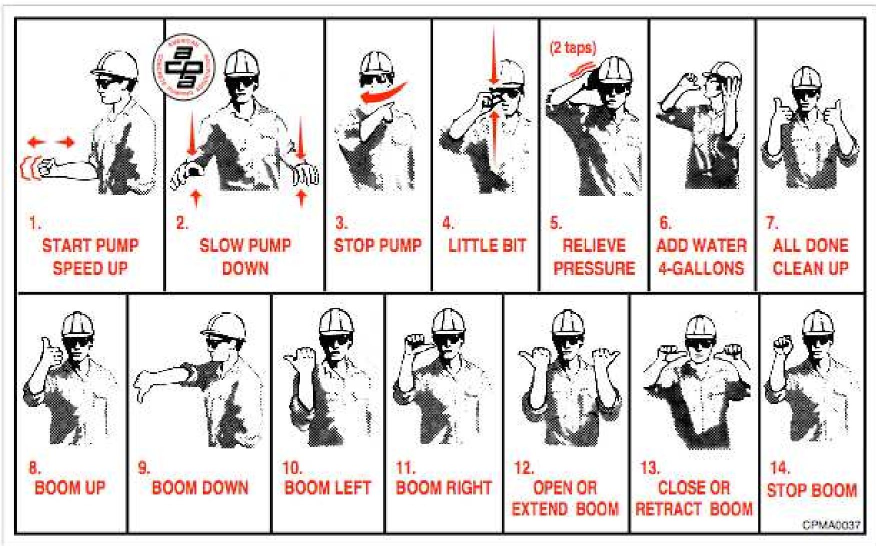
Some of the main special features of concrete pumps that give rise to hazards are:

- Mobile pumps are large vehicles and need care when driven to and from the site and manoeuvring into position.
- Mobile pumps are subject to the same types of forces as mobile cranes and so must be sited in the same way.
- All mobile pumps work with high pressures, so the pump itself and all pipes and hoses must be carefully maintained, positioned and held securely in place.
- Concrete for pumping is poured into a hopper and drawn forward by powerful pumping mechanisms. This hopper must be covered by a strong and well-fixed grill to prevent any part of a human body getting into it.
- Emptying and cleaning the pipeline can cause explosive pressures if not done carefully.
- There must be safe workplaces for those using the pump, including safe means of access and egress.
- Handling the discharge pipe can give rise to strong forces so can cause muscular and impact injuries.
- Concrete is a corrosive substance to human skin, so good PPE must be provided.
- It is often the case that the pump operator cannot see the end of the pumping hose, so a banks-man is required.

The photo below shows a good example of the way in which concrete pumps can be used to place concrete in inaccessible places, and also illustrates how pump operators sometimes have to operate completely out of sight of the placing team.

(Photo by Richard Neale. St David's 2, Cardiff, UK)

Signalling should be as shown below.



(Source: http://www.concretepumpers.com/pdfs/Pumping_Checklist_FINAL.pdf
The ILO is grateful to ACPA for permission to use this graphic.)

6 FALLS OF MATERIALS

Working at height obviously creates the potential hazard of falling materials, tools and equipment. Every effort must be made to prevent these incidents, primarily by:

- Planning all activities carefully
- Keeping all plant and equipment in a condition that is safe to use
- Installing all plant and equipment securely
- Making sure that loads are attached properly and that no part of the load can become detached
- Keeping all working platforms tidy, so reducing the likelihood of loose tools and material being dislodged and falling
- Providing properly designed safety nets or solid ‘fans’ to catch anything that does fall

The photo below shows a building that has been carefully sheeted to prevent falling objects landing in the street, and also a solid fan to catch falling objects. [The sheeting also improves working conditions in bad weather.]

(Photo: Richard Neale. Old Town, Geneva)

7 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

L: HORIZONTAL MOVEMENT

(Photo: Richard Neale. Permission given by the operator and www.carillionplc.com)

Summary of content	
1.	Preface
2.	Common hazards with horizontal movement
3.	General principles of safety for moving plant
4.	Excavating plant
5.	Earthmoving and compacting plant
6.	Road-making plant
7.	Concrete production and movement
8.	Site transport
9.	Appendix: Truck drivers
10.	Brief bibliography

1 PREFACE

This Module Summary describes the processes of moving materials, components, plant, equipment, people and all other items that have to be moved within and around a construction site. The design, maintenance and inspection of the plant and equipment in these processes are described in the Module Summary J: “General plant and equipment”.

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“1. General provisions

1.1. Objective

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>
> *(b) ensuring appropriate design and implementation of construction projects;*
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This Module Summary also includes extracts from the ILO’s “Safety, health and welfare on construction sites: A training manual” (the “manual”).

This Module Summary follows the sections shown in the table above.

2 COMMON HAZARDS WITH HORIZONTAL MOVEMENT

Moving materials, components and items of plant and equipment horizontally should create no hazards for anyone on a construction project. Many of the hazards that do arise have the following causes:

- Poor mechanical design (breaks in use, not powerful enough, components fracture or malfunction)
- Poor functional design (not properly designed for the stated purpose)
- Poor workplace design
- Signalling systems (manual, mechanical, electronic) malfunction
- Misuse (not used as designed)
- Loads insecurely attached
- Release of pressure (concrete pumps)
- Poor maintenance (breaks or emits noxious gases)

These cause the following hazards:

- Loads fall from vehicles
- Crushing due to impact of moving or toppling plant and equipment
- Impact from release of pressure (e.g. concrete exploding from concrete pump hose failure)
- Falling from plant and equipment
- Falls caused by swinging loads, plant and equipment
- Limbs or bodies caught in machinery
- Poor ergonomics
- Physiological and psychological damage through repetitive work
- Stress caused by poor environment (noise, heat, poor ventilation, chemicals, noxious gases)

These are, of course, just some of the main hazards; there are many more which are specific to particular projects.

3 GENERAL PRINCIPLES OF SAFETY FOR MOVING PLANT

"Machine Safety Checks

Operators and drivers should be trained to walk round their machine before starting work for the day in order to check it in accordance with an employer's or manufacturer's check-list. Items to be checked should include:
(a) Fuel, oil, and water levels;
(b) Water, fuel, and hydraulic lines for leaks;
(c) The condition of the tracks or tyres as applicable;
(d) The condition of attachment cutting edges and teeth;
(e) That good visibility is possible from the cab, windows, mirrors, and headlights;
(f) That steps and pedals do not have worn or slippery surfaces;
(g) That warning devices are working and that there is no loose gear or material on the machine.

Any defects noticed should be immediately reported to the supervisor for correction. If any defect affects the safe operation of the machine, it should be rectified before the machine is used.

After starting the engine and before moving off, operators should check that the brakes, controls and gauges are functioning correctly, and that other workers are clear.

Inspect your machine before starting work.
Keep your windows and mirrors clean and avoid accidents."

[Taken from Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE Department of Labour, Wellington New Zealand: http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf. **Construction OS&H** has used a number of extracts from this very good Guide, for which the ILO is very grateful. The Department of Labour web site states (on 27 04 2010) "download pdf copies free" and goes on to give advice on how to download them and use them, so ILO has presumed that this documents is in the public domain for copyright purposes.]

6.1.2. The drivers and operators of vehicles and earthmoving or materials handling equipment should be medically fit, trained and tested and of a prescribed minimum age as required by national laws and regulations.

Hours of work must be controlled. Driving and using moving plant safely requires concentration and long hours make this difficult.

6.1.3. On all construction sites on which vehicles, earthmoving or materials handling equipment are used:

(a) safe and suitable access ways should be provided for them;

(b) traffic should be so organised and controlled as to secure their safe operation.

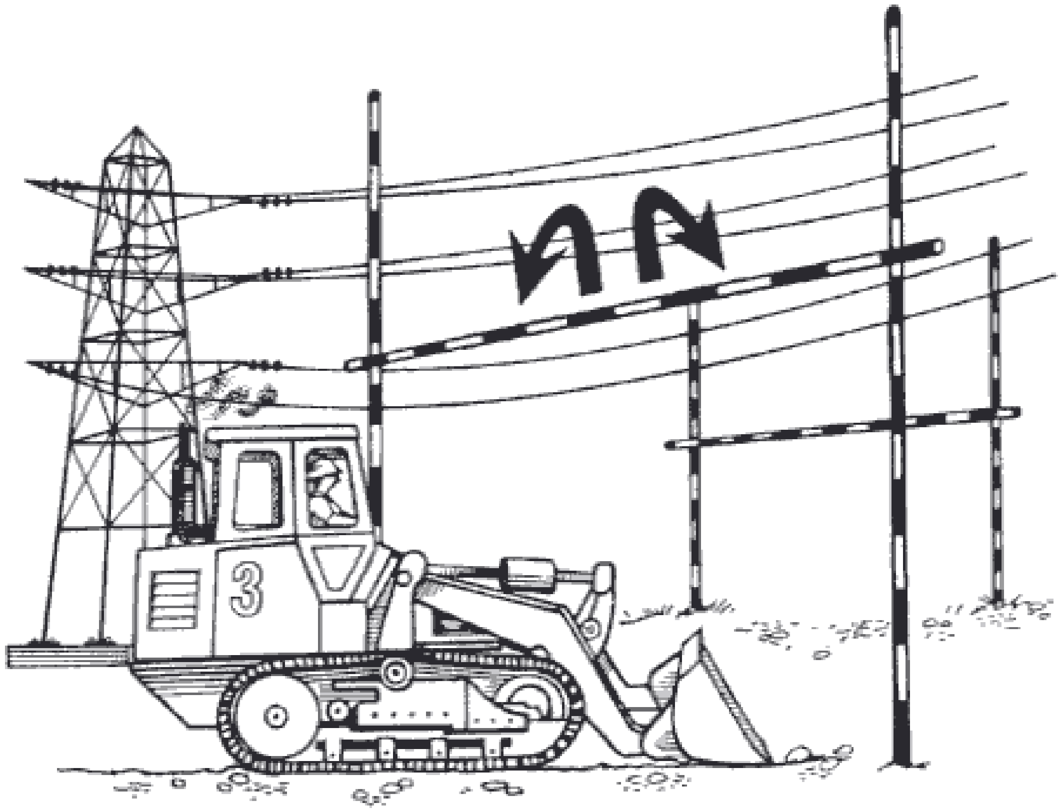
When construction plant, equipment and vehicles have to travel through densely populated public areas, they should be escorted by a banksman (perhaps two banksmen in some circumstances) at all times. The photo below shows two banksmen escorting a vehicle in a busy street.

(Photo: Richard Neale. Paving project, Cardiff, UK.)

6.1.4. Adequate signalling or other control arrangements or devices should be provided to guard against danger from the movement of vehicles and earth-moving or materials-handling equipment. Special safety precautions should be taken for vehicles and equipment when manoeuvering backwards.

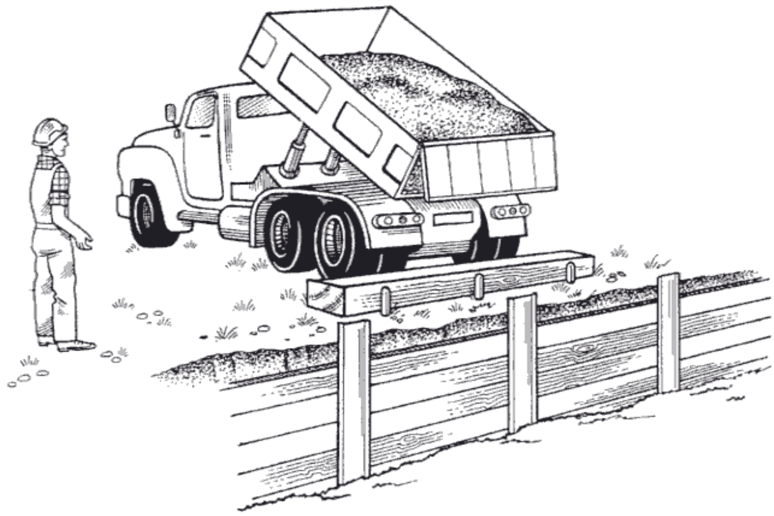
6.1.5. The assistance of a trained and authorised signaller should be available when the view of the driver or operator is restricted. The signalling code should be understood by all involved.

6.1.6. When earth-moving or materials-handling equipment is required to operate in dangerous proximity to live electrical conductors, adequate precautions should be taken, such as isolating the electrical supply or erecting overhead barriers of a safe height.



If routes have to approach overhead structures or overhead power lines, contact with them can be avoided by erecting warning barriers of the goalpost type. The crossbar should be of rigid material, preferably timber, and painted in two contrasting warning colours. In the case of power lines, there should be a barrier on both sides of the line and set at least 6m horizontal distance away. Operating a crane in the area of overhead power lines requires arrangements to be made in advance with the power company for power to be diverted or cut off whenever the crane is in use.

6.1.7. Preventive measures should be taken to avoid the fall of vehicles and earth-moving or materials-handling equipment into excavations or into water.



6.1.8. Vehicles and earth-moving or materials-handling equipment should not travel on bridges, viaducts, embankments, etc., unless it has been established that it is safe to do so.

6.1.14. When cranes and shovels are being moved, out of service, the boom should be in the direction of travel and the scoop or bucket should be raised and without load, except when travelling downhill.

6.1.15. On earth-moving and materials-handling equipment, motors, brakes, steering gear, chassis, blades, blade-holders, tracks, wire ropes, sheaves, hydraulic mechanisms, transmissions, bolts and other parts on which safety depends should be inspected daily.

6.1.17. Deck plates and steps of vehicles and equipment should be kept free from oil, grease, mud or other slippery substances.

6.1.16. Vehicles and earth-moving or materials-handling equipment should not be left on a slope with the engine running.

Sites should be securely fenced to protect the public from moving construction plant and equipment. The photo below shows very secure, double fencing around a site near a popular public footpath.

(Photo: Richard Neale)

Warning notices should be displayed prominently.

(Photo: Richard Neale)

4 EXCAVATING PLANT

Falls of vehicles into excavations or openings occur frequently when vehicles get too near the edge of an excavation and cause the side to cave in, or when in tipping materials over the edge the driver approaches too close and cannot stop in time. The precautions are barriers, banksmen and fixed stops.

6.2.13. Before leaving the excavator the operator should:

(a) disengage the master clutch;

(b) lower the bucket or grab to the ground.

6.2.14. Buckets and grabs of power shovels should be propped to restrict movement while they are being repaired or teeth are being changed.

6.2.15. When an excavator is at work near a wall or similar construction, persons should be prevented from entering the danger zone in which they may be crushed when the machine turns.

6.2.16. Trucks should not be loaded in any place where there may be danger from materials such as rocks falling from buckets passing overhead; where this cannot be avoided, no person should remain in the cab during loading.

(Photo: Richard Neale. Permission given by the operator and www.carillionplc.com)

6.2.17. Trucks should be stationed at such a distance from the excavator that there is a clearance of at least 60cm between the truck and the superstructure of the excavator even when it turns.

6.2.11. The boom of excavators should be prevented from accidentally swinging during operation or transport.

6.2.12. The bucket or grab of an excavator should be prevented from accidentally dipping, tipping or swinging in operation.

Do’s and Don’ts – Excavators

***Do** – When excavating trenches, place the excavated material at least 600mm clear of the edge, where there is no danger of it falling back into or collapsing the side of the trench.*
***Do** – Create a level area to operate from when working on a steep grade. If you cannot do this, avoid swinging your boom downhill any further than necessary and operate your machine slowly to maintain stability.*
***Do** – When travelling up or down a steep slope, place the track sprockets at the rear of the machine. For uphill travel extend the boom and bucket forward, and for downhill travel place them close in, in order to maximise stability and traction.*
***Do** – Watch boom clearance when travelling. Uneven ground may cause the boom to weave or collide into obstructions.*
***Do** – Take care at the point of balance on the peak of a steep slope. Reduce speed and maintain stability until on level ground.*
***Do** – Avoid jerky swings or sudden braking. These can make the machine unstable and overload machine components.*
***Don’t** – Turn sharply while travelling up a steep slope, because the machine’s stability will be threatened.*
***Do** - Use boom to maximise stability and traction when going up or down hill.*
***Don’t** – Attempt to operate attachments while travelling as this may starve one of the track drive motors and result in an unintended turn.*

[Taken from Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE Department of Labour, Wellington New Zealand: http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf. **Construction OS&H** has used a number of extracts from this very good Guide, for which the ILO is very grateful. The Department of Labour web site states (on 27 04 2010) “download pdf copies free” and goes on to give advice on how to download them and use them, so ILO has presumed that this documents is in the public domain for copyright purposes.]

5 EARTHMOVING AND COMPACTING PLANT

Bulldozers

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

6.3.1. Before leaving a bulldozer the operator should:

(a) apply the brakes;

(b) lower the blade and ripper;

(c) put the shift lever in neutral.

6.3.2. At the close of work bulldozers should be left on level ground.

6.3.3. When a bulldozer is moving uphill the blade should be kept low.

6.3.4. Bulldozer blades should not be used as brakes except in an emergency.

Do's and Don'ts – Bulldozers

***Do** – Wherever possible avoid sidehill travel. Drive straight up and down slopes. If the machine starts to slide sideways when working across a slope, turn the machine downhill and drop the blade. Watch for falls of rocks and trees when slip clearing.*
***Do** – If you have to drive down a steep slope, keep a good bladeful of spoil in front of the blade on the way down. If dirt is being lost, lowering the blade slightly may help, but lowering it too far brings the danger of overturning.*
***Do** – When you are working on slip clearing, proceed with caution and watch the slope. Further falls may occur.*
***Do** – When clearing trees, watch out for dead branches in tree tops as abrupt contact with a butt may dislodge them.*
***Do** – Avoid obstacles such as rocks or logs. If you are forced to cross them, use extreme caution and change to the lowest gear. Ease up to the break-over point and ease down to minimise the jolt on contact on the other side.*
***Do** – Be careful when working near the edge of banks and ditches or under overhanging material. The vibration and weight of your machine may cause the edge to give way or overhanging material to fall.*

[Taken from Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE Department of Labour, Wellington New Zealand: http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf. **Construction OS&H** has used a number of extracts from this very good Guide, for which the ILO is very grateful. The Department of Labour web site states (on 27 04 2010) "download pdf copies free" and goes on to give advice on how to download them and use them, so ILO has presumed that this documents is in the public domain for copyright purposes.]

Scrapers & graders

(Photo: Robert Carr, http://myconstructionphotos.smugmug.com)

6.4.2. Scraper bowls should be propped while blades are being replaced.

6.4.3. Scrapers moving downhill should be left in gear.

Dos and Don'ts – Motor Scrapers

***Don't** – Accelerate a tandem scraper's rear engine when entering a sharp turn, or the machine may jack-knife.*
***Do** - Place warning signs when operating on roads.*
***Do** – Face in the direction of travel. If you have to watch the operation of rear equipment, use your rear vision mirror.*
***Do** – When entering sharp turns, fill areas or downgrades, apply retarder and/or service brakes. Select the correct gear before travelling downhill.*
***Do** – On long downgrades use the engine to assist braking. Avoid "fanning" the air brake pedal. Repeated light application of the brake may exhaust air pressure faster than the system is able to replenish it, leading to brake failure.*
***Do** – Drop the bowl in an emergency!*
***Don't** – Speed as a relief from boredom!*

Do's and Don'ts – Graders

***Do** – When grading across a slope, avoid blade down-pressure and obstacles, as either can tip the machine. For maximum stability operate at low speed, lean the front tyres towards the uphill side, and cast material to the downhill side of the machine.*
***Do** – Operate on as level a surface as possible when cutting high banks. With the blade raised, the grader is less stable than normal.*
***Do** – When working on existing roads, place warning signs and watch out for that unexpected vehicle.*

[Taken from Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE Department of Labour, Wellington New Zealand: http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf. **Construction OS&H** has used a number of extracts from this very good Guide, for which the ILO is very grateful. The Department of Labour web site states (on 27 04 2010) "download pdf copies free" and goes on to give advice on how to download them and use them, so ILO has presumed that this documents is in the public domain for copyright purposes.]

6 ROAD-MAKING PLANT

Mobile asphalt layers and finishers

6.5.6. When asphalt plants are working on public roads, an adequate traffic control system should be established and reflective jackets provided for the workers.

6.5.7. A sufficient number of fire extinguishers should be kept in readiness on the worksite, including at least two on the spreader.

6.5.8. Material should only be loaded on to the elevator after the drying drum has warmed up.

6.5.9. No naked flame should be used for ascertaining the level of asphalt in the tank.

6.5.10. Thinners (cut-backs) should not be heated over an open flame.

6.5.11. If a burner flame is extinguished:

(a) the fuel supply should be cut off;

(b) the heating tube should be thoroughly blown out by the fan so as to prevent a backfire.

6.5.12. Inspection openings should not be opened while there is any pressure in the boiler.

Pavers are very complex items of machinery and require great skill to operate safely. All those involved must be properly and thoroughly trained.

(Photo: Richard Neale. Permission given by the operator)

Spreading asphalt by hand causes another set of hazards: heat, chemical contamination etc.

(Photo: Fiona Murie, BWI)

Road rollers

(Photo: Fiona Murie, BWI)

6.7.1. Before a road roller is used the ground should be examined for bearing capacity and general safety, especially at the edges of slopes such as embankments.

6.7.2. Rollers should not move downhill with the engine out of gear.

6.7.3. When a roller is not in use:

(a) the brakes should be applied;

(b) the engine should be put into bottom gear if the roller is facing uphill;

(c) the engine should be put into reverse if the roller is facing downhill;

(d) the contact should be switched off;

(e) the wheels should be blocked.

(Photo: Richard Neale. Permission given by the operators)

Dos and Don'ts – Road Rollers

Do – Take care not to overbalance over the edge of a road formation. Examine edges for soft spots before starting work.
Do – Avoid gear changes on steep sections. Remember that a missed gear change may result in loss of control and the roller overturning. Hand or parking brakes should not be relied on to maintain control.
Do – Park on the flat. If you must park on a slope, chock your wheels.
Don't – Climb onto a moving roller.

[Taken from Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE Department of Labour, Wellington New Zealand: http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf. **Construction OS&H** has used a number of extracts from this very good Guide, for which the ILO is very grateful. The Department of Labour web site states (on 27 04 2010) "download pdf copies free" and goes on to give advice on how to download them and use them, so ILO has presumed that this documents is in the public domain for copyright purposes.]

7 CONCRETE PRODUCTION AND MOVEMENT

7.9.4. While the drum of a concrete mixer is being cleaned, adequate precautions should be taken to protect the workers inside by locking switches open, removing fuses or otherwise cutting off the power.

7.9.6. Loaded concrete buckets should be guided into position by appropriate means.

7.9.7. Concrete buckets positioned by crane or aerial cableways should be suspended by safety hooks.

7.9.8. When concrete is being tipped from buckets, workers should keep out of range of any kick-back due to concrete sticking to the bucket.

7.9.9. Concrete bucket towers and masts with pouring gutters or conveyor belts should:

> *(a) be erected by competent persons;*
>
> *(b) be inspected daily.*

7.9.10. The winch for hoisting the bucket should be so placed that the operator can see the filling, hoisting, emptying and lowering of the bucket. Where this is not practicable, a banksman should direct the operator.

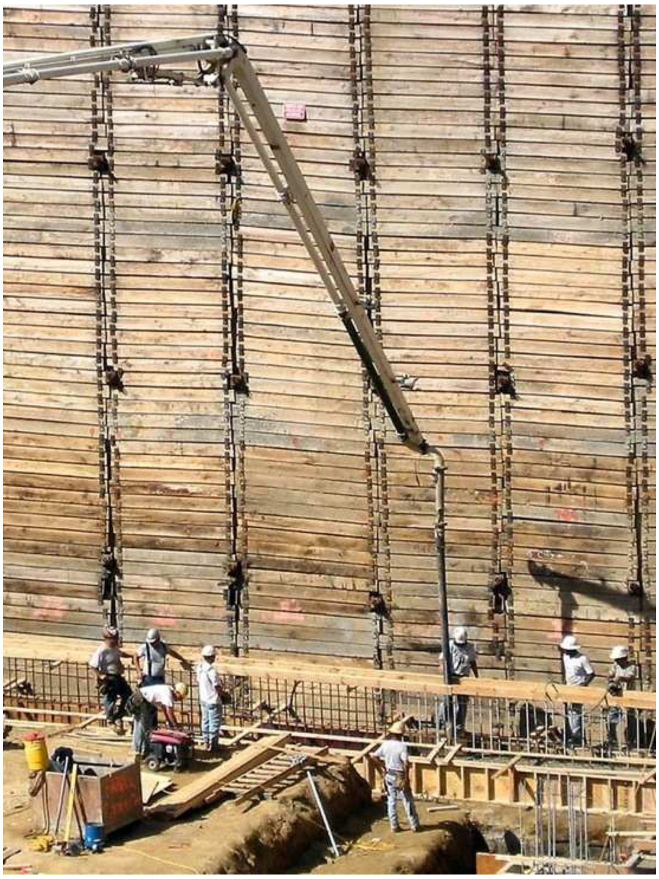
7.9.11. If the winch operator cannot see the bucket, he should, where practicable, be provided with an adequate means indicating its position.

7.9.12. Guides for the bucket should be correctly aligned and so maintained as to prevent the bucket from jamming in the tower.

7.9.14. Pipes for carrying pumped concrete should:

> *(a) be securely anchored at the ends and at curves;*
>
> *(b) be provided near the top with air release valves;*
>
> *(c) be securely attached to the pump nozzle by a bolted collar or equivalent means.*

Workers must take care when handling the discharge end of a concrete pump – see image below. This is a very heavy item and concrete is being driven out of it by strong pressure, so there is a health hazard of back and other muscular strains. The pump operator has a very important part to play in placing the boom so that the worker at the discharge end does not have to exert much force to place the concrete accurately.



(Photo: Robert Carr, http://myconstructionphotos.smugmug.com. This is a detail of a photo shown in Module Summary 11)

8 SITE TRANSPORT

Transport may include trucks, tipper lorries, tractors and trailers and dumpers.

(Photo: Robert Carr. http://MyConstructionPhotos.smugmug.com)

The underlying cause of most site traffic accidents is the failure to plan a safe system of work and to train workers how to follow it. However, the common immediate causes are one or a combination of the following factors:

- Bad driving techniques which include reversing blind
- Carelessness or ignorance of special hazards, e.g. work near overhead power lines or excavations
- Carrying unauthorized passengers
- Poor maintenance of vehicles
- Overloading or bad loading
- Site congestion
- Poor traffic layout
- Lack of proper roadways combined with uneven ground and debris

Safety precautions

Drivers must be properly trained and to take a vehicle on or across a public road requires a national driving licence. It is good practice for all drivers to possess a driving licence in any case. Training should include instruction on negotiating steep slopes, driving a vehicle up and down the slope, rather than across it, whenever practicable.

Routes should be levelled, marked and planned in such a way as to avoid potential hazards such as overhead power lines and steeply sloping ground. Where possible a one-way system should be used. Speed limits should be required and clearly displayed; they should be reduced for adverse site conditions and for areas near work in progress.

Vehicles travelling backwards when the driver's rear view is obscured frequently strike workers. The help of another worker is required, who must be kept in view at all times. If no one is available, the driver must walk round to the rear of the vehicle themselves to see that all is clear and give a sound signal before starting to reverse. Many vehicles now have an audible warning device such as a horn or warning hooter which sounds when reverse gear is engaged, but drivers should not rely on this alone.

An unattended vehicle should have the engine switched off, and unless the vehicle is on a marked incline the gear should be left in neutral and the handbrake on; on sloping ground the wheels should also be chocked. Tipping bodies should be lowered when the machine is unattended, but if it is occasionally necessary to leave them in the raised position they should be blocked to prevent their fall.

Foot injuries to drivers and their assistants during loading and unloading are common, so they should wear safety boots or shoes.

Maintenance

Maintenance of vehicles falls into three categories:

- A daily check by the driver of water, oil, fuel, lights, inflation of tyres and brakes – remember the acronym WOFLIB
- A weekly check by a fitter
- Periodic servicing to the manufacturers' requirements

A written record of maintenance and repairs should be kept on site.

Overturning

Construction vehicles can overturn if not used carefully so it is important not to turn at an excessive speed. Vehicles such as tractors and lift trucks should be equipped with protection to prevent the driver being hit by falling objects and from being thrown from the cab in the event of overturning.

Points to remember

- All vehicles should be kept tidy and the cab kept free from tools and materials which might obstruct the controls

- Speed limits must be enforced

- Passengers should only be carried in properly designed passenger vehicles

- Vehicles should not be driven across a slope

Loading

Loads within the capacity of the vehicle should be evenly distributed and properly secured, and should not project beyond the plan area of the vehicle. If some degree of projection is unavoidable, it should be clearly shown by the attachment of flags. Uneven loading can cause a loss of control when cornering or braking, and insecure loads may swerve or fall off the vehicle during travel. The body of a tipper lorry should always be lowered before you drive off.

Loading and unloading should be an integral part of driver training.

9 APPENDIX: TRUCK DRIVERS

The following useful advice is taken from:

Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE.
Department of Labour, Wellington New Zealand
http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf

Loading

Watch for and avoid other vehicles, personnel and rock outcrops on entering or leaving the loading area. Wait a safe distance for trucks ahead of you at the loading point, and follow the direction of the signalman or loader operator before moving into the loading position. Never enter or leave the cab while loading is in progress. Move off when signalled that loading is complete.

Load materials such as timber so that they do not project beyond the truck body and present a hazard to other plant, people or structures.

Keep clear when trucks are being loaded.

Reverse safely. Use a signalman.

Secure loads at the lowest possible level on the tray with ropes or chains, and take special care when your truck is to travel over rough terrain.

Drive defensively. Obey road signs. Never race other vehicles. When you are following another vehicle, always allow enough distance to stop safely. One truck length for every 10km per hour of truck speed should be the minimum space between vehicles.

Backing

Backing is the most hazardous truck operation. Every year at least one worker is killed by being run over by a reversing truck. Reversing alarms, which are fitted on some trucks, are effective in warning workers of the danger. Back trucks only when they are under the direction of a signalman or when you are satisfied that the way is clear and will remain clear.

Tips and Fills

Don’t raise your truck’s tray to unload material unless the truck has stopped. Unless you are spreading road metal, do not move the truck unless the tray is fully down. Take special care when running out metal on a road. With the tray up, trucks are less stable and are prone to roll over, particularly on hilly sections and on roads with surface irregularities or steep shoulders. Also the tray may hit overhead power or telephone wires.

Transporting Workers

Trucks which are regularly used for transporting workers should be enclosed, have seats which are attached to the vehicle, and have a safe means of access and egress.

Drivers of trucks carrying passengers should be alert, dependable and careful. Safety rules you should follow are:
(a) Don't allow passengers to ride on the sides or ends of trucks with their legs hanging over or arms outside. Nor should they be allowed to ride on running boards or on loads likely to shift.
(b) Don't start the truck until everyone is seated.
(c) Don't allow workers to get on or off the truck while it is in motion.
(d) Don't allow tools, plant or gear to be stored in the same compartment as workers. If minor items are stored in the compartment secure them against movement.
(e) Ensure that exhaust fumes do not enter the passengers' compartment.

[Taken from Safety in Construction No. 25. ROAD WORKS SAFETY GUIDE Department of Labour, Wellington New Zealand: http://www.osh.govt.nz/order/catalogue/archive/roadworksafety.pdf. **Construction OS&H** has used a number of extracts from this very good Guide, for which the ILO is very grateful. The Department of Labour web site states (on 27 04 2010) "download pdf copies free" and goes on to give advice on how to download them and use them, so ILO has presumed that this documents is in the public domain for copyright purposes.]

10 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

Title	My construction photos
Author(s)	Dr Robert I Carr
Type of source	Web site
Publication or other source details	http://myconstructionphotos.smugmug.com/
Date & ISBN/ISSN	This site was accessed for **ILO Construction OS&H** in July 2009
Summary of contents	This is the personal site of Dr Robert I Carr, one of the most highly respected professors in the construction world. He has offered more than 2000 high quality photos, fully captioned, for free use. Here he is in person: http://myconstructionphotos.smugmug.com/gallery/2435976/ Although largely taken in the USA, there are photos taken in other countries.
Comments on relevance	This is a wonderful resource for trainers.
Other information	There are some superb photos of construction hazards

M: WORKING AT OR BELOW GROUND LEVEL

(Photo: Fiona Murie, BWI)

Summary of content

1 PREFACE

This Module Summary describes how to work at or below ground level in ways that safeguard the people involved. The components, plant and equipment used are described in Module Summary J: "General plant and equipment".

This Module Summary follows the relevant structure and content of the "ILO Code of Practice: Safety & health in construction" (the "Code"). The following passage is taken from this Code:

1.1. Objective

1.1.1. The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

> *(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;*
>
> *(b) ensuring appropriate design and implementation of construction projects;*
>
> *(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.*

1.1.2. This code also provides guidance in the implementation of the provisions of the ILO Safety and Health in Construction Convention, 1988 (No. 167), and the ILO Safety and Health in Construction Recommendation, 1988 (No. 175)."

Other passages from this Code are included in this Module Summary, and they are shown in the same format as above.

This Module Summary also includes extracts from the ILO's "Safety, health and welfare on construction sites: A training manual" ("The Manual").

A brief bibliography is given at the end of this Module Summary.

This Module Summary follows the sections shown in the table above.

2 COMMON HAZARDS WITH WORKING AT OR BELOW GROUND LEVEL

Working at or below ground level should create no hazards for anyone on a construction project. Many of the hazards that do arise have the following causes:

- Inadequate site investigation
- Poor technical design leading to collapse under load or working conditions
- Poor mechanical design of plant and equipment (breaks in use, not powerful enough, components fracture or malfunction)
- Failure to control groundwater
- Poor workplace design
- Poor general supervision
- Signalling systems (manual, mechanical, electronic) malfunction
- Misuse of plant and equipment (not used as designed)
- Collisions with moving plant and equipment
- Poor maintenance (breaks or emits noxious gases)

These cause the following hazards:

- Earthworks collapse or cave in
- Exposure to 'unexpected' risks in excavations
- Vehicles fall into excavations
- Loads fall from vehicles
- Crushing due to impact of moving or toppling plant and equipment
- Impact from release of pressure (e.g. concrete exploding from concrete pump hose failure)
- Falling from plant and equipment
- Falls caused by swinging loads, plant and equipment
- Limbs or bodies caught in machinery
- Poor ergonomics
- Physiological and psychological damage through repetitive work
- Physiological and psychological damage caused by poor environment (wet conditions, noise, heat, poor ventilation, chemicals; noxious gases)

These are, of course, just some of the main hazards, there are many more which are specific to particular projects.

3 COMMON EXCAVATIONS

Introduction

Most construction work involves some form of excavation for foundations, sewers and underground services. Excavation or trenching work can be highly dangerous and even some of the most experienced workers have been caught by the sudden and unexpected collapse of the unsupported sides of a trench.

Persons buried under a cubic metre of soil will be unable to breathe due to pressure on the chest, and quite apart from any physical injury they will quickly suffocate and die, for even this comparatively small amount of soil weighs over 1 tonne.

Excavation work involves the removal of soil or a mixture of soil and rock. Water is nearly always present, even if only as moisture in the soil, and heavy rain is a frequent cause of soil slip. The possibility of flooding presents an additional hazard which should always be considered. Cracks are caused by pressure release as soil is removed, or from drying out in hot weather.

Soil varies in its nature (e.g. fine sand which flows easily, and stiff clay which is more cohesive). However, no soil can be relied upon to support its own weight and precautions always need to be taken to prevent the collapse of the sides of an excavation of more than 1.2m in depth.

Some of the specific hazards caused by excavations are:

- Persons becoming trapped and buried in an excavation owing to the collapse of the sides
- Persons being struck and injured by material and other items falling into the excavation
- Persons falling into the excavation
- Unsafe means of access and insufficient means of escape in case of flooding
- Vehicles driven into or too close to the edge of an excavation, particularly while reversing, causing the sides to collapse
- Asphyxiation or poisoning caused by fumes heavier than air entering the excavation, e.g. exhaust fumes from diesel and petrol engines

General requirements

9.1.1. Adequate precautions should be taken in any excavation, shaft, earthworks, underground works or tunnel:

(a) by suitable shoring or otherwise, to guard against danger to workers from a fall or dislodgement of earth, rock or other material;

(b) to guard against dangers arising from the fall of persons, materials or objects or the inrush of water into the excavation, shaft, earthworks, underground works or tunnel;

(c) to secure adequate ventilation at every workplace so as to maintain an atmosphere fit for respiration and to limit any fumes, gases, vapours, dust or other impurities to levels which are not dangerous or injurious to health and are within limits laid down by national laws or regulations;

(d) to enable the workers to reach safety in the event of fire, or an inrush of water or material;

(e) to avoid risk to workers arising from possible underground dangers such as the circulation of fluids or the presence of pockets of gas, by undertaking appropriate investigations to locate them.

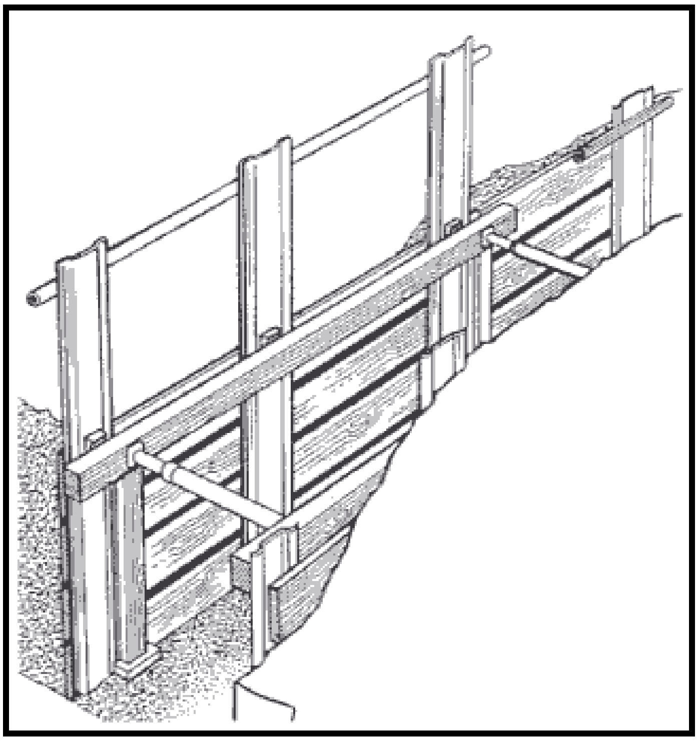
The sides of the excavation or trench should be sloped or battered back to a safe angle of repose, usually 45°, or be supported by timbering or other suitable means to prevent a collapse. The type of support necessary will depend upon the type of excavation, the nature of the ground and the groundwater conditions.

(Photo: Fiona Murie, BWI)

The photo above shows one side of a large excavation battered back, perhaps at rather too steep an angle but the ground may be firm enough to justify the slope. There is also a set of access steps with handrails, but these may not be large enough for all these workers to escape in a sudden emergency, such as flooding.

Close boarding or sheeting is required if the ground is unstable or lacks cohesion. Work should not proceed ahead of the trench support.

The diagram below shows a trench in soft ground being supported by metal 'trench sheets' vertically, which support horizontal timbers. The vertical spacing of the timbers depends upon the assessed strength of the ground.



The struts between the sides of the trench are metal 'trench struts', which are adjustable so that they can be firmly braced against the supports. Timber struts, tightened by the use of wedges at the ends, are just as effective.

9.1.2. Shoring or other support for any part of an excavation, shaft, earthworks, underground works or tunnel should not be erected, altered or dismantled except under the supervision of a competent person.

Shoring should be erected, altered or dismantled only by a competent worker operating under supervision. Wherever practicable, it should be installed before excavating to the final depth of the trench – it is necessary to begin when the trench is less than 1.2m deep. The excavation and installation of shoring should then proceed by stages until the full depth is reached.

Workers and others often fall into excavations. Erect suitable barriers high enough (i.e. about 1m) to prevent falls. As shown in the diagram above, projecting vertical trench supports can often be used for this purpose.

As a simple search of 'trench support systems" on the Internet will show, there are many types of trenching and excavation support system available, for example: http://www.aplant.com/catalogue.

9.1.3. Every part of an excavation, shaft, earthworks, underground works and tunnel where persons are employed should be inspected by a competent person at times and in cases prescribed by national laws or regulations, and the results recorded.

9.1.4. Work should not commence therein until the inspection by the competent person as prescribed by national laws or regulations has been carried out and the part of the *excavation, shaft, earthworks, underground works or tunnel has been found safe for work.*

9.2.1. Before digging begins on site:

(a) all excavation work should be planned and the method of excavation and the type of support work required decided;

(b) the stability of the ground should be verified by a competent person;

(c) a competent person should check that the excavation will not affect adjoining buildings, structures or roadways;

(d) the employer should verify the position of all the public utilities such as underground sewers, gas pipes, water pipes and electrical conductors that may cause danger during work;

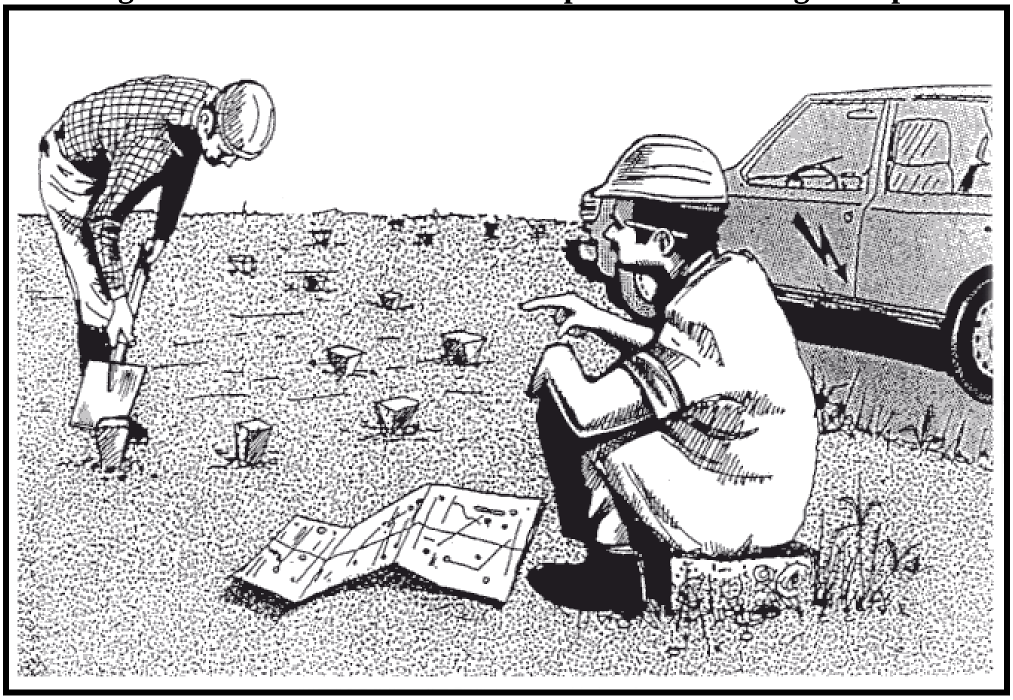
It is safe to assume that there may be underground services below the surface. In built-up areas, it is almost certain that electrical cables, water services and sewers are present. In some locations there may also be gas pipes. Some of these services look alike.

Striking electric cables may cause death or severe injuries by electric shock or severe burns. Broken gas pipes will leak and may cause a fire or explosion. Water and sewer pipes if broken may create sudden risks by flooding an excavation or by causing its sides to collapse.

Every year workers digging on construction sites suffer severe burns when they accidentally hit live buried electrical cables. Buried cables should always be assumed to be live. Before excavating, the project management must inquire of the electricity authority, the local authority or the site owner if they have any plans of the layout of cables in the area. Even if plans exist, it is possible that some cables may not be marked on the plan or may not be exactly where the plan shows, for cables rarely follow an exact straight line.

Traffic signs, street lights and substations which are usually supplied by buried cables, so these give clues to the location of the services. A cable locator must be used if available, but if cables are close together the locator may not be able to tell them apart, and some types of cable cannot be traced by locators.

Locating buried electrical cables from a plan and marking their position



The position of cables should be marked with chalk, crayon or paint or, if the ground is too soft for this, with wooden pegs (and never use sharp spikes). Once the approximate position of a buried cable is known, hand tools must be used to expose it, preferably spades and shovels rather than forks or pick-axes.

Power tools should not be used within half a metre of a cable.

Do not use mechanical excavators within half a metre of a gas pipe. If there is a smell of gas, there must be no sources of ignition nearby such as a lit cigarette or running vehicle engine. The area must be cleared of all persons and the authorities informed and asked to make the pipe safe. Plant or equipment should never be used over or near a gas pipe, as the pipe may fracture.

All exposed pipes and cables should be supported when an excavation is open. They should not be used to support equipment or as steps to get in and out of the excavation. When backfilling a trench with a gas pipe, the fill must be adequately compacted beneath the pipe to prevent settlement which could lead to pipe fracture.

Points to remember when searching for buried services

Hand dig with care, as cables may be just below the surface

Use a spade or shovel and not a fork or pick-axe,
and do not spear the tools into the ground

If you find a cable embedded in concrete,
do not break it out but seek advice

If a cable is damaged, even slightly, keep well clear

Do not work bare-chested
Normal work clothing can provide some protection from flash burns

(e) if necessary to prevent danger, the gas, water, electrical and other public utilities should be shut off or disconnected;

(f) if underground pipes, cable conductors, etc., cannot be removed or disconnected, they should be fenced, hung up and adequately marked or otherwise protected;

(g) the position of bridges, temporary roads and spoil heaps should be determined;

(h) if necessary to prevent danger, land should be cleared of trees, boulders and other obstructions;

(i) the employer should see that the land to be excavated is not contaminated by harmful chemicals or gases, or by any hazardous waste material such as asbestos.

9.2.2. All excavation work should be supervised by a competent person and operatives doing the work should be given clear instructions.

9.2.3. Sides of excavations should be thoroughly inspected:

(a) daily, prior to each shift and after interruption in work of more than one day;

(b) after every blasting operation;

(c) after an unexpected fall of ground;

(d) after substantial damage to supports;

(e) after heavy rain, frost or snow;

(f) when boulder formations are encountered.

9.2.4. No load, plant or equipment should be placed or moved near the edge of any excavation where it is likely to cause its collapse and thereby endanger any person unless precautions such as the provision of shoring or piling are taken to prevent the sides from collapsing.

[Source of image & caption: Robert Carr, http://myconstructionphotos.smugmug.com)

"Trench construction, safety: Caterpillar 3128 crawler mounted backhoe straddles trench for underground pipe. Worker in trench is fine grading/cleaning trench with shovel. Workers standing in 8ft deep trench have no support against sidewall collapse. Safety and laws require the trench walls to be supported or sloped back at depths greater than 5ft."

9.2.5. Adequately anchored stop blocks and barriers should be provided to prevent vehicles being driven into the excavation. Heavy vehicles should not be allowed near the excavation unless the support work has been specially designed to permit it.

9.2.6. If an excavation is likely to affect the security of a structure on which persons are working, precautions should be taken to protect the structure from collapse.

9.2.7. Sides of excavations where workers are exposed to danger from moving ground should be made safe by sloping, shoring, portable shields or other effective means.

9.2.8. All support work should be regularly checked to ensure that the props, wedges, etc., are tight and no undue deflection or distortion is taking place.

9.2.9. All timber subject to the varying weather conditions should be regularly checked for dryness, shrinkage and rot.

Points to remember when working in excavations

Never work ahead of the side supports in a trench
even when you are erecting shoring

Appearances can be deceptive. The shallowness of an excavation or the solid appearance of the ground are not necessarily an indication of safety

Deep trenches look dangerous,
but most fatal accidents occur in trenches less than 2.5m deep

Always wear a safety helmet when you work in an excavation

Underground construction

9.3.1.1. Underground construction work should be carried on in accordance with plans approved by the competent authority when required by national laws and regulations. The plan should define excavation methods, rescue and evacuation methods in case of fire, flood and fall or dislodgement of earth or rock.

9.3.1.2. All underground construction work should be supervised by a competent person and operatives doing the work should be given clear instructions.

9.3.1.3. All occupied workplaces underground should be inspected at least once in every shift.

9.3.1.4. Places occupied by solitary workers should be inspected at least twice in every shift.

9.3.1.5. At least once in every week, thorough inspection should be made of all machinery, equipment, structures, supports, roadways, means of egress, magasines, medical facilities, sanitation and working places.

9.3.1.6. All workers should be withdrawn from underground workings if:

> *(a) the ventilation fails; or*
>
> *(b) other imminent danger threatens.*

9.3.1.7. A suitable communication system should be maintained from the vicinity of the face of underground workings to the surface with stations at intermediate workplaces.

9.3.1.8. In tunnels and other underground workings where an explosive mixture such as methane and air may form, operations should be carried on in accordance with national laws and regulations applicable to gassy mines or coal mines.

9.3.1.9. Air should be tested to ascertain if it is hazardous and no one allowed entry until it is fit for breathing.

9.3.1.10. Escape routes should be properly indicated with signs visible in dim light.

4 SHAFTS AND HEADINGS

See also Module Summary 10: “General plant & equipment”.

9.3.2.1. Every shaft not sunk through solid rock should be cased, lined or otherwise made safe.

9.3.2.2. Shuttering for masonry lining of shafts should only be removed gradually as the masonry progresses.

9.3.2.3. Workers employed on sinking shafts should be provided with staging, scaffolds or cradles from which they can work safely.

9.3.2.4. A thorough inspection of the shaft should be made:

(a) before a shift descends;

(b) after blasting.

9.3.3.1. All underground workings should be traversed by a regular air current to keep them in a fit state for working and, in particular:

(a) to avoid excessive rises in temperature;

(b) to dilute harmful dusts, gases, vapours and fumes to safe concentrations;

(c) to prevent the oxygen content of the atmosphere from falling below 17 per cent or a level prescribed in national laws and regulations.

9.3.3.2. In all underground workings it should be possible to reverse the air flow.

9.3.3.3. In tunnels where blasting is done:

(a) an adequate supply of air should be taken to the face by mechanical ventilation;

(b) after every blast the face should be cleared of harmful gases and dust as far as practicable by exhaust ventilation; where necessary, the dust should be controlled with water sprays or fog guns;

(c) if necessary to remove the fumes, auxiliary ventilation should be provided.

9.3.3.4. Where adequate ventilation is not possible, workers should be provided with suitable breathing apparatus. Only in very exceptional circumstances should people be allowed to work without adequate ventilation.

9.3.4.1. No combustible structure should be built or any flammable material stored within 30m of a shaft, tunnel mouth, hoisting-engine house or ventilation-fan house.

9.3.4.2. As far as practicable, combustible materials and flammable liquids should not be stored underground.

9.3.4.3. Lubricating oils, grease and rope dressings underground should:

(a) be kept in closed metal containers;

(b) be stored in a safe place away from shafts, hoists, explosives and timber.

9.3.4.4. Unless there is no risk of fire or explosion, naked lights and smoking should not be allowed underground.

9.3.4.5. Petrol engines should not be used underground except under conditions approved by the competent authority.

9.3.4.6. If welding or flame cutting is done underground:

(a) timber supports and other combustible structures or materials should be protected by a fireproof screen;

(b) suitable fire extinguishers should be kept readily available;

(c) a constant watch should be kept for outbreaks of fire;

(d) welding fumes should be removed by exhaust ventilation.

9.3.5.1. Electrical installations in shafts and tunnels should comply with the relevant national laws or regulations.

9.3.6.1. All places where workers have to work or pass should be adequately lit.

9.3.6.2. In addition to the main lighting, there should be emergency lighting that functions long enough to enable the workers to reach the surface safely.

9.7.1. The haulage system should comply with the national laws and regulations.

9.7.2. In tunnels where there are rail tracks, unless there is adequate clearance between the rolling stock and the sides, recesses should be provided at suitable intervals which should be large enough to accommodate two persons and should be at least 60cm deep.

9.7.3. Mechanical haulage operations should be controlled by suitable signals.

9.7.4. Trains and single cars should have headlights and tail-lights.

9.7.5. Rerailing by hauling with a winch should only be done under the control and supervision of a competent person.

9.7.6. Workers should not be transported on locomotives or in cars other than those specially provided for that purpose.

9.8.1. Adequate measures should be taken to prevent the formation of, or to suppress as close to the source as practicable, all dust in tunnelling operations and in particular siliceous dusts consisting of particles less than 5 microns in size.

5 DEMOLITION AND CONTAMINATED SITES

See also Module Summary N: "Working at height".

General provisions

14.1.1. When the demolition of any building or structure might present danger to workers or to the public:

(a) appropriate precautions, methods and procedures should be adopted, including those for the disposal of waste or residues, in accordance with national laws or regulations;

(b) the work should be planned and undertaken only under the supervision of a competent person.

14.1.2. Before demolition operations begin:

(a) structural details and builders' drawings should be obtained wherever possible;

(b) wherever possible, details of the previous use should be obtained to identify any possible contamination and hazards from chemicals, flammables, etc.;

(c) an initial survey should be carried out to identify any structural problems and risks associated with flammable substances and substances hazardous to health. The survey should note the type of ground on which the structure is erected, the condition of the roof trusses, the type of framing used in framed structures and the load-bearing walls;

(d) premises such as hospitals, telephone exchanges and industrial premises containing equipment sensitive to vibration and dust and all premises sensitive to noise should be located;

(e) a method of demolition should be formulated after the survey and recorded in a method statement having taken all the various considerations into account and identifying the problems and their solutions;

(f) a building should be checked and it should be verified that it is vacant.

14.1.3. All electric, gas, water and steam service lines should be shut off and, as necessary, capped or otherwise controlled at or outside the construction site before work commences.

14.1.4. If it is necessary to maintain any electric power, water or other services during demolition operations, they should be adequately protected against damage.

14.1.5. As far as practicable, the danger zone round the building should be adequately fenced off and signposted. To protect the public a fence 2m high should be erected enclosing the demolition operations and the access gates should be secured outside working hours.

14.1.6. Demolition operations should only be carried out by competent workers.

14.1.7. The fabric of buildings contaminated with substances hazardous to health should be decontaminated and where necessary appropriate protective clothing and suitable respiratory protective equipment should be provided and worn.

14.1.8. Where plant has contained flammable materials, special precautions should be taken to avoid fire and explosion.

14.1.9. The plant to be demolished should be isolated from all other plant that may contain flammable materials. Any residual flammable material in the plant should be rendered safe by, for example, cleaning, purging or the application of an inert atmosphere as appropriate.

14.1.10. Care should be taken not to demolish any parts which would destroy the stability of other parts.

14.1.11. Demolition activities should not be continued under climatic conditions such as high winds, which could cause the collapse of already weakened structures.

14.1.12. When necessary to prevent danger, parts of structures should be adequately shored, braced or otherwise supported.

14.1.13. Structures should not be left in a condition in which they could be brought down by wind pressure or vibration.

14.1.14. Where necessary to keep down dust, buildings being demolished should be sprayed with water at suitable intervals.

14.1.15. Foundation walls serving as retaining walls to support earth or adjoining structures should not be demolished until the adjoining structure has been underpinned or braced, and the earth removed or supported by sheet piling or sheathing.

14.1.16. Where a deliberate controlled collapse technique is to be used, expert engineering advice should be obtained, and:

(a) it should only be used where the whole structure is to come down because it relies on the removal of key structural members to effect a total collapse;

(b) it should only be used on sites that are fairly level and where there is enough surrounding space for all operatives and equipment to be withdrawn to a safe distance.

14.1.17. Buildings and structures which are not carrying their design loads may be pre-weakened prior to a deliberate collapse, but in such cases:

(a) the pre-weakening should be carefully planned so that, despite the removal of redundant members and the partial cutting of load-bearing members, the structure should have sufficient strength to resist wind loads or impact loads until such time as a deliberate collapse is achieved;

(b) the dead load should be reduced systematically by the removal of surplus material, machinery, cladding, walls and parts of floors before work begins on the structural frame.

14.1.18. Where explosives are used to demolish key members, the blast protection and safe distances should be agreed in advance. The work should only be undertaken by personnel experienced in the controlled application of explosives in accordance with national laws and regulations.

14.1.19. The shot-firers should establish the area at risk to enable the area to be appropriately cleared or evacuated, if necessary. Blast protection should be of a high standard but should not be considered as an alternative to defining the area likely to be affected.

14.1.20. When equipment such as power shovels and bulldozers are used for demolition, due consideration should be given to the nature of the building or structure, its dimensions, as well as to the power of the equipment being used.

Cranes used in demolition

A cast-steel ball or weight suspended from a crane jib is an extensively used method of demolition. Cranes as such are not designed for extremes of shock loading likely to arise when a demolition ball is in use and therefore should be used only to drop the ball vertically on a free fall for such operations as breaking up concrete slabs. They should not be used for swinging the ball. Excavators which are convertible to cranes are designed for drag-line operations which impose a shock load and are more suited to use with a ball.

The excavator manufacturer's recommendations as to weight and attachment of the ball should be followed. Generally the weight of the demolition ball should not be more than 33 per cent of the machine's safe working load and not exceed 10 per cent of the hoist rope's minimum breaking load. All parts should be inspected twice daily, and a high standard of maintenance is necessary. As an operator you need to be familiar with demolition balling and should be protected from debris by a protective structure with safety glass or metal mesh.

14.1.21. If a swinging weight is used for demolition, a safety zone having a width of at least one-and-a-half times the height of the building or structure should be maintained around the points of impact.

14.1.22. Swinging weights should be so controlled that they cannot swing against any structure other than the one being demolished.

Useful advice from The Concrete Network:
http://www.concretenetwork.com/concrete/demolition/ball_and_crane.htm

Ball and Crane for Demolishing Masonry and Concrete Structures

One of the oldest and most commonly used methods for building demolition, the ball and crane uses a wrecking ball weighing up to 13,500 pounds to demolish concrete and masonry structures. During the process, the ball is either dropped onto or swung into the structure that is to be demolished.

The ball and crane, however, is not suitable for all demolition applications. Some limitations:

- *While the concrete can be broken into rather small pieces, additional work in the form of cutting rebar may be necessary.*
- *Only highly skilled and experienced crane operators should be used on ball and crane demolition projects -- smoothness in controlling the swing of the ball is important since missing the target may tip or overload the crane and a mild swing-back may cause the ball to hit the boom.*
- *The size of the building that can be demolished with this method is limited by crane size and working room, including proximity to power lines.*
- *This form of demolition creates a great deal of dust, vibration and noise.*

(185 words so ‘fair use)

14.1.23. If a clamshell bucket is used for demolition, a safety zone extending 8m from the line of travel of the bucket should be maintained.

14.1.24. Where necessary during the demolition of buildings or other structures, appropriate catch platforms capable of withstanding safely a live load of 6.0 kN/m2 and at least 1.5m wide should be provided along the outside of exterior walls so as to prevent danger from falling objects.

Demolition of walls

14.2.1. Walls should be demolished storey by storey beginning at the roof and working downwards.

(Photo & caption by (Photo: Robert Carr, http://myconstructionphotos.smugmug.com)
Building construction demolition:
Samsung SE 350 LC2 backhoe grapple tears window out of building wall.

14.2.2. Where necessary, unsupported walls should be prevented from falling by means such as shoring and ties.

Demolition of floors

14.3.1. When necessary to prevent danger, workers demolishing floors should be provided with planking or walkways on which to stand or move.

14.3.2. Openings through which material is dropped should be adequately fenced or barricaded to prevent danger.

14.3.3. All work above each tier of floor beams should be completed before the safety of the tier supports is impaired.

Demolition of structural steelwork

14.4.1. All practicable precautions should be taken to prevent danger from any sudden twist, spring or collapse of steelwork, ironwork or reinforced concrete when it is cut or released.

14.4.2. Steel construction should be demolished tier by tier.

14.4.3. Structural steel parts should be lowered and not dropped from a height.

6 CONFINED SPACES

Introduction

Every year there are fatal and serious accidents caused by persons entering confined spaces without the necessary tests being carried out or the correct safety and rescue equipment being provided. In many cases attempted rescue has ended in tragedy, with the death of the poorly equipped rescuer as well as the person to be rescued. While a closed tank with a restricted access opening may be the obvious example of a confined space, such spaces may also include open manholes, sewers, trenches, bored piles, pipes, ducts, enclosed basements and other places where there is inadequate ventilation.

Dangerous atmospheres can arise when there is a lack of oxygen or when toxic or flammable gases are present. These may be due to exhaust gases from plant and transport, carbon dioxide forming in chalk soil, decomposition of sludge in a sewer, leaks from gas mains, rusting of metalwork, or the presence of petrol and various kinds of waste from factories and trade premises. Work being done in a confined space can make it dangerous. Examples are some painting work, the use of adhesives to fix floor tiles, and cleaning fluids.

Many of these accidents would have been avoided if supervisors and workers had been properly trained and a permit to enter and a permit to work system had been in operation.

The ILO Code

17.4.1. An information system should be set up by the competent authority, using the results of international scientific research, to provide information for clients, architects, contractors, employers' and workers' representatives on the health risks associated with the hazardous substances used in the construction industry.

17.5.1. Where workers are required to enter any area in which a toxic or harmful substance may be present, or in which there may be an oxygen deficiency or a flammable atmosphere, adequate measures should be taken to guard against danger.

17.5.2. The measures regarding dangerous atmospheres to be taken pursuant to paragraph 17.4.1 above should be prescribed by the competent authority and should include prior written authority or permission from a competent person, or any other system by which entry into any area in which a dangerous atmosphere may be present can be effected only after completing specified procedures.

17.5.3. No naked light or flame or hot work such as welding, cutting and soldering should be permitted inside a confined space or area unless it has been made completely free of the flammable atmosphere, tested and found safe by a competent person. Only non-sparking tools and flameproof hand lamps protected with guard and safety torches should be used inside such confined space or area for initial inspection, cleaning or other work required to be done for making the area safe.

17.5.4. No person should enter a confined space or area with a dangerous atmosphere or deficiency of oxygen unless:

(a) the atmosphere has been found to be safe after suitable testing by a competent person (which should be repeated at suitable intervals);

(b) adequate ventilation is provided.

17.5.5. If the conditions in the preceding paragraph cannot conveniently be fulfilled, persons may enter such spaces for prescribed periods using air lines or self-contained breathing apparatus and safety harnesses with lifelines.

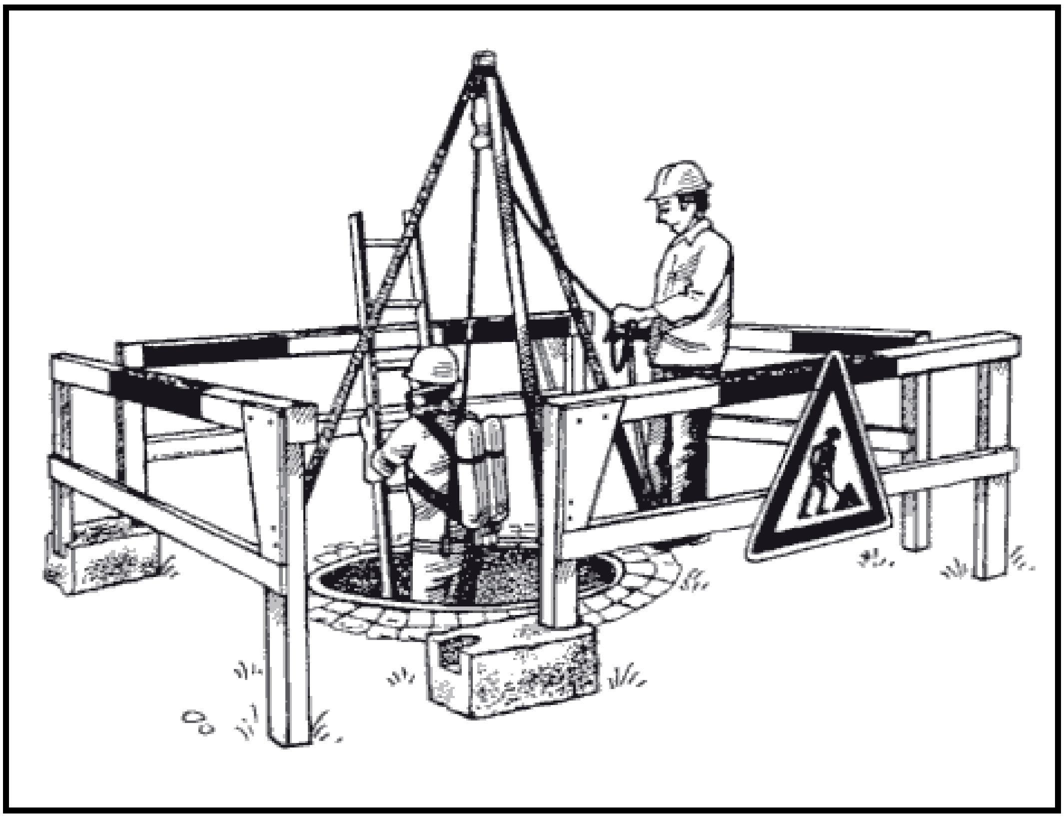
17.5.6. While a worker is in a confined space:

(a) adequate facilities and equipment including breathing apparatus, resuscitation apparatus and oxygen should be readily available for rescue purposes;

(b) a fully trained attendant or attendants should be stationed at or near the opening;

(c) suitable means of communication should be maintained between the worker and the attendant or attendants.

Working in confined spaces



Persons who are actively engaged in work in confined spaces must be fit and properly trained for the job and have the necessary personal protective equipment. They should remember that an oxygen deficiency can render them unconscious, and that toxic fumes can additionally cause dizziness and a feeling of sickness, while gases can be flammable or explosive.

The following precautions are essential before anyone enters a confined space:

- *Nobody should enter without instructions from a supervisor and without a written permit to enter or permit to work. Nobody may enter the confined space until the competent person is satisfied that entry is safe.*

- *Equipment for monitoring the atmosphere at frequent intervals must be provided and must be used by a competent person.*

- *There should be forced ventilation to remove and dilute dangerous gases and provide fresh air.*

- *Monitoring must continue while work proceeds, and everyone must leave immediately if told to do so.*

- *Everyone should have received proper training and instruction in the precautions to be taken, including the use of emergency breathing apparatus.*

- *Rescue harnesses should be worn by everyone inside the confined space, with lifelines attached to a point outside the space.*

- *Not less than two persons should be present when there is work in a confined space. One should be outside the confined space to keep watch and to offer rescue action or assistance. Additional emergency and accident assistance must also be readily available.*

- *A proper procedure for rescue in an emergency should be laid down, with specific duties allocated to specific persons.*

- *When working at a manhole in a road or public area, guard stands must be provided and the appropriate traffic signs displayed.*

- *Everyone has to be trained by a competent person in the use of the safety and rescue equipment.*

7 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

Title	My construction photos
Author(s)	Dr Robert I Carr
Type of source	Web site
Publication or other source details	http://myconstructionphotos.smugmug.com/
Date & ISBN/ISSN	This site was accessed for **ILO Construction OS&H** in July 2009
Summary of contents	This is the personal site of Dr Robert I Carr, one of the most highly respected professors in the construction world. He has offered more than 2000 high quality photos, fully captioned, for free use. Here he is in person: http://myconstructionphotos.smugmug.com/gallery/2435976/ Although largely taken in the USA, there are photos taken in other countries.
Comments on relevance	This is a wonderful resource for trainers.
Other information	There are some superb photos of construction hazards

N: WORKING AT HEIGHT

(Photo: Fiona Murie, BWI)

Summary of content	
1.	Preface
2.	Common hazards with working at height
3.	General OS&H requirements when working at height
4.	Scaffolding
5.	Structural frames
6.	Demolition of above ground structures
7.	Roof-work
8.	Brief bibliography

1 PREFACE

This Module Summary describes ways in which to work at height in ways that safeguard the people involved. The components, plant and equipment used are described in the Module Summary J: "General plant and equipment".

This Module Summary follows the relevant structure and content of the "ILO Code of Practice: Safety & health in construction" (the "Code"). The following passage is taken from this Code:

1.1. Objective

1.1.1. The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;

(b) ensuring appropriate design and implementation of construction projects;

(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.

1.1.2. This code also provides guidance in the implementation of the provisions of the ILO Safety and Health in Construction Convention, 1988 (No. 167), and the ILO Safety and Health in Construction Recommendation, 1988 (No. 175)."

Other passages from this Code are included in this Module Summary, and they are shown in the same format as above.

This Module Summary also includes extracts from the ILO's "Safety, health and welfare on construction sites: A training manual" (the "manual").

A brief bibliography is given at the end of this Module Summary.

This Module Summary follows the sections shown in the table above.

2 COMMON HAZARDS WITH WORKING AT HEIGHT

Although obviously hazardous, working at height should create no hazards for anyone on a construction project. Many of the hazards that do arise have the following causes:

- Poor conceptual design of the permanent works (designed with no thought or provision for how they will be built)
- Poor structural design (breaks under load, not strong enough, components fracture or malfunction)
- Poor functional design (not properly designed for the stated purpose)
- Inadequate planning and provision for weather
- Structural elements incorrectly erected or installed
- Poor (or perhaps no) workplace design (working platforms, access, egress)
- Signalling systems (manual, mechanical, electronic) malfunction
- Misuse (elements and equipment not used as designed or planned)
- Unprotected edges and openings
- Loads insecurely attached
- Release of pressure (concrete pumps)

These cause the following hazards:

- Workers put in dangerous positions
- Workers handling very heavy or awkward loads causing falls or injury
- Falls due to collapses of partly built permanent works
- Workers crushed by falling or otherwise moving elements or equipment
- Falling loads
- Crushing due to impact of moving or toppling plant and equipment
- Impact from release of pressure (e.g. concrete exploding from concrete pump hose failure)
- Falling from plant and equipment
- Falls caused by swinging loads, plant and equipment
- Limbs or bodies caught in parts of the permanent works or machinery
- Physiological damage through exposure to weather
- Poor ergonomics
- Physiological and psychological damage through stress of dangerous work
- Stress caused by poor environment (noise, heat, poor ventilation, chemicals, noxious gases)

(Photos: Richard Neale. Project in Dar es Salaam)

3 GENERAL OS&H REQUIREMENTS WHEN WORKING AT HEIGHT

Fall of materials

8.1.1. Where necessary to guard against danger, or where the height of a structure or its slope exceeds that prescribed by national laws or regulations, preventive measures should be taken against the fall of workers and tools or other objects or materials.

3.4.1. Adequate precautions should be taken such as the provision of fencing, look-out men or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered.

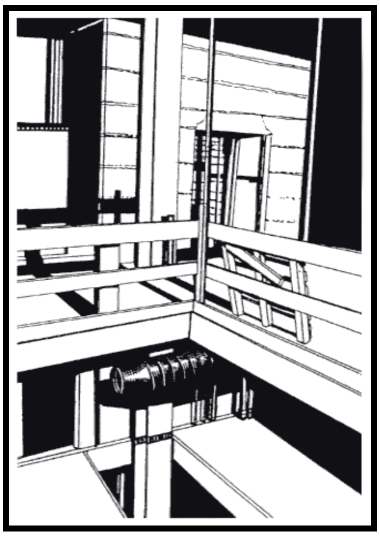
Openings

3.4.3. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.

3.4.4. As far as practicable, guard-rails and toe-boards in accordance with national laws and regulations should be provided to protect workers from falling from elevated work places. Wherever the guard-rails and toe-boards cannot be provided:

> *(a) adequate safety nets or safety sheets should be erected and maintained; or*
>
> *(b) adequate safety harnesses should be provided and used.*

8.1.2. Elevated workplaces, including roofs more than 2m or as prescribed, above the floor or ground should be protected on all open sides by guard-rails and toeboards complying with the relevant national laws and regulations. Wherever guard-rails and toe-boards cannot be provided, adequate safety harnesses should be provided and used.



Ladders

8.1.3. Elevated workplaces, including roofs, should be provided with safe means of access and egress such as stairs, ramps or ladders complying with the relevant national laws and regulations.

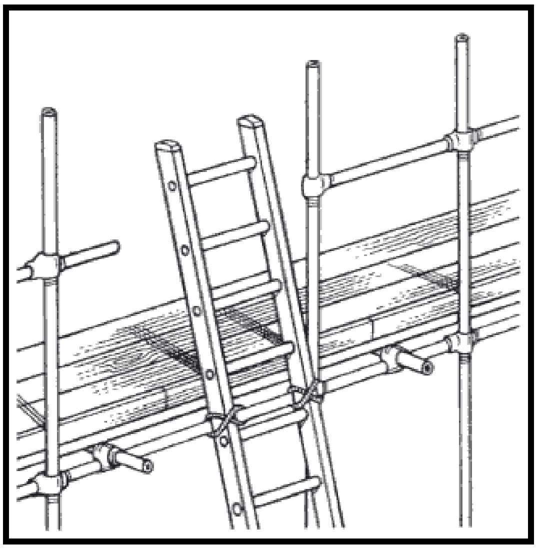
Every year many workers are killed or severely injured while using ladders of all types. Because a ladder is so readily available and inexpensive, its limitations are easily overlooked. So the first question to ask is – can the job be done more safely using other equipment? For example, a proper working platform can often ensure that the job is performed more quickly and efficiently.

If a ladder is properly used it:

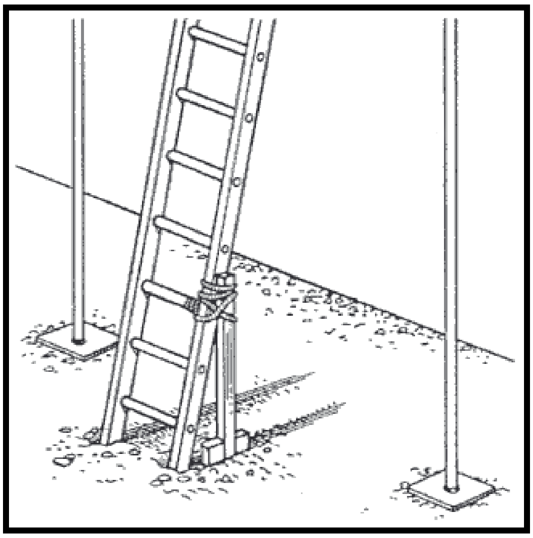
- Enables only one person to climb or descend at any one time.
- Enables only one person to work from it at any one time.
- If not lashed at the top, it requires two workers for use – one on the ladder and the other at the bottom.
- Leaves only one hand free; carrying tools or loads up a ladder is difficult and dangerous and the weight which can be carried is severely limited; there is also the risk of dropping items on passers-by.
- Restricts movement.
- Has to be safely situated and secured.
- Has a limitation on heights at which it can be used.

More than half of ladder accidents are caused by the ladder slipping at the base or at the top. The foot of a ladder should be on a firm and level base. If possible, the ground should be levelled or the foot of the ladder buried. If the ground is soft, the ladder should stand on a board. The ladder should never be supported by carrying its total weight on the bottom rung – only the stiles or side members are meant for this.

The head of the ladder should rest against a solid surface able to withstand the loads imposed on it; otherwise a ladder stay should be used. Ladders should be tied or otherwise fixed at the top – someone should hold the ladder at the foot while this is done.



If this is impracticable, the ladder must be secured at the bottom by tying it to stakes in the ground or by using sandbags.

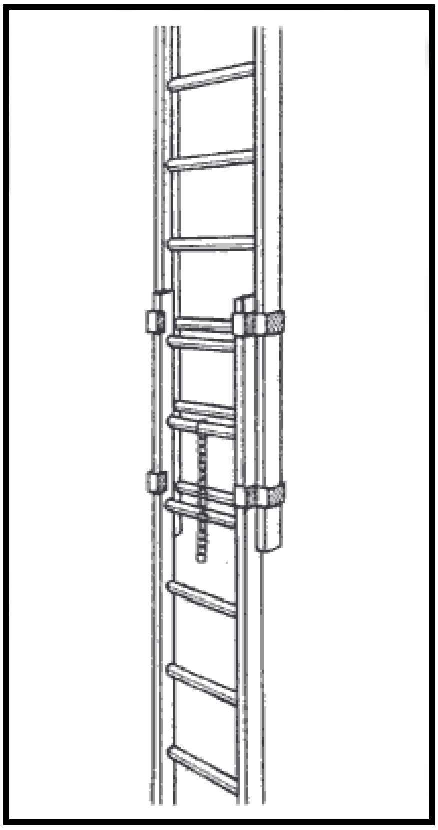


If neither is practicable, a worker should be at the foot of the ladder to prevent it slipping while someone is working from it, but this precaution is only effective if the ladder is not more than 5m in length. The fellow worker should face the ladder with a hand on each stile and with one foot resting on the bottom rung. The use of non-slip pads on ladder feet helps to prevent ladders slipping at the base.

Using ladders safely means observing the following precautions:

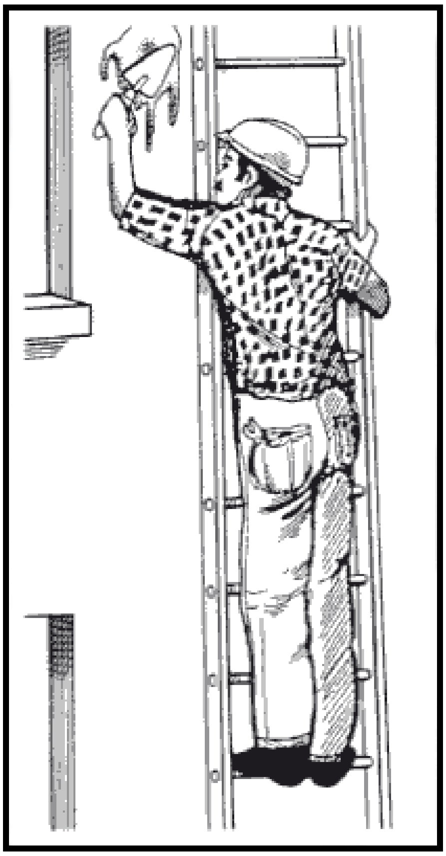
- Make sure there are no overhead power lines with which the ladder might make contact.
- Wooden ladders with wire-reinforced stiles should be used with the wired side facing away from you. Wire tie rods should be beneath and not above the rungs.
- The ladder should extend at least 1m above the landing place, or above the highest rung on which the worker has to stand, unless there is a suitable handhold to provide equivalent support; this is to stop the risk of over-balancing when stepping off and on at the top.

- Workers should be able to step off the ladder at the working place without being required to climb over or under guard-rails or over toe boards; the gaps in guard-rails and toe boards must as small as possible.
- Ladders which are too short should never be used. And they should never be stood on something such as a box, bricks or an oil drum to gain extra height.
- The ladder should be placed at a safe angle of about 75° to the horizontal, that is about 1 m out at the base for every 4m in height.
- Workers must face the ladder when climbing or descending and ensure that there is sufficient space behind the rungs to provide a proper footing.
- On extension ladders, there must be an overlap of at least two rungs for sections up to about 5m in length and at least three rungs for sections of more than 5m in length.



- Extension ladders must always be raised and lowered from the ground and hooks or locks must be properly engaged before use.
- Workers should make sure that their footwear is free from mud or grease before they begin to climb a ladder.
- Ideally, tools should be carried in pockets or a holster or bag when climbing ladders so as to leave both hands free to grip the stiles.

- It is better not to carry materials while climbing ladders – a hoist line should be used instead.



- A common cause of accidents is overbalancing or overreaching; instead move the ladder.

Points to remember

Make sure that the ladder is long enough for the job

Avoid carrying tools or materials in your hand while you are climbing ladders

Don't over-reach

Clean your footwear before climbing

Care of ladders:

- Ladders need to be inspected regularly by a competent person and damaged ladders removed from service.
- Timber ladders should be checked for splits or cracks, splintering or warping, and metal ladders for mechanical damage. Both should be checked for missing, loose or worn rungs.
- Ladders should be capable of being individually identified, e.g. by some form of marking.
- Ladders not in use should not be left on the ground so that they are exposed to weather water and impact damage. They should be properly stored on racks under cover and above ground, and ladders over 6 m in length should have at least three support points to avoid sagging.
- A ladder should not be hung from its rungs or from one stile as this tends to pull out the rungs.
- Timber ladders should be kept in areas with good ventilation which are free from excessive heat or dampness.
- Timber ladders and equipment may be coated with transparent varnish or preservative, but should not be painted as paint conceals defects.
- Aluminium ladders should be given an adequate protective coating when they are likely to be subject to acids, alkalis or other corrosive substances.

Points to remember

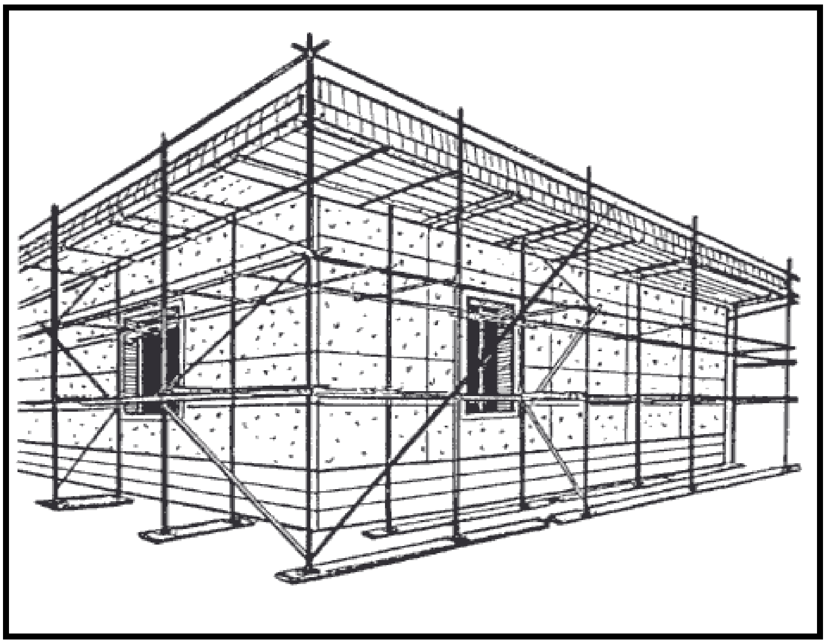
Always inspect your ladder before you use it

Remove damaged ladders from use and make sure that they are properly repaired. If they cannot be properly repaired, they must be destroyed

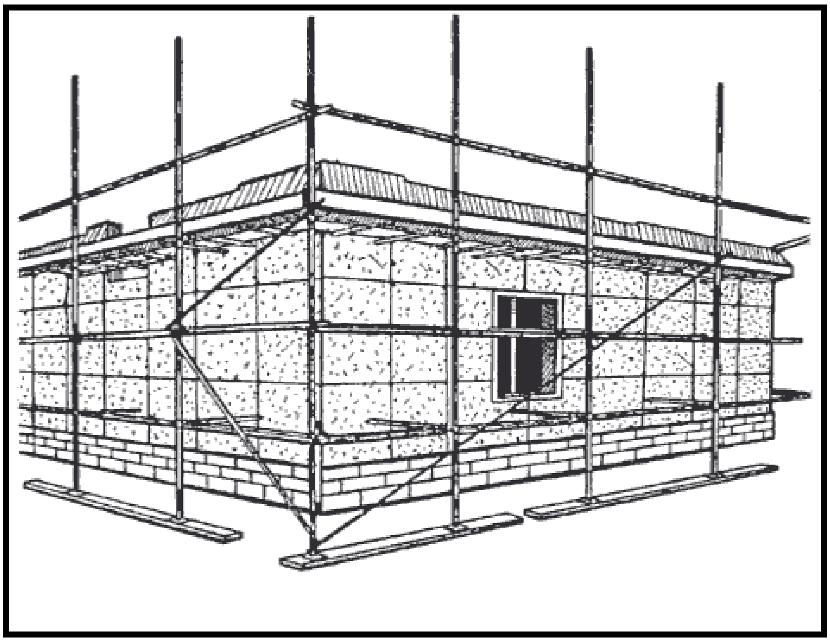
4 SCAFFOLDING

General requirements

4.1.1. Where work cannot safely be done on or from the ground or from part of a building or other permanent structure, a safe and suitable scaffold should be provided and maintained or other equally safe and suitable provision should be made.



The diagram above shows an independent tied scaffold which does not rely on the building for its strength. It has inner and outer rows of uprights or standards.



The above shows a single pole or putlog scaffold, with a single outer row of uprights or standards and which is partly supported by the building which consists of a platform resting on horizontal putlogs (called transoms in independent scaffolds) fixed at 90° to the face of the building. The outer ends of the putlogs are supported on horizontal ledgers fixed parallel to the face of the building and secured to a single row of uprights or standards, also parallel to the wall. The flattened inner end of the putlogs rests flat on the wall, or in holes in the wall, rather than on ledgers. It follows that the scaffold cannot stand without the support of the structure. Putlog scaffolds are mostly used where brick structures are being built. The same principles of good construction as for independent scaffolds are generally applicable.

A good base for the single row of uprights is essential and the base plates for each upright should again rest on a timber sole board – a sole board should be long enough to support at least two uprights. The uprights should be not more than 2m apart and set at 1.3m from the wall to allow for a five-board platform. Ledgers should be connected on the inside of the uprights, at a vertical distance of not more than 2m – a lesser distance may be necessary for some types of work – and left in position as the scaffold rises.

Putlogs should rest on and be secured to the ledgers at horizontal gaps depending on the thickness of the boards used – of not more than 1.5m for boards of 38mm – while their flattened, or spade, ends should lie on the brickwork, or enter the wall to a depth of at least 75mm. For repointing old brickwork, the spade ends can rest vertically in joints in the brickwork. Tying into the building is of even greater importance than with independent scaffolds, as putlogs can easily work loose in brickwork. In this type of scaffold, bracing along the face and to the full height of the scaffold is required. Bracing should be at an angle of about 45° to the horizontal and at 30metre intervals. The requirements already described for the construction of working platforms and gangways and for the erection of guard-rails and toe boards apply equally to putlog scaffolds.

4.1.2. Scaffolds should be provided with safe means of access, such as stairs, ladders or ramps. Ladders should be secured against inadvertent movement.

(Photo: Richard Neale, permission granted by the scaffolders)

The photo shows ladder leading from one secure platform to another, securely tied at top and midway.

4.1.3. All scaffolds and ladders should be constructed, erected and used in accordance with national laws and regulations.

4.1.4. Every scaffold should be properly designed, constructed, erected and maintained so as to prevent collapse or accidental displacement when properly used.

4.1.5. Every scaffold and part thereof should be:

(a) designed so as to prevent hazards for workers during erection and dismantling;

(b) designed so that guard rails and other protective devices, platforms, putlogs, rakers, transoms, ladders, stairs or ramps can be easily put together;

(c) of suitable and sound material and of adequate size and strength for the purpose for which it is to be used and maintained in a proper condition.

4.1.6. The competent authority should establish and enforce laws, regulations or standards covering detailed technical provisions for the design, construction, erection, use, maintenance, dismantling and inspection of the different kinds of scaffolds and ladders used in construction work.

Design and construction

4.3.1. Scaffolds should be designed for their maximum load and with a safety factor of at least 4, or as prescribed by the competent authority.

4.3.2. Scaffolds should be adequately braced.

(Photo: Richard Neale, permission granted by the scaffolders)

(Photo: Richard Neale, permission granted by the scaffolders)

The main photo shows good diagonal bracing in two directions. The detailed photo shows additional lateral bracing between reveals of an old doorway in the building.

4.3.3. Scaffolds which are not designed to be independent should be rigidly connected to the building at suitable vertical and horizontal distances.


(Photo: Richard Neale, permission granted by the scaffolders)

This detail of the main photo shows how the top of the scaffold has been taken over the ridge of the roof to anchor the scaffold to the building.

4.3.4. A scaffold should never extend above the highest anchorage to an extent which it might endanger its stability and strength.

4.3.5. Sufficient putlogs and transoms should remain in position and securely fastened to the ledgers, uprights or standards, as the case may be, to ensure the stability of the scaffold until it is finally dismantled.

4.3.6. All scaffolds and appliances used as supports for working platforms should be of sound construction, have a firm footing, and be adequately strutted and braced to maintain their stability.

4.3.7. Loose bricks, drainpipes, chimney-pots or other unsuitable material should not be used for the construction or support of any part of a scaffold.

4.3.8. When necessary to prevent danger from falling objects, working platforms, gangways and stairways of scaffolds should be provided with overhead screens of adequate strength and dimensions.

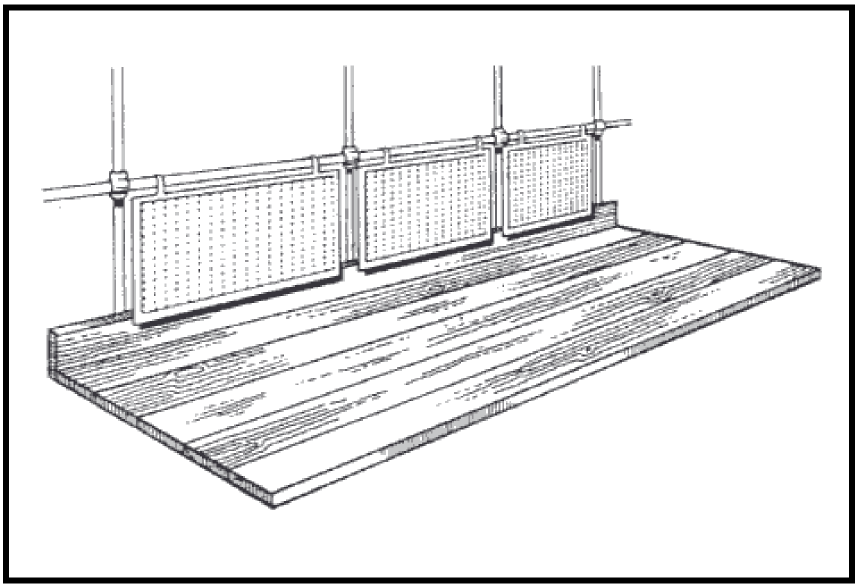
4.3.9. Nails should be driven full length, and not driven part way and then bent over, and should not be subject to direct pull.

4.3.10. Scaffolding materials should not be thrown from scaffolds or from heights. Other materials should only be thrown from scaffolds or heights where the landing area has been designated, protected, appropriate notices displayed, and is under the supervision of a person on the landing level.

4.3.11. Metal scaffolds should not be erected in closer proximity than 5m to overhead electricity transmission lines equipment except in accordance with safety distances laid down by the competent authority or after the electrical transmission line or equipment has been rendered electrically dead.

4.3.12. As far as practicable, every part of a working platform, gangway or stairway of a scaffold from which a person is liable to fall a distance of 2m or as prescribed in the national laws or regulations, should be provided with guard-rails and toe-boards complying with the relevant national standards.

Guard-rails and toe-boards should be fitted on the inside of the uprights. Guard-rails should be between 90cm and 115m above the platform to prevent workers from easily falling over or under the rail. Toe boards, which are also intended to prevent material being knocked over the edge of the platform, must rise at least 15cm above the working platform to achieve this, and if materials are stored to greater than this height then additional boards may be necessary or the space filled in with wire mesh.



Working platform showing guard-rail and toe board with wire mesh filling between them and the closely boarded platform.

(Photo: Richard Neale. St David's 2, Cardiff, UK)

The photo shows propriety safety barriers, scaffolding safety barriers, 'fans' to catch falling materials and other items, and some protective netting.

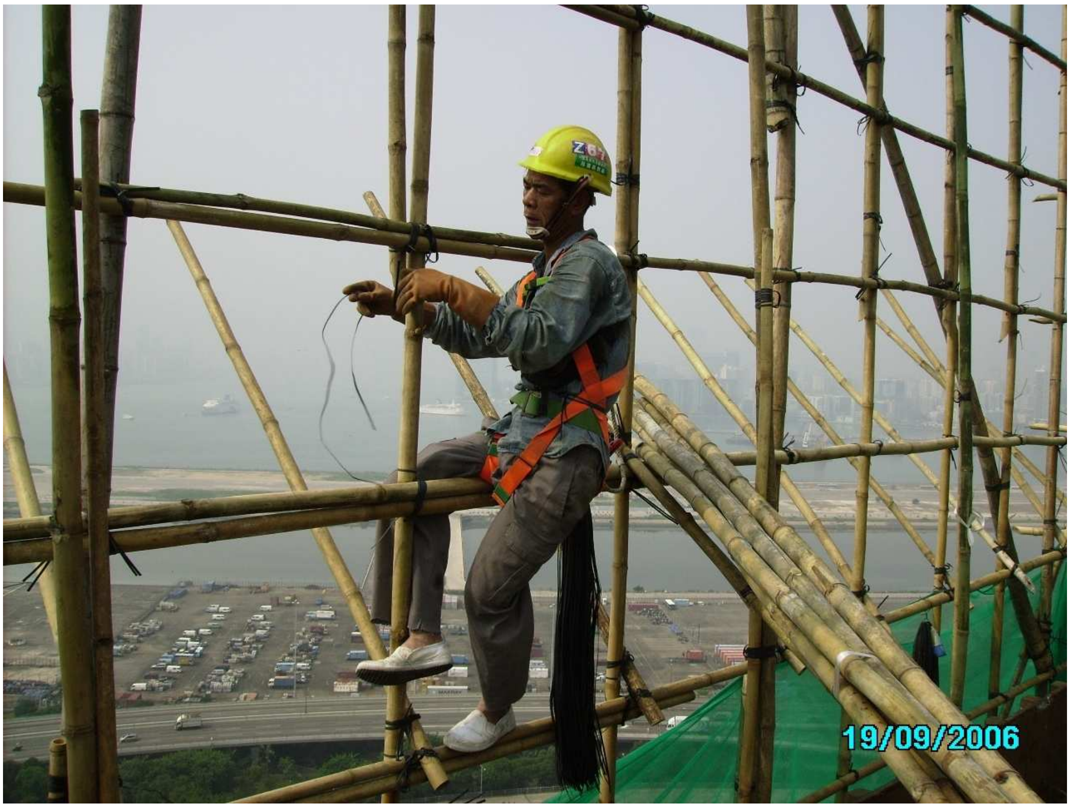
4.3.13. Platforms on scaffolds should be of adequate dimension, especially in width, for the tasks performed from the scaffold.

Bamboo scaffolding

This is widely used in parts of Asia. It has been the subject of a research study in Hong Kong, published by the Institution of Civil Engineers, which concluded:

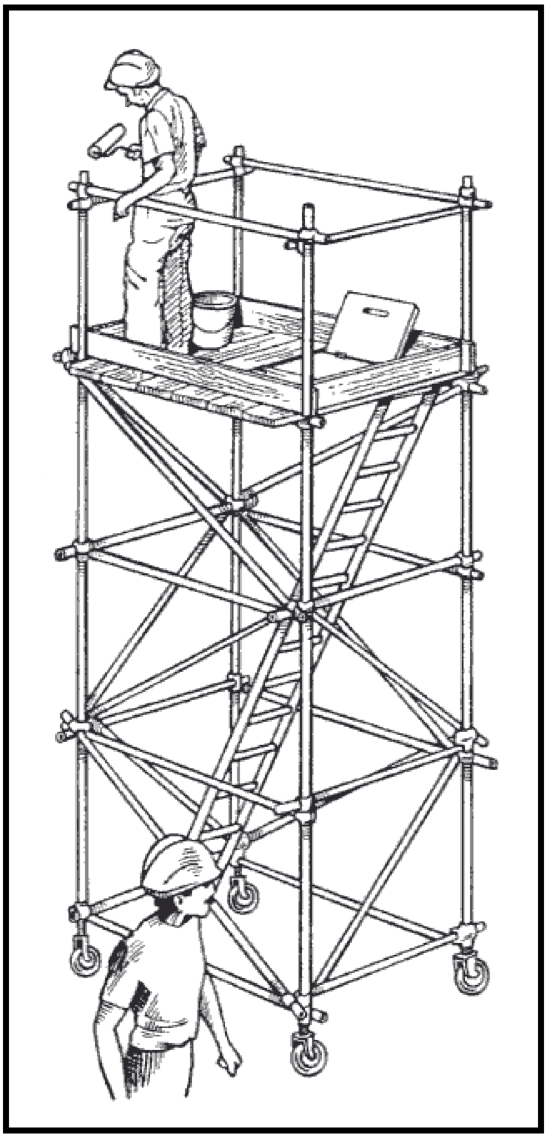
Hong Kong's skyline is dominated by some of the world's tallest buildings. Nevertheless, the city still uses bamboo scaffolding for much of its construction work – a traditional skill passed down over 5000 years. Bamboo is sustainable, lightweight and cheap and, as long as it remains fairly dry, a good construction material with significant mechanical properties. Researchers, engineers, environmentalists and bureaucrats have taken an increasing interest in the craft, such that regulations and practice continue to be improved and refined. However, to alleviate remaining design and safety concerns a structural design code is needed.

One of the important findings was the increased use of personal protective equipment, although being a bamboo scaffolder remains a dangerous occupation.



[From the paper "Hong Kong-bastion of bamboo scaffolding", by M Ramanathan, Proceedings of ICE-Civil Engineering, Volume: 161, Issue: 4, November 2008.
Photograph by the author of the paper, Muthukaruppan Ramanathan}

Tower scaffolds



A tower scaffold consists of a platform resting on horizontal ledgers connected to four uprights, supported on base plates if static or on castor wheels if mobile. It is devised for painters and others who do lightweight work of limited duration mainly in one place.

The first precaution with tower scaffolds is to achieve stability. For this the ratio of height to base width should not be more than 4:1 for a static tower used indoors. For a static tower used outdoors the ratio is reduced to 3.5:1, while for a mobile tower used outdoors it should not be more than 3:1. Any loading on the platform will raise the centre of gravity of the tower and too great a load will endanger its stability.

Static towers should not exceed 12m in height when free-standing, and above this height they should be tied. Mobile towers should not exceed 9.6m in height when free-standing or 12m when tied to a structure.

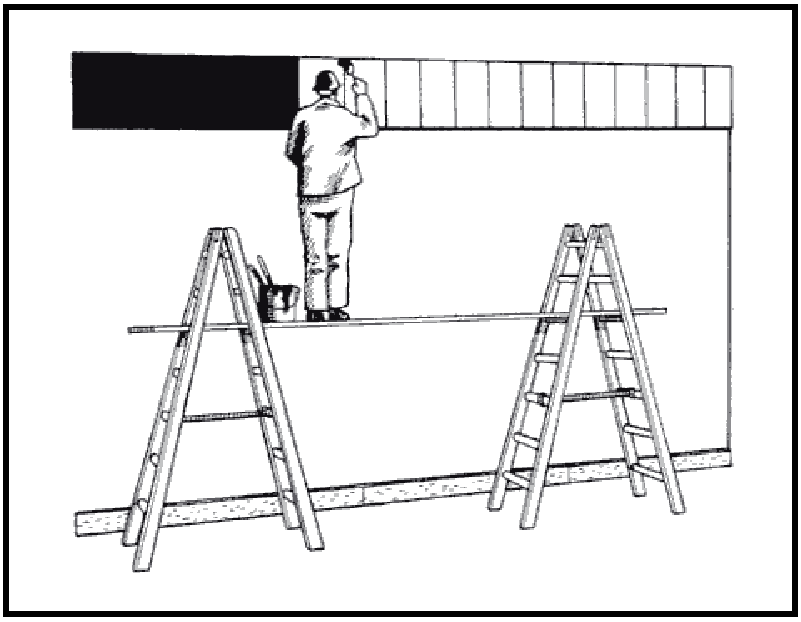
Towers should be vertical, have a single platform and be used only on a firm and level base, with the uprights of static towers on adequate base plates. Dimensions will vary according to need but corner standards should never be less than 1.2m apart. The uprights of mobile towers should have castor wheels of not less than 125mm in diameter which are locked into the base of the uprights. The castor wheels should be fitted with locks or brakes which cannot be accidentally released, and you should ensure that the brakes are applied whenever the tower is stationary.

The platform should be equipped with a cover for the ladder access opening which is able to be fixed in both open and closed positions with a latch. This prevents an accidental step into the opening. The cover should be provided with a suitable handhold to provide support when climbing through the opening. Guard-rails and toe boards will be necessary for the sides of the working platform, erected as for independent scaffolds. The ladder provided for access to the working platform should be positioned inside the tower as a precaution against overturning.

Accidents can happen when a tower topples over. This is likely to happen in any of the following cases:

- The ratio of the height of the tower to the width of the base is excessive
- The top working platform is overloaded causing the tower to become unstable
- Mobile tower scaffold-wheels not locked when in use
- A ladder is placed on the top platform to extend the height of the tower
- Work involving percussion tools produces an outward horizontal or lateral force at the top of the tower
- A mobile tower is moved with persons or materials carried on the top platform
- The tower is used on sloping or uneven ground
- The tower is not tied to the building or structure where this is necessary
- Access to the platform is via the outside of the tower

Trestle scaffolds



Trestle scaffolds are simply working platforms supported on "A" frames or a similar type of folding support.

Trestle scaffolds, whether the trestles be fixed or folding in type, should be used only for light work of comparatively short duration. Folding trestles should be used only for scaffolds of one tier in height, and the working platform should be at least 430mm (two scaffold boards) wide. One-third of the height of the trestles should be above the working platform. Fixed trestles should not be used for scaffolds of more than two tiers in height, and where the working platform is more than 2m high guard-rails and toe boards should be provided.

Mobile platforms

In many applications, mobile towers, as shown in the photo below, are superseding tower and trestle scaffolds. These offer a more flexible and safe alternative.

(Photo: Richard Neale. St David's 2, Cardiff, UK)

Inspection and maintenance

4.4.1. Scaffolds as prescribed by national laws or regulations should be inspected, and the results recorded by a competent person:

(a) before being taken into use;

(b) at periodic intervals thereafter as prescribed for different types of scaffolds;

(c) after any alteration, interruption in use, exposure to weather or seismic conditions or any other occurrence likely to have affected their strength or stability.

4.4.2. Inspection by the competent person should more particularly ascertain that:

(a) the scaffold is of suitable type and adequate for the job;

(b) materials used in its construction are sound and of sufficient strength;

(c) it is of sound construction and stable;

(d) that the required safeguards are in position.

4.4.3. A scaffold should not be erected, substantially altered or dismantled except by or under the supervision of a competent person.

4.4.4. Every scaffold should be maintained in good and proper condition, and every part should be kept fixed or secured so that no part can be displaced in consequence of normal use.

4.4.5. No scaffold should be partly dismantled and left so that it is capable of being used, unless it continues to be safe for use.

Use of scaffolds

4.7.1. The employer should provide competent supervision to ensure that all scaffolds are used appropriately and only for the purpose for which they are designed or erected. In transferring heavy loads on or to a scaffold a sudden shock should not be transmitted to the scaffold.

4.7.2. When necessary to prevent danger, loads being hoisted on or to scaffolds should be controlled, e.g. by a hand rope (tag line), so that they cannot strike against the scaffold.

4.7.3. The load on the scaffold should be evenly distributed, as far as practicable, and in any case should be so distributed as to avoid disturbance of the stability of the scaffold.

4.7.4. During the use of a scaffold care should constantly be taken that it is not overloaded or otherwise misused.

4.7.5. Scaffolds should not be used for the storage of material except that required for immediate use.

4.7.6. Workers should not be employed on external scaffolds in weather conditions that threaten their safety.

Suspended scaffolds

4.8.1. In addition to the requirements for scaffolds in general as regards soundness, stability and protection against the risk of falls, suspended scaffolds should meet the following specific requirements in so far as such requirements are applicable:

(a) platforms should be designed and built with dimensions that are compatible with the stability of the structure as a whole, especially the length;

(b) the number of anchorages should be compatible with the dimensions of the platform;

(c) the safety of workers should be safeguarded by an extra rope having a point of attachment independent of the anchorage arrangements of the scaffold;

(d) the anchorages and other elements of support of the scaffold should be designed and built in such a way as to ensure sufficient strength;

(e) the ropes, winches, pulleys or pulley blocks should be designed, assembled, used and maintained according to the requirements established for lifting gear adapted to the lifting of persons according to national laws and regulations;

(f) before use, the whole structure should be checked by a competent person.

5 STRUCTURAL FRAMES

General

3.4.2. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.

11.1.1. The erection or dismantling of buildings, structures, civil engineering works, formwork, falsework and shoring should be carried out by trained workers only under the supervision of a competent person.

11.1.2. Adequate precautions should be taken to guard against danger to workers arising from any temporary state of weakness or instability of a structure.

Provision of temporary floors

11.4.1. All tiers of open joists and girders on which workers are employed should be securely covered with close planking or any other effective covering until the permanent floor is installed.

11.4.2. Parts of the protection should only be removed to the extent required for the continuation of the work.

11.4.3. In halls and similar buildings without intermediate walls, columns or chimneys, close planking may be replaced by working platforms with adequate safeguards.

11.4.4. In buildings or structures of skeleton steel construction, permanent floor filling should as far as practicable be installed as the erection progresses.

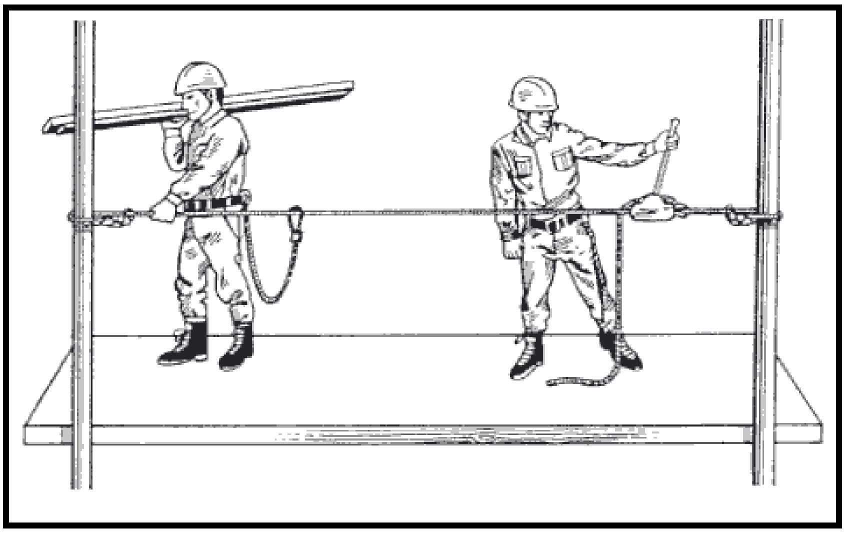
Erection and dismantling of steel and prefabricated structures

11.2.1. As far as practicable the safety of workers employed on the erection and dismantling of steel and prefabricated structures should be ensured by appropriate means, such as provision and use of:

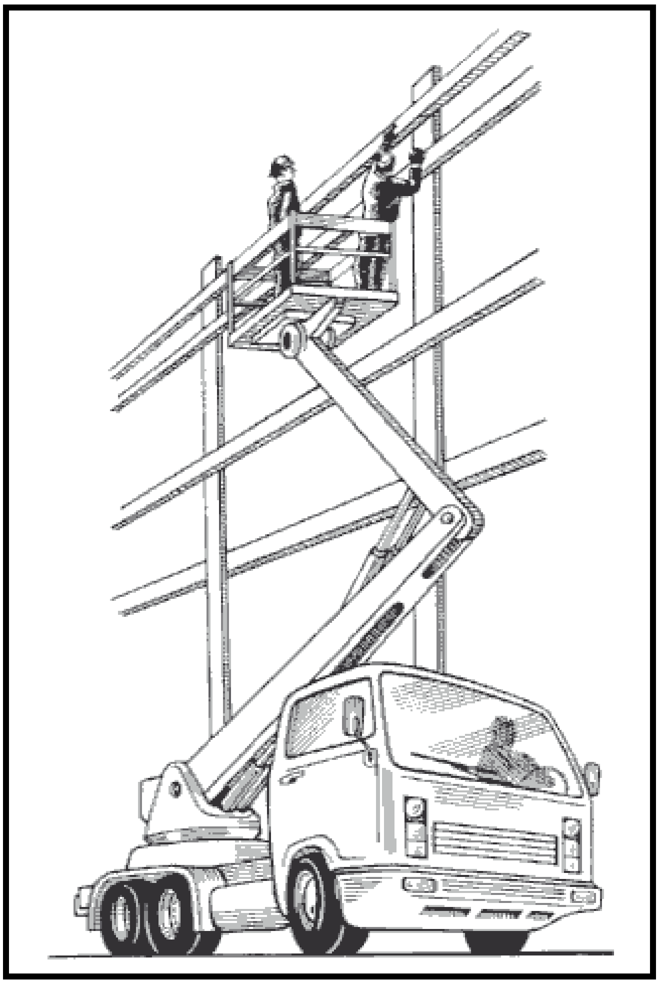
(a) ladders, gangways or fixed platforms;

(b) platforms, buckets, boatswain's chairs or other appropriate means suspended from lifting appliances;

(c) safety harnesses and lifelines, catch nets or catch platforms;



(d) power-operated mobile working platforms.



Mobile hydraulic platforms provide safe means of access for steel erectors

11.2.2. Steel and prefabricated structures should be so designed and made that they can be safely transported and erected, and if required by national laws and regulations each unit should be clearly marked with its own weight.

11.2.3. In addition to the need for the stability of the part when erected, when necessary to prevent danger the design should explicitly take into account:

(a) the conditions and methods of attachment in the operations of transport, storing and temporary support during erection or dismantling as applicable;

(b) methods for the provision of safeguards such as railings and working platforms, and, when necessary, for mounting them easily on the structural steel or prefabricated parts.

11.2.4. The hooks and other devices built in or provided on the structural steel or prefabricated parts that are required for lifting and transporting them should be so shaped, dimensioned and positioned as:

(a) to withstand, with a sufficient margin, the stresses to which they are subjected;

(b) not to set up stresses in the part that could cause failures, or stresses in the structure itself not provided for in the plans, and be designed to permit easy release from the lifting appliance. Lifting points for floor and staircase units should be located (recessed if necessary) so that they do not protrude above the surface;

(c) to avoid imbalance or distortion of the lifted load.

11.2.5. Prefabricated parts made of concrete should not be stripped or erected before the concrete has set and hardened sufficiently to the extent provided for in the plans, and before use should be examined for any sign of damage which may indicate weakness.

11.2.6. Storeplaces should be so constructed that:

(a) there is no risk of structural steel or prefabricated parts falling or overturning;

(b) storage conditions generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions;

(c) racks are set on firm ground and designed so that units cannot move accidentally.

11.2.7. While they are being stored, transported, raised or set down, structural steel or prefabricated parts should not be subjected to stresses prejudicial to their stability.

11.2.11. Structural steel or prefabricated parts should be lifted by methods or appliances that prevent them from spinning accidentally.

11.2.12. When necessary to prevent danger, before they are raised from the ground, structural steel or prefabricated parts should be provided with safety devices such as railings and working platforms to prevent falls of persons.

11.2.13. While structural steel or prefabricated parts are being erected the workers should be provided with and use appliances for guiding them as they are being lifted and set down, so as to avoid crushing of hands and to facilitate the operations.

11.2.14. Before it is released from the lifting appliance a raised structural steel or prefabricated part should be so secured and wall units so propped that their stability cannot be imperilled, even by external agencies such as wind and passing loads, in accordance with national laws and regulations.

11.2.15. At workplaces adequate instruction should be given to the workers on the methods, arrangements and means required for the storage, transport, lifting and erection of structural steel or prefabricated parts, and before erection starts a meeting of all those responsible should be held to discuss and confirm the requirements for safe erection.

11.2.16. During transport, attachments such as slings and stirrups mounted on structural steel or prefabricated parts should be securely fastened to the parts.

11.2.17. Structural steel or prefabricated parts should be so transported that the conditions do not affect the stability of the parts or the means of transport result in jolting, vibration or stresses due to blows, or loads of material or persons.

11.2.18. When the method of erection does not permit the provision of other means of protection against falls of persons, the workplaces should be protected by guard-rails, and, if appropriate, by toe-boards.

11.2.19. When adverse weather conditions such as snow, ice and wind or reduced visibility entail risks of accidents the work should be carried on with particular care, or, if necessary, interrupted.

11.2.20. Structures should not be worked on during violent storms or high winds, or when they are covered with ice or snow, or are slippery from other causes.

11.2.21. If necessary to prevent danger, structural steel parts should be equipped with attachments for suspended scaffolds, lifelines or safety harnesses and other means of protection.

11.2.22. The risks of falling, to which workers moving on high or sloping girders are exposed, should be limited by all means of adequate collective protection or, where this is impossible, by the use of a safety harness that is well secured to a sufficiently strong support.

11.2.23. Structural steel parts that are to be erected at a great height should as far as practicable be assembled on the ground.

11.2.24. When structural steel or prefabricated parts are being erected, a sufficiently extended area underneath the workplace should be barricaded or guarded.

11.2.25. Steel trusses that are being erected should be adequately shored, braced or guyed until they are permanently secured in position.

11.2.26. No load-bearing structural member should be dangerously weakened by cutting, holing or other means.

11.2.27. Structural members should not be forced into place by the hoisting machine while any worker is in such a position that he could be injured by the operation.

11.2.28. Open-web steel joists that are hoisted singly should be directly placed in position and secured against dislodgement.

Points to remember

Trying to save crane time by reducing the number of bolts used in connections is a dangerous practice

Do not work in high winds or on wet steelwork

Always wear suitable personal protective equipment

If you climb or walk on bare steel, sooner or later you will fall

Cast-in-situ concrete structures

11.3.1. The construction of cast-in-situ, large span and multi-storey concrete structures should be based on plans that:

> *(a) include specifications of the steel, concrete and other material to be used, including technical methods for safe placing and handling;*
>
> *(b) indicate clearly the position and arrangement of reinforcements in structural elements;*
>
> *(c) provide, if appropriate, calculations of the load-bearing capacity of the structure.*

11.3.2. During the construction of cast-in-situ, large span and multi-storey concrete structures, a daily record should be kept of the progress of the work, including indications of all data which could affect the curing of the concrete.

11.3.3. Precise procedures for all stages of erection should be prepared and a competent person appointed to co-ordinate the work and check procedures.

Formwork

11.1.3. Formwork, falsework and shoring should be so designed, constructed and maintained that it will safely support all loads that may be imposed on it.

11.1.4. Formwork should be so designed and erected that working platforms, means of access, bracing and means of handling and stabilising are easily fixed to the formwork structure.

11.3.4. During pouring, shuttering and its supports should be continuously watched for defects.

11.5.2. Clear and concise procedures to cover all stages of work should be prepared.

11.5.3. A competent person should be appointed to coordinate the work and check that the procedures are being followed.

11.5.4. No changes should be made without consulting the co-ordinator.

11.5.5. All materials and scaffolding should be carefully examined and checked with the drawings before being taken into use.

11.5.6. The foundations should be checked to see that the excavated ground conditions are as the original soil report suggested.

11.5.7. Shuttering should be examined, erected and dismantled under the supervision of qualified and experienced persons and, as far as practicable, by workers familiar with the work.

11.5.8. The necessary information for the erection of shuttering, including particulars of the spacing of stringers and props to stringers, should be provided for the workers in the form of sketches or scale drawings.

11.5.9. Lumber and supports for shuttering (forms) should be adequate, having regard to the loads to be borne, spans, setting temperature and rate of pour. Where necessary to prevent danger, adequate shoring should be provided to support slabs and beams as a protection against superimposed loads.

11.5.10. All adjustable shoring should be locked in position when adjusted.

11.5.11. Shoring should be so arranged that when it is being removed sufficient props can be left in place to afford the support necessary to prevent danger.

11.5.12. Shoring should be adequately protected from damage from moving vehicles, swinging loads, etc.

11.5.13. Shoring should be left in place until the concrete has acquired sufficient strength to support safely not only its own weight but also any imposed loads. It should not be removed until authorisation has been given by a competent person.

11.5.14. Shoring should be adequately braced or tied together to prevent deformation or displacement.

11.5.15. To prevent danger from falling parts when shuttering is being taken down, the shuttering should as far as practicable be taken down whole, or else remaining parts should be supported.

11.5.16. Mechanical, hydraulic or pneumatic lifting appliances for handling forms should be provided with automatic holding devices to prevent danger if the power of the lifting mechanism fails.

11.5.17. Vacuum-lifting appliances should only be applied to smooth, clean surfaces.

11.5.18. Vacuum-lifting devices should be provided with an automatic cut-off to prevent loss of suction in the event of a power or equipment failure.

6 DEMOLITION OF ABOVE GROUND STRUCTURES

Causes of incidents ('accidents')

The principal causes of incidents during demolition are:

- The choice of an incorrect method of demolition
- An unsafe place of work
- The unintentional collapse of the building being demolished, or of an adjoining structure, because of lack of temporary support
- Unexpected exposure to toxic substances

Planning and training

Demolition must be supervised by persons with a thorough knowledge not only of demolition processes but of the principles of building construction. First, a survey of the physical characteristics and design of the building to be demolished must be carried out in order to choose a safe method of work. Contained within the structure of buildings are various forces and stresses, whether the buildings be of concrete, brick, masonry, steel or timber. When the building is complete, these forces and reactions are in balance, and equilibrium and stability is achieved. The severance or removal of a load-carrying member may unbalance the forces, upset the equilibrium and cause collapse of the whole or that part of the building.

There are particular problems in some newer buildings which are post-tensioned or un-bonded stressed structures, or are structures which have been progressively stressed as construction proceeds. Preliminary inquiries of the client or local authority may reveal such problems. The proposals for demolition should be contained in a written method statement which should also include drawings or sketches showing the sequence of operations, and the machinery or equipment to be used, including personal protective equipment.

Demolition is an inherently dangerous process and everyone on site must wear personal protective equipment (PPE) including helmet, gloves and safety footwear. The presence of debris and dust, and such jobs as the cutting of bolts or rivets, call for the provision of eye protection such as goggles or visors.

Before demolition begins, all services to the building or structure must be disconnected. Failure to do this adequately can result in electric shock, gasing, fire, explosions or flooding. Arrangements should be made to keep the public as far away as possible from the site, and wherever practicable a fence not less than 2m high should be erected around it.

Points to remember

Plan before you demolish and demolish according to plan

Have a written method statement for your demolition site

The demolition process

The aim should be to adopt methods which do not expose persons to falls from heights. While in general it is a sound rule gradually to reduce the height of a building and to demolish in the reverse order to construction, a deliberately engineered collapse, the licensed use of explosives, a demolition ball on a crane, or a pusher arm may sometimes be the quickest and most economical method of demolition, leaving work to be completed at ground level. It is dangerous to leave isolated walls or parts of walls standing and liable to collapse from the effect of high winds. Whatever the process adopted, debris should not be allowed to build up against walls or on floors with the consequent risk of the structure being unintentionally overloaded.

Debris chutes should be used rather than throwing down material indiscriminately, even on isolated sites.

Wherever practicable, workers should avoid working directly from parts of the building or structure they are demolishing, such as standing on the top of a brick wall. This usually means that they have both poor handholds and poor footholds.

When work cannot safely be carried out from a building, a scaffold platform, self-supporting and independent of the part of the building being demolished, should be provided. On brick and masonry structures in particular, much of the work can be done from such scaffolding, the material being dropped to the interior of the building.

Person-carrying skips or power-operated mobile work platforms can also be used to work at heights. The use of safety nets or safety harnesses may sometimes be necessary

Tanks and vessels

The use of hot processes such as flame-cutting to demolish or dismantle plant which has contained flammable materials has caused many deaths and serious injuries. It is essential to make such tanks and vessels safe before work commences, and workers should always follow a written permit-to-work system. It is usually easier to ensure that a flammable concentration of vapour is not present in a tank than it is to remove residues. Residue fires during demolition are common. In the case of small vessels up to about 50 cubic metres capacity both vapours and residues can usually be removed by steaming out, but this is often impracticable for larger vessels. The nature and distribution of residues is thus a key factor in deciding on the techniques to be used. There are other ways of cutting tanks and drums by means of cold processes and these should be considered before you adopt a hot process.

Health hazards

Insidious and unexpected health hazards frequently arise during demolition on account of exposure to dust and fumes. Short-term effects of poisonous fumes, or acute gasing, arise when a plant is opened up without having first been properly isolated, purged or cleaned, or when a vessel is entered without taking precautions. Another cause is the flame-cutting of plant which has been painted with zinc or cadmium paint. Long-term or systemic poisonings arise from flame-cutting lead-painted steelwork, and from the inhalation of dust or fumes from chemical deposits. The site survey should have assessed the risk, and the method of work statement should set out permit-to-work systems, the use of breathing apparatus, approved respirators, and rescue equipment.

Exposure to asbestos-bearing materials is now a particular risk in demolition. Indeed, construction workers may be more at risk from the presence of asbestos than almost any other category of worker. This applies particularly to exposure to asbestos which was commonly used in sprayed insulation on columns and on the underside of ceilings and roofs for fire protection or for thermal insulation. Stringent precautions need to be taken to avoid contaminating the general atmosphere and to prevent breathing in of the dust. Material containing asbestos must be removed in isolation from other work, and workers must wear positive pressure breathing apparatus and protective clothing, and be trained in their use and the techniques of asbestos removal. Where possible, wet methods of asbestos removal should be adopted rather than dry methods. Special arrangements need to be made by management for the safe disposal of asbestos-contaminated debris. The best way to deal with asbestos is to employ a specialist company.

Points to remember

Never work on a tank or enclosed vessel without a written permit to work

Always check whether asbestos is present in the building to be demolished

7 ROOF-WORK

8.2.1. All roof-work operations should be pre-planned and properly supervised.

8.2.2. Roof work should only be undertaken by workers who are physically and psychologically fit and have the necessary knowledge and experience for such work.

8.2.3. Work on roofs should not be carried on in weather conditions that threaten the safety of workers.

8.2.4. Crawling boards, walkways and roof ladders should be securely fastened to a firm structure.

8.2.5. Roofing brackets should fit the slope of the roof and be securely supported.

8.2.6. Where it is necessary for a person to kneel or crouch near the edge of the roof an intermediate rail should be provided unless other precautions, such as the use of a safety harness, are taken.

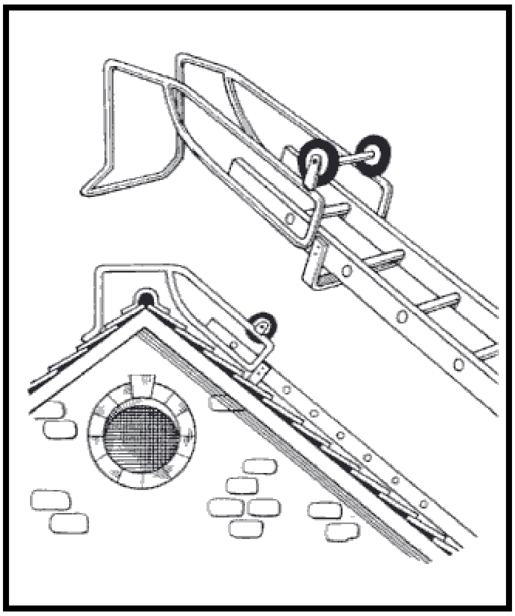
8.2.7. On a large roof where work does not have to be carried out at or near the edge, a simple barrier consisting of crossed scaffold tubes supporting a tubing guardrail may be provided. Such barriers should be positioned at least 2m from the edge.

8.2.8. All covers for openings in roofs should be of substantial construction and be secured in position.

8.2.9. Roofs with a pitch of more than 10 should be treated as sloping.

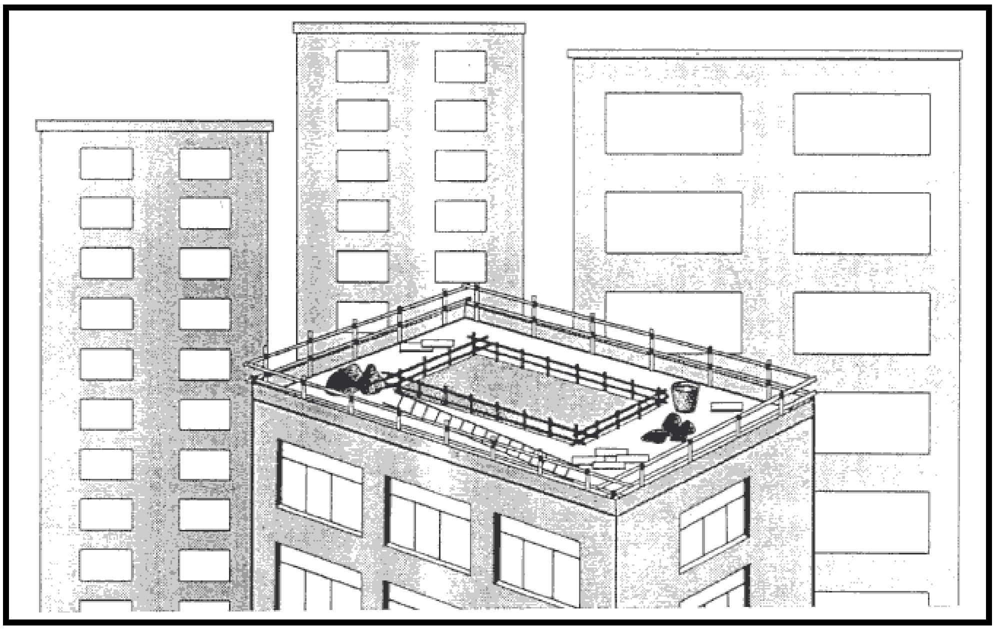
8.2.10. When work is being carried out on sloping roofs, sufficient and suitable crawling boards or roof ladders should be provided and firmly secured in position as soon as is practicable.

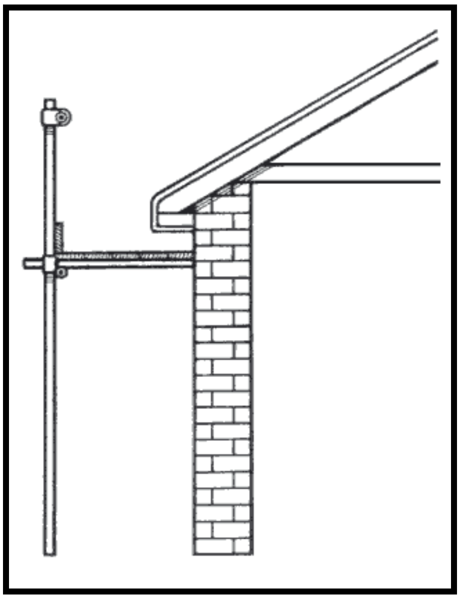
The picture below shows a ladder specially made for roof work.

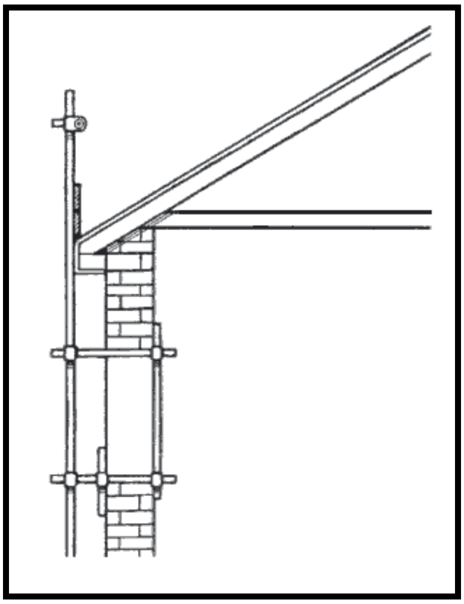


8.2.11. During extensive work on the roof, strong barriers or guard-rails and toeboards should be provided to stop a person from falling off the roof.

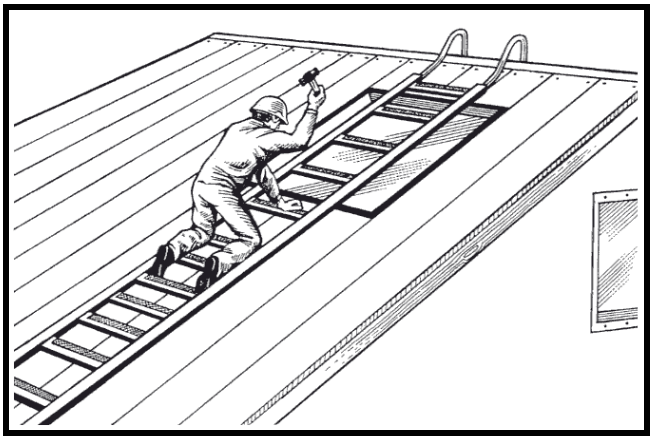
The three pictures below shows ways of protecting workers from falling from roofs.







8.2.12. Where workers are required to work on or near roofs or other places covered with fragile material, through which they are liable to fall, they should be provided with sufficient suitable roof ladders or crawling boards strong enough, when spanning across the supports for the roof covering, to support those workers.



8.2.13. A minimum of two boards should be provided so that it is not necessary for a person to stand on a fragile roof to move a board or a ladder, or for any other reason.

8.2.14. To prevent danger, suitable material such as steel wire mesh should be placed in position before any roof sheeting of asbestos cement or other fragile material is placed upon it.

8.2.15. Purlins or other intermediate supports for fragile roofing material should be sufficiently close together to prevent danger.

8.2.16. Where a valley or parapet gutter of a fragile roof is used for access, protection against falling through the fragile material should be provided by covering the adjacent fragile material to a minimum distance of 1m up the roof.

8.2.17. Buildings with fragile roofs should have a warning notice prominently displayed at the approaches to the roof.

EXAMPLE OF GOOD PRACTICE

(Poster provided by Charles Obongpiny, Uganda Building Worker's Union)

Finally

"Construction safety, roof construction, demolition: Three roofers at edge of roof, without fall protection, manhandle lifting and tying off flared top of trash chute with which to funnel old roofing material into dump truck for disposal. The crew is using two pitch forks (hand tools for roof demolition) to pry top flared part of chute over and above roof edge and gutter. Worker on right lost his balance an instant before this photo was taken, and in photo he is raising left arm and sitting back with grimace on his face, which saved him from pitching over roof edge and falling two floors. Of course, workers return next day to demolish roof, including near edge, and walk to edge of roof to drop debris into chute. They should all be wearing body harnesses, with lanyards tied back with safety line to a secure support near center of roof. California, 2006."

[Source of image & caption: Robert Carr, http://myconstructionphotos.smugmug.com)

8 BRIEF BIBLIOGRAPHY

Title	ILO Code of Practice: Safety & health in construction
Type of source	Code of practice, 174 pages
Publication or other source details	ILO Publications http://www.ilo.org/global/Publications
Date & ISBN/ISSN	1992. 92-2-107104-9
Summary of contents	*"It goes a long way in mapping out the agenda for health and safety professionals in this most dangerous and populous industry."* Content: 1. General provisions 2. General duties 3. Safety of workplaces 4. Scaffolds and ladders 5. Lifting appliances and gear 6. Transport, earth-moving and materials-handling equipment 7. Plant, machinery, equipment and hand tools 8. Work at heights including roof work 9. Excavations, shafts, earthworks, underground works and tunnels 10. Cofferdams and caissons and work in compressed air 11. Structural frames, formwork and concrete work 12. Pile-driving 13. Work over water 14. Demolition 15. Electricity 16. Explosives 17. Health hazards, first aid and occupational health services 18. Personal protective equipment and protective clothing 19. Welfare
Comments on relevance	This Code of Practice is fundamental to this training package. It has influenced the structure and informed the content.

Title	My construction photos
Author(s)	Dr Robert I Carr
Type of source	Web site
Publication or other source details	http://myconstructionphotos.smugmug.com/
Date & ISBN/ISSN	This site was accessed for **ILO Construction OS&H** in July 2009
Summary of contents	This is the personal site of Dr Robert I Carr, one of the most highly respected professors in the construction world. He has offered more than 2000 high quality photos, fully captioned, for free use. Here he is in person: http://myconstructionphotos.smugmug.com/gallery/2435976/ Although largely taken in the USA, there are photos taken in other countries.
Comments on relevance	This is a wonderful resource for trainers.
Other information	There are some superb photos of construction hazards

Title	ILO Safety, health and welfare on construction sites A training manual
Author(s)	ILO
Type of source	Training manual, 134 pages
Publication or other source details	ILO Geneva, International Labour Office Can be downloaded from: http://www.ilo.org/public/english/protection/safework/training/english/download/architecture.pdf
Date & ISBN/ISSN	1995. ISBN 92-2-109182-1
Summary of contents	Preface 1. Introduction 2. Safety organization and management 3. Site planning and layout 4. Excavations 5. Scaffolding 6. Ladders 7. Hazardous processes 8. Vehicles 9. Movement of materials 10. Working positions, tools and equipment 11. The working environment 12. Personal protective equipment (PPE) 13. Welfare facilities Annexes 1. Safety, health and welfare on construction sites: Check-list 2. The Safety and Health in Construction Convention, 1988 (No. 167), and Recommendation, 1988 (No175)
Comments on relevance	This is a comprehensive manual, which follows the contents of ILO C167 very closely. Extracts have been used in Construct OS&H, especially in the technical sections.

Title	Hong Kong – bastion of bamboo scaffolding
Type of source	Journal article
Publication or other source details	Journal name: Civil Engineering Author(s): Ramanathan DOI: 10.1680/cien.2008.161.4.177 Volume: 161 | Issue 4 Pages: 177 - 183
Date & ISBN/ISSN	01/11/2008. 0965-089X
Summary of contents	Hong Kong's skyline is dominated by some of the world's tallest buildings. Nevertheless, the city still uses bamboo scaffolding for much of its construction work – a traditional skill passed down over 5000 years. Bamboo is sustainable, lightweight and cheap and, as long as it remains fairly dry, a good construction material with significant mechanical properties. Researchers, engineers, environmentalists and bureaucrats have taken an increasing interest in the craft, such that regulations and practice continue to be improved and refined. However, to alleviate remaining design and safety concerns a structural design code is needed.
Comments on relevance	Generally relevant to the Modules 'General plant and equipment' and 'Working at height'.

P: CONCLUSION

Summary of content	
1.	Preface
2.	Systems integration
3.	Checklists
4.	Concluding case study
5.	Brief bibliography

1 PREFACE

Construction OS&H provides a comprehensive and wide-ranging review of current thinking and good practices. It is based on a 'systems approach' and systematic principles and procedures have been described. In actual practice, the reality of managing a construction project requires many of these principles and practices to be applied simultaneously in an 'integrated' way. In addition, OS&H has to be managed within the whole of the project, and so OS&H systems have to be applied alongside other systems, such as quality assurance and technical compliance with drawings and specifications.

This concluding Module Summary is mainly about integration. It begins with a brief review of the principles of systems integration, taken largely from a research and development programme led by Professor Alan Griffith. A series of Checklists then draw together the key content of the other Module Summaries, giving an overview of the principal factors to be considered for OS&H. This Module Summary concludes with a case study of a collapsed excavation in Uganda, in which eight workers died. This case study shows that poor OS&H has a very adverse effect on the client, the design teams, the contractor and of course the workers and their families. All parties to a construction contract must co-operate, therefore, to eliminate avoidable 'accidents' and strive towards 'zero incidents'.

2 SYSTEMS INTEGRATION

(See reference to Professor Alan Griffith in the Brief Bibliography at the end of this Module Summary).

All management systems have a similar 'anatomy'. They:

- Advocate a 'whole organisation' view
- Have a well-defined framework
- Develop formal directives and operating procedures
- Are pro-active, seeking to be preventative or quickly re-active, rather than retrospective in the actions that they expect
- Have measurable indicators of success
- Have formal audit and review procedures

Management systems are based on standards, which have the following key features:

- Policy
- Aims and objectives
- Programmes
- Documentation
- Working procedures
- Record keeping
- Audit and review

To be useful, a management system should:

- Be simple to understand, interpret and implement by the people who work with and around it
- Give reliable and consistent outcomes
- Be capable of being translated into easily conducted sets of procedures and tasks

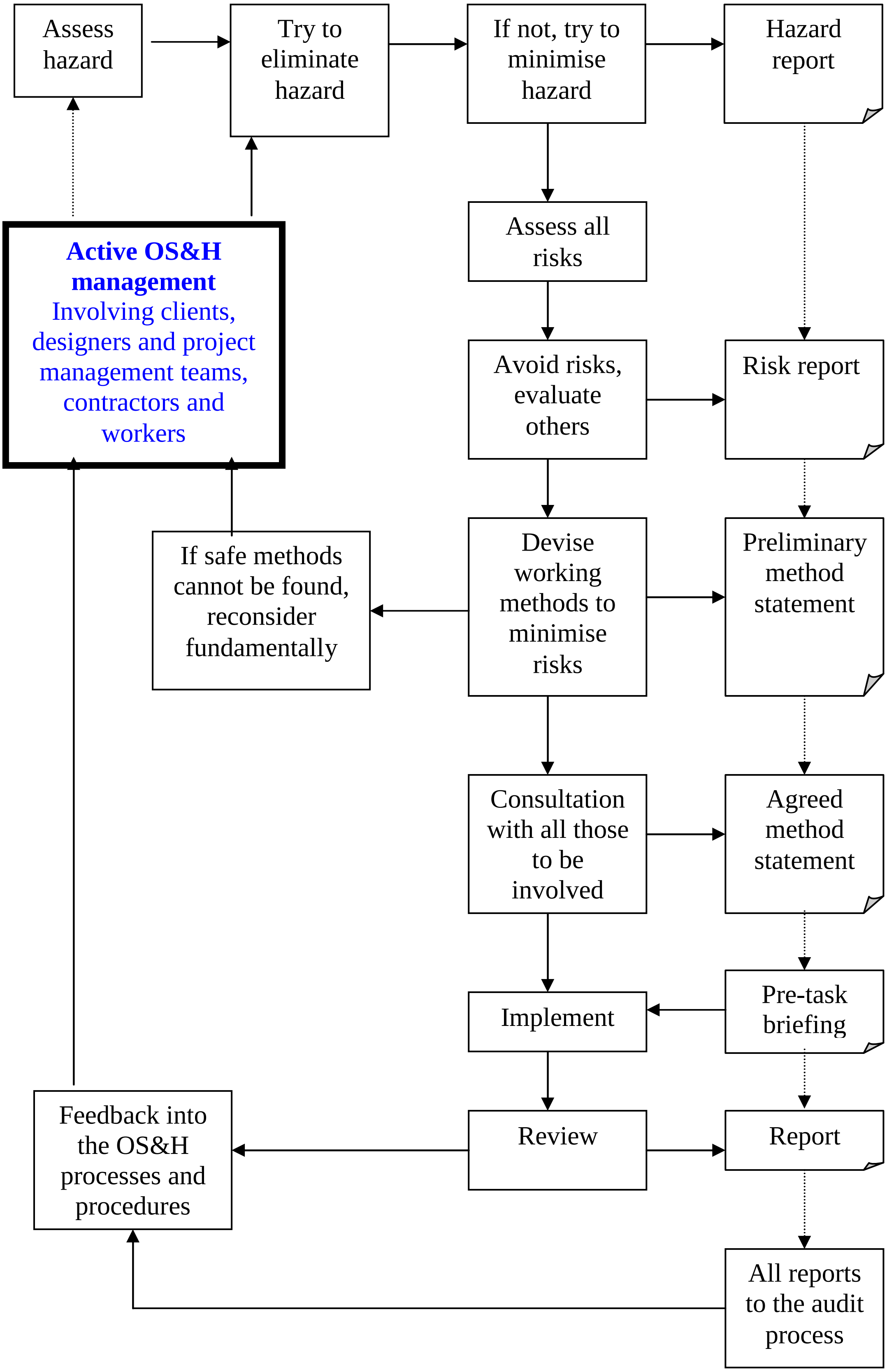
An integrated management system has four levels of documentation:

1. System manual
2. Management procedures:
    - ➢ Technical support services
    - ➢ Company support services
    - ➢ Project management
    - ➢ System management
3. Working instructions
4. Project plans

Conclusion on systems integration

Although Construction OS&H has argued strongly that a systems approach is vital to providing a safe and healthy environment, it must be recognised that OS&H systems must be designed and implanted within the framework and operating practices of other systems within an organisation. Systems designed in isolation will fail, through confusion, duplication of information, demands for excessive effort, and consequential inaccurate information. Since most modern systems follow a similar 'anatomy', this should not be too difficult.

As reminders, the following diagrams, which have been used previously in **Construction OS&H**, illustrate the essential elements of OS&H management systems.


Assess hazard
Try to eliminate hazard
If not, try to minimise hazard
Hazard report
Active OS&H management
Involving clients, designers and project management teams, contractors and workers
Assess all risks
Avoid risks, evaluate others
Risk report
If safe methods cannot be found, reconsider fundamentally
Devise working methods to minimise risks
Preliminary method statement
Consultation with all those to be involved
Agreed method statement
Implement
Pre-task briefing
Feedback into the OS&H processes and procedures
Review
Report
All reports to the audit process

3 CHECKLISTS

The Construction OS&H system to eliminate ‘preventable OS&H incidents’:

- Senior management commitment
- Strong policies
- Comprehensive participatory processes and procedures
- A systematic way of assessing and managing hazards and risks
- Well-developed preventative safety culture
- Good project briefing
- Strong contract clauses in all contracts
- Effective OS&H plans by all parties involved
- Effective OS&H processes and procedures
- Safety through design of the permanent works
- OS&H as a central part of project planning and organisation
- Safety conscious design of the temporary works
- Competent management and supervision
- Safe materials and components
- Safe plant and equipment
- Good workplace design
- Good welfare facilities

Policy and systems

A progressive and continual process of:

- Developing OS&H policy
- Organising to implement the policy
- Planning and taking OS&H actions
- Monitoring and evaluating the results
- Taking further action for continual improvement

All the organisations involved in a construction project should have a written and agreed OS&H policy. The policy must be:

- Written specifically by and for the organisation
- Formulated with the participation of employees and their representatives
- Adopted positively at all levels, especially by senior management
- Clearly stated and effectively communicated to all
- Continually reviewed and up-dated

The policy should include the following:

- A strong commitment to protecting the safety and health of all members of the organisation
- A statement of compliance with all relevant laws, regulations and agreements
- A management structure of organisation and responsibility
- Comprehensive consultation processes and procedures
- Comprehensive review, audit and feedback processes, and a firm commitment to continual improvement
- Compatibility with other management systems or embedded in them

The project brief

The project brief should be a clear, comprehensive statement of the client’s requirements of the project: The client ‘doing the job in the mind’.

The brief will usually include the following:

- General introduction to the client and the other organisations involved
- General statement of intention (i.e. an outline description of a building)
- Location and its implications (e.g. topographic, climatic, social)
- Feasibility and cost studies, leading to the cost plan
- Requirements of authorities and permissions
- Occupational safety and health policy
- Contract documents
- Designs, appropriate to the form of contract
- Overall programme for the whole project
- Other important issues (such as the requirements of fund providers)

Essential elements of an OS&H plan

- Title page
- Authorisations
- Introduction
- OS&H procedures
- OS&H hazard and risk assessments
- Technical controls
- Working practices
- Welfare
- Training
- Consultation and communication
- Review, audit and corrective action
- No safety policy or plan is workable without assigning a specific duty:
  - to a specific person
  - to be completed at a specific point of time
- The safety policy and plan must be transmitted down the line to the workers – it is their safety that the plan is intended to safeguard.

An effective OS&H plan should comprise:

- Clear, measurable and prioritised objectives
- A plan for achieving each objective
- A process for assessing achievements against the objectives
- Specification of the human, physical, financial and environmental resources required
- Improving OS&H performance usually requires changes, so it is important to have a plan for ‘managing change’

Method statement

The Method Statement is of crucial importance to effective OS&H management. This should comprise, as a minimum requirement, a clear, fully documented and agreed statement of the way in which a specific construction element shall be built, taking into account such aspects as:

- The assessment of the hazards and risks inherent in this element
- The sequence of construction and the plan of work
- The materials and components to be used
- The construction plant and equipment to be used
- Temporary works and their possible effects on the finished element
- Provision of safe access, egress and work places
- The sequence of dismantling, removal and, in some cases, disposal of all the plant, equipment, temporary works and waste
- A full statement of compliance with the policy and other requirements of the OS&H plan
- A full statement of all those who will be involved, their roles and confirmation that all have been fully consulted and properly briefed

Key qualities of an effective project manager

- Good team leader, builds good relationships
- Has an open and honest management style
- Good communicator - “management as a performing art”
- Focuses on results, has a ‘sense of mission’
- Technically competent - understands the construction process
- Financially competent - understands project income and costs
- Confident & resilient - “when the going gets tough, the tough get going”
- Understands management systems and uses them effectively

Functions of Trades Union safety representatives

- Talking to workers and Union members, and taking up their complaints with management
- Involving, informing, and consulting workers and Union members on their priorities, and agreeing strategies for tackling risks
- Systematically inspecting the workplace on a regular basis
- Investigating accidents, ill-health and near misses
- Consulting with management
- Monitoring the employer’s performance on health and safety
- Making representations, and negotiating with the employer to ensure the safety and health of workers
- Talking to Government health and safety inspectors
- Participating in joint management - Union safety committees in the workplace

Functions of OS&H committees

- Conduct regular inspections and surveys on safety and health
- Respond to workers’ concerns on OS&H
- Make reports and recommendations to improve compliance with law and standards
- Propose policies, work plans, projects and activities to reduce accidents and illness
- Propose and organise training programmes for the workforce
- Promote and support activities on OS&H
- Follow up progress of proposals
- Report on results achieved, point out obstacles and problems
- Investigate, record and report on all accidents, ill-health and near misses
- Propose regulations on health and safety
- Organise occupational health services

Workplace trades union representatives & ILO agreements

- The right to make representations to the employer on these matters and to negotiate
- The right to be consulted over safety and health arrangements
- The right to be consulted about the use of technical advisers by the employer and to call in technical advisers
- The right to accompany safety and health authority inspectors when they inspect the workplace and to make complaints to them when necessary
- Participation, and equal representation, in the Joint Safety and Health Committee

4 CONCLUDING CASE STUDY

The case study is the collapse of the side of an excavation for a large building project, which killed eight people (seven on site and one later in hospital).

The case study shows a photo and gives extracts from the preliminary report by the Ugandan official investigation team.

The ILO is grateful to Evelyn Katusabe of the Occupational Safety and Health Department, Ministry of Gender, Labour and Social Development, Uganda, for providing this case study.

The building as planned.

The collapse

According to one worker interviewed on site who declined to identify himself, the accident occurred at around 11:30am on 14th October 2008. He said that at the time of the accident occurrence, workers were reinforcing the excavation with iron bars and wood. Further, there was a compactor that was reportedly compacting soil close to the cave in point. He also said that there had been a spate of soil cave-in the past including one that occurred on 30th September 2008 in which part of the site offices collapsed into the excavation.

Observations at the scene

The team observed the following:

- The plot comprising of the site had been excavated to nearly 100%. The excavation was about 15m deep and nearly vertical.
- Most parts of the excavation base up to the height of about 7m bore strutting of metal and wood, with the exception of the western part immediately to the site offices and the eastern part where there is a main trucks’ gate. In addition, the rest of the excavation above the strutting had a plaster covering of about 2inches (as viewed at the point of collapse).
- At the western part there seemed to have been a previous cave in, downing part of the site offices, as cleavage markings were observed from the site office structure.
- Near to the accident point was an excavator with fresh stamp marking on the ground an indication that it was in use probably at the time the accident occurred.
- Above the accident point was a house that also caved into the site with the soil cave-in.
- On site, seven (7) bodies were recovered and two injured workers taken to hospital. There were reports that could not be independently confirmed by the investigation team, that one of the injured workers had also passed away in hospital. The identities of the dead and injured could not immediately be established.
- Further, terms and conditions of employment of the workers could not be established.

Contractor compliance with the OSH Act, 2006

- Pursuant to Section 40(2) of the OSH Act, the site was notified to the Commissioner for Occupational Safety and Health on 12th May 2008.
- In addition, the Contractor, ROKO Construction Ltd, submitted to the Department of Occupational Safety and Health a Construction Phase Safety, Health and Environment Plan for the project. This was in compliance with Section 14 of the OSH Act. The Construction Phase Safety, Health and Environment Plan for the project was reviewed for adequacy and a response requesting the Constructor to further submit safety method statements for particular operations among others was sent on 14th July 2008 as the Plan was inadequate. To date, we have not received a response from ROKO Construction Ltd.

Issues that could have contributed to the accident occurrence

- The presence of a house is an indication of disturbed ground and therefore special attention needed to be undertaken. Further, the water run-off from the house enabled water percolation in the ground which could have been compounded by the rainy season.
- An excavation of such magnitude could have been undertaken progressively i.e. section by section proceeded by strutting and backfilling. It should also be noted that the previous cave-in at the site was an indication of poor methods of work. The steps taken to prevent the reoccurrence are yet to be established.
- The methods of excavation protection were inadequate and did not provide protection to the ground level.
- Seemingly, the excavator vibrations and rumbling at the time of the accident could have triggered the chain of events.

Progress of investigations

Further investigations shall be undertaken and there is a need to work with other stakeholders to establish the circumstances of the accident and propose actions to avoid reoccurrence of such tragedies. In addition, it shall be established how the safety, health and environment plan was operationalised on site.

Conclusions by ILO Construction OS&H

This is a clear case of inadequate support to a major excavation, and also failure to take due care not to make it even more unsafe by restricting the movement of plant and equipment at the surface near to the excavation. No realistic hazard and risk analysis or method statement would have allowed this excavation to proceed in this way.

The case study shows that everyone involved suffers through such incidents.

The **clients'** dream of an impressive building has been tarnished by such loss of life and the project will be delayed considerably while the excavation is cleared. The OSH investigation takes place and the excavation process is re-engineered to provide a safe method of working.

The **designers** have allowed unsafe practices, which has will have damaged their reputation as competent supervisors of construction work on behalf of their clients. In addition, the question has to be asked about the need for such a deep basement in ground of this nature and whether a different design of the building would have provided similarly useful areas and facilities which were easier and safer to build. If in fact the deep basement was necessary, the designers may have considered the use of such construction methods as contiguous piling, which supports the ground while constructing the wall and eliminating the need for working space, reduces the excavated volume which offsets the cost to some extent.

The **contractor** will suffer increased costs, delays, legal action and compensation costs, and may find it difficult to attract good workers to a site with such a reputation. In a tightly regulated procurement system, the contractor may find it more difficult to get future work.

And of course it was eight **workers** and their families who suffered the ultimate loss. Surely this is a good example of the need for worker participation in the construction process?

THIS CASE STUDY EMPHASISES WHY THE TRAINING OFFERED BY ILO CONSTRUCTION OS&H IS SO IMPORTANT TO ALL THOSE INVOLVED IN CONSTRUCTION PROJECTS WORLDWIDE.

DECENT WORK

A better world starts here.

5 BRIEF BIBLIOGRAPHY

Title	Developing an integrated quality, safety and environmental management system
Author(s)	A. Griffith
Type of source	Journal paper
Publication or other source details	Construction Information Quarterly (a journal of the Chartered Institute of Building, Ascot, SL5 7TB, UK)
Date & ISBN/ISSN	Vol 1 Issue 3 1999 (No ISSN appears in the journal)
Summary of contents	The paper provides a research-based explanation of project quality, safety and environment issues, and in particular the concept of an integrated management system (IMS). The paper provides a basic introduction to the principles of IMS, to its application and to the issues that it raises for the future management of the construction process. Current issues and concerns are discussed and some pioneering applications reported.
Comments on relevance	This is an important subject because OS&H systems cannot be implemented in isolation; they must be designed to work alongside other project management systems.
Other information	See also: "Contractors' experiences of integrated management systems" by A. Griffith and K. Bhutto. Proceedings of the Institution of Civil Engineers, Management, Procurement and Law 161, August 2008, pp 93-98. Paper 800049

Title	Managing international construction projects: an overview
Author(s)	R Neale (Ed)
Type of source	Book, 239 pages
Publication or other source details	International Labour Office, Geneva. International construction management series No 7
Date & ISBN/ISSN	1995. 92-2-108751-4 & 4020-0142
Summary of contents	An edited book with contributions from Richard Neale, Williams Sher, Alistair Gibb and Simon Barber Chapters 1: Construction project management 2: Project management organisation 3: System support for projects 4: Control of quality and quality assurance 5: Site layout and facilities 6: Key considerations for site layout and facility planning 7: Construction site safety 8: Planning case studies 9: Cost analysis case study
Comments on relevance	A useful but very general book, apart from the case studies which are quite detailed. This is the last book (No7) in the series so some detailed case studies were seen to be useful. The planning case study has been adapted to provide an integrative project on OS&H for **Construction OS&H**
Other information	See Tutor's Guide for more on the content of this book.