

WELL Study

Review of Safety in Construction and Operation for the WS&S Sector: Part I

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1. Introduction

Water and sanitation projects are frequently justified on the basis of their contribution to health. Those familiar with the sector know that the necessary facilities (e.g. treatment works, storage tanks, pumping stations and sewers) all involve significant occupational risks for those building and operating these facilities. Construction and operation in developing countries is particularly dangerous, and a cursory inspection of any job site will reveal many health and safety hazards.

The majority of the health and safety guidance from international organisations such as the International Labour Organisation (ILO) assumes the existence of powerful regulatory authorities, and therefore stresses an administrative approach to the problem. While these techniques have worked well in industrialised countries, they are inappropriate where regulation is weak or non-existent. This advice note is based on a literature review on safety for construction and operation of infrastructure, water and sanitation facilities for developing countries. It provides a background to the safety problems associated with construction projects and outlines a framework of basic safety principles to be considered in managing construction and operation of such facilities.

This brief summary note is aimed at policy makers and practitioners in the infrastructure sector.

2. Background

Most of the construction industry workers in developing countries are poor. The construction industry is one of the few industries, besides agriculture, that can provide a living for a variety of poor workers including those who are not formally qualified, illiterate, or who seek casual work; and operate in the informal sector. In urban areas, the construction industry is the key provider of employment for most of the poor.

Besides employing many of the poor, construction contributes around 6-10 per cent of the GNP of many countries. Construction plays an important role in any infrastructure related sector, including water and sanitation. The industry is a cross-cutting sector and has many economic spin-offs. Its benefits are not just financial, but social as well; construction leads to employment generation, skills improvements, workers organisations, and an improved quality of life. However, it also leads to the exposure of human beings to increased health and safety hazards.

The construction industry is one of the most hazardous industries. Wherever reliable records are available, construction is found to be one of the worst, and often *the worst* industry on health and safety criteria. The industry that provides the most access to the poor is also the most hazardous.

Many construction hazards lead to loss of life, injuries, disease and permanent disability. The direct impacts on the worker of such hazards can include loss of working days due to disease or injury and job loss. These effects generally spill over to the family, community and society around the worker. Naturally, the effect on the poor and vulnerable members of society is the severest.

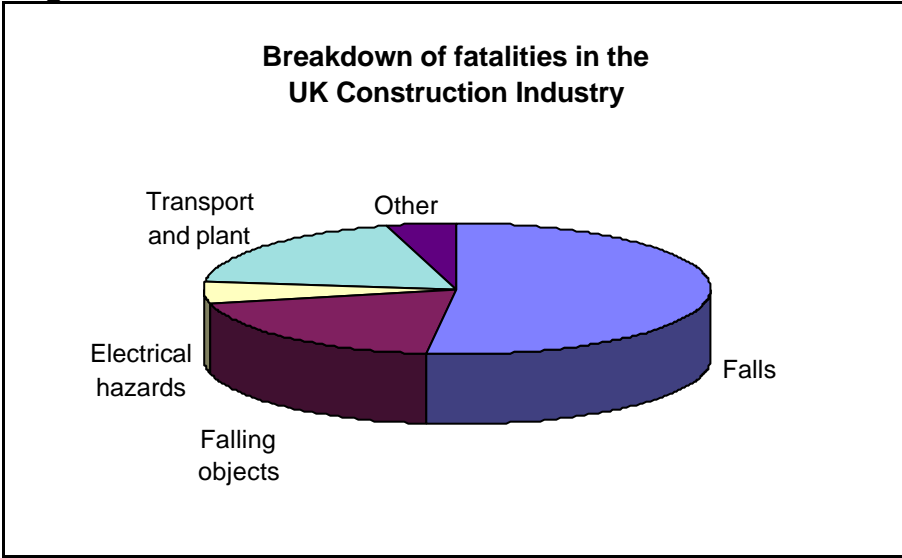
Limited available records suggest the following:

- The construction industry has almost six times as many fatalities and twice as many injuries per hour worked compared with the manufacturing industry (Helander 1991 - USA).
- Construction accidents amount to 6 per cent of the total construction cost (Helander 1991-USA).
- It is not just new construction which is dangerous. In the UK one third of work-related fatalities occur as a result of maintenance work (HMSO 1988).
- The construction industry accounts for 20 per cent of all work related serious injuries and 40 per cent of all work-related fatalities in the UK (ICE 1986).
- 1.5 per cent of construction workers were killed and 5.3 per cent disabled in one year (Gambatese 1998 - USA).

3. The Health and Safety Problem

The construction industry’s appalling health and safety record is a worldwide problem affecting both the developed and developing countries. Very few statistics exist on the nature of accidents and injuries affecting workers in developing countries primarily due to the poor or non-existent regulatory framework. However, health and safety data collected in developed countries show a consistent pattern for worker fatalities and injuries. As the nature of construction work is similar in both developed and developing countries, the problems reported in the industrialised world do not appear particularly "high tech". As the data from developing countries are so scarce, it would appear reasonable to assume that the types of fatalities and injuries are similar worldwide.

Figure 1



Source Helander 1991

The types and frequency of injuries that occur to construction workers will vary according to the tasks that they carry out. The table below lists the primary events which cause injuries to all the different trades within the construction industry.

Table 1. Main events which cause injury to construction workers
1. Falls
2. Overexertion or strenuous movement
3. Handling accidents
4. Struck by falling/flying objects
5. Contact with stationary objects (missed steps etc.)
6. Contact with moving objects
7. Contact with heat or cold
8. Contact with chemicals
9. Exposure to electricity

10.Fire, explosion or blast 11.Others
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Source: Helander 1991

It can be seen from the statistics above that a large proportion of both injuries and fatalities are caused by similar incidents. The highest risk injury is a fall which can occur while accessing the workplace, for example on ladders, or at the workplace itself e.g. due to poor scaffolding. Injury due to falling objects can occur in a number of ways. Material can fall from loads that are being lifted or material knocked off a raised working area. Workers can also be injured or killed by falling objects when excavations, buildings or structures collapse. Electrical injuries occur when workers use unsafe equipment, make contact with overhead wires or break underground cables. Transport and plant results in accidents either by collision with workers or driver injuries due to overturning the equipment. In developing countries the amount of electrical equipment and construction plant on site is likely to be reduced which implies that falls and falling objects could account for more than three quarters of fatalities in these countries.

In addition to accidents construction workers generally have a poor health record. This is primarily due to their exposure to harsh working conditions and hazardous materials. Dusts, including asbestos, and solvents can lead to respiratory and/or skin diseases, dermatitis and ultimately cancer. Back and limb injuries can also be caused by repeated lifting and carrying of heavy objects

Poor health and safety in construction projects may be attributed to: ILO (1987)

- the high proportion of small firms and of self employed workers;
- the variety and comparatively short life of construction sites;
- the high turnover of workers;
- the large proportion of seasonal and migrant workers;
- various trades and occupations working in the same area.

4. Health and Safety in Developed Countries

As the construction industry's health and safety record in developed countries is poor it can not be used as a model for developing countries. For example, despite the proportion of fatalities caused by falls and falling objects, the wearing of a hard hat on site in the UK has only been made a legal requirement in the last 10 years. Nevertheless there are two major differences between the approach to Health and Safety in developed countries and developing nations; legislation and hazard awareness.

4.1 Legislation

The Health and Safety Executive (HSE) strictly enforce a vast amount of UK legislation which may be applied to the construction industry. There are over 100 acts and regulations which affect the construction industry, but the most important legislation covering health and safety is discussed below. The main points to note from this legislation is that the responsibility for health and safety is divided between contractors, clients and employees. The HSE is very powerful, having the ability to close a large construction site immediately, as soon as they discover any unsafe working practices. The fines or penalties for breaking the legislation described below are limitless and directors of defaulting firms may be held personally liable.

4.1.1 Health and Safety at Work Act 1974

This act applies to all work activities including construction. It requires employers to ensure as far as is reasonably practical the health and safety of their employees, other people at work and members of the public affected by their work. Employees also have the following duties under the act:

- follow instructions given to them by their supervisors;
- cooperate with their employers on health and safety matters;
- follow health and safety rules which apply to their job;
- use the health and safety equipment provided;
- report equipment defects to their supervisor;
- take care of their own health and safety as well as other affected by their work.

4.1.2 The Construction (Design and Management) Regulations 1994

The Construction (Design and Management) Regulations 1994 (CDM) require health and safety to be taken into account throughout a project, from planning and design, through construction to maintenance and repair of the structure. This regulation requires everybody involved in a project to contribute to health and safety including the client, designers and contractors. For example, the client is responsible for taking reasonable steps in ensuring that designers and contractors are competent to deal with health and safety issues. Designers should ensure that they consider foreseeable health and safety risks during construction and maintenance and balance them with other considerations such as cost and aesthetics.

4.1.3 Contract Documents

UK contract documents, which are commonly used overseas, attempt to apportion the various project risks to the different parties according to their ability to manage these construction risks.

Traditionally it has been an implicit assumption that the contractor is in the best position to manage the health and safety risks on site. Contract documentation therefore requires contractors to take responsibility for health and safety and indemnify the client against any claims that may be made. An alternative approach which is gaining more support recognises that as the designer determines much of the configuration and work process, he/she should be involved in the safety considerations.

4.2 Hazard awareness

The awareness of both employers and the majority of employees of safety hazards is generally good. Under UK practice, each construction site should have a nominated safety officer who is responsible for reviewing working practices, advising on safety issues and providing safety training. On a large site this is frequently a full time job, and involves promoting hazard awareness, organising induction training and promoting continuous safety training. Safety officers can obtain support, information and training material from the Health and Safety Commission (HSC). The Health and Safety Commission has a duty to assist and encourage adherence to the general provisions of the Health and Safety acts, to encourage research and safety training, to ensure wide dissemination of advice and information and to prepare and propose legislation.

In addition to promoting health and safety each construction site will have qualified first aiders to initially treat injuries. Larger sites are also likely to have a nurse or medical officer who would be able to deal with minor injuries without referral to hospital.

5. Health and Safety in Developing Countries

Statistics are not available on the level of accidents and fatalities in developing countries, but based on data available from the UK and the level of legislation and/or hazard awareness it will be reasonable to assume that there is a serious health and safety problem in developing countries.

In many countries the legislation governing health and safety is significantly limited when compared with the UK. The ILO (international Labour Office) convention 167 *Safety and Health in Construction 1988* still needs to be ratified in many countries. There are frequently no special provisions for construction workers' safety and the general conditions for workers are often not addressed. In many countries where safety legislation exists but the regulatory authority is very weak or non-existent, many employers will only 'pay lip service' to the regulations. There have been cases reported where first aid kits are provided on site 'for show' and never used by injured workers. Injuries are often not reported and the employer provides some form of cash compensation for an injury to the employee. (Koehn et al 1995)

There also appears to be general lack of awareness or poor attitudes towards safety. Typical examples of unsafe working practices include:

- breaking rocks for aggregate without safety goggles
- pouring heated bitumen with open toed sandals
- working in unsupported excavations

Previous research (Dedobeeler & German 1997) has shown that young workers under 26 years old are more at risk from accidents than older workers. This is probably because they are less aware, and have an unfavourable attitude towards the hazards associated with their work.

It is not clear why both employees and employers adopt unsafe working practices. The possible explanations are:

1. Employers and employees are unwilling to spend or invest in safety measures, equipment or practice.
2. The hazards are considered a necessary part and consequence of construction.
3. Employees cannot afford to purchase their own 'safety' equipment (e.g. shoes) and fear they may be penalised if they request items from their employer.
4. The implication is that in many cases the contractors are not aware of their implicit legal responsibilities in relation to the health and safety issues.

Regardless of the reasons for unsafe working practices, the risks of injuries or fatalities will increase if the key players involved in the construction process, including workers, are either not aware or do not perceive the safety risks to be important. In changing behaviour, it is not the actual risks which are important, but the combination of the perceived risks and the strength of the belief that the risks can be reduced through behavioural change. Many accidents occur because the real hazards were either not perceived or were perceived to be less dangerous than they actually were.

6. Dealing with Health and Safety

6.1 On the Construction Site

From the health and safety statistics that are available the two initiatives which will have the biggest impact on accidents and fatalities would be the prevention of worker falls and injury due to falling objects. The two actions that would make significant progress towards these goals would be to:

1. Ensure that scaffolding is suitable for the work and handled by competent people. The scaffold should be tied and be on firm ground. It should be properly designed to take the load encountered in the construction and include proper platforms, gangways and hand rails.
2. Hard hats should be provided and worn on site when any work is being undertaken above head height or in excavations.

Although these two actions would greatly decrease the number of injuries, in many cases, they would be very difficult to achieve. In some countries a hard hat (which is frequently out of date and cracked) is worn as a 'badge of rank' by the senior artisans who have attained a certain level of skill. Scaffolding is often made from wood and bamboo lashed together rather than standard steel poles and couplings. It is constructed by workers who are 'skilled' in its erection but unable to carry out design checks and often do not provide suitable accessways and working platforms.

Taking a more general view, the most important factors found to improve health and safety on UK construction sites are:

- 1 Maintain safe work conditions.
- 2 Establish safety training.
- 3 Safety education for workers and supervisors to promote good safety habits.
- 4 Effective control of the main contractors on site.
- 5 Maintain a close supervision of the work.
- 6 Assignment of safety responsibility to all levels of management and workers.
- 7 Ergonomic design of hand tools.
- 8 Improving the comfort of protective equipment and clothing to ensure it is used.

Some employers also have a bonus scheme where gangs get additional payments if they have not been involved in, or their work has not caused, an accident.

6.2 Institutional Approach

Health and safety is not an issue to be resolved by the contractor alone. The Client and Engineers generally do not take liability for accidents, thus leaving the contractor to deliver projects safely on his own. An integrated approach is warranted with contributions from; law makers, regulators, policy makers, managers, researchers, trainers, operators and workers to have any impact on the prevailing unsafe working conditions in construction projects. Achieving this level of integration among such a diversified group, though desirable, is likely to

be unrealistic in many developing countries particularly where a legal framework for health and safety does not exist. Should it be possible to extend the group of stakeholders who are responsible for health and safety, the status of donors or financiers of the development project may need to be examined, especially if they were involved in the project design and approval process.

Procurement or contract procedures could be one route for effective intervention. The contract documents outline the agreement between parties on the management of risks associated with the project. Guidelines on safety help in identifying, transferring and mitigating some of these risks. Relevant safety requirements could be made through tendering and contract documents. Where there is little relevant enforceable legislation in developing countries, contract documents may assist to cover some safety requirements. However, additional clauses in a contract alone will not result in safety improvements; monitoring, supervision and advocacy are required to ensure that the minimum health and safety requirements laid out in the contract are met.

Safety costs money; which will ultimately be paid for by the client either directly or indirectly. The financial, economic, environmental and social costs of deaths, injuries, disabilities and diseases to an industry, in particular, and to a society in general, is colossal. Promoting safety is a prudent managerial decision in addition to good humanitarian work. It is worth paying the financial costs rather than suffering from economical or social losses associated with a lack of health and safety.

7. DFID role in Health and Safety in Construction Projects

The level of DFID involvement in water and sanitation projects can vary greatly in nature. Potential projects may range from supporting the financing of a large water treatment plant constructed by a large international contractor, to a micro project enabling a local community to improve their own sanitation drainage in an urban improvement scheme. The health and safety interventions that can be made, by DFID, for this wide range of projects will vary significantly.

Regardless of the type of project there are four factors that DFID will have to contend with when addressing health and safety issues:

1. There is highly likely to be no regulatory body to oversee or promote health and safety legislation or best practice.
2. It may be difficult to have direct control over the affected workers particularly in projects promoting small and micro enterprises or community contracts.
3. There will be an additional cost for any health and safety interventions or improvements that will inevitably have to be met by additional DFID funds.
4. The importance placed on health and safety issues by local stakeholders may well be far less than the importance given to these issues by DFID.

The table overleaf outlines the range of interventions that could be made by DFID and the type of contract that would be suitable for each intervention. Discussion of each intervention is provided below. Some of the interventions could be implemented relatively rapidly while others are more of a “wish list” which could be taken as long terms targets.

1. Promote safety education and training

The promotion of safety education and training can be carried out at all levels. It may be possible to support an independent project that could promote a similar organisation to the UK Health and Safety Commission which would be able to provide training and advocate safe working practices on a wide range of projects. Alternatively, individual projects may have an additional health and safety element which could promote best practice and carry out training at a suitable level for the specific project. The latter approach is more likely to be successful for small community based or micro contract projects.

2. Advocate simple legislation

Health and safety legislation supported by a regulating body is non-existent in many countries. While it would be very difficult to persuade host governments to develop or adopt a wide range of safety legislation and incur the costs of a regulating body, it may be possible to advocate the ratification of ILO conventions or develop simple legislation that would be easy to enforce. Naturally, this should be done after a review of existing legislation and the constraints and experience of its implementation.

3. Safety records

At the tendering stages for a project one of the tendering criteria could be an acceptable previous safety record. This intervention may be difficult to implement in the short term as many local contractors are unlikely to maintain safety records. It would also be necessary to ensure that submitted records were a true reflection of the company's safety record. A shorter term

interventions a more formal safety inspection system may be operated. The tender and contract documents should outline the relevant safety practices which should be followed and minimum safety criteria that should be met. An independent safety inspector would then be hired to make an agreed number of visits to the site and report to DFID / the client. Where the inspector found the agreed standards were not being met the contractor may be removed from, or penalised on, future tender lists. Alternatively he may be 'fined' by the forfeiture of a percentage of his monthly payment. Regardless of which option is adopted the penalties that will be imposed should be clearly stated in both the contract and tender documents.

5. Restrict working hours / payment systems

Research has shown that workers who consistently work long hours are more likely to have an accident due to fatigue. It may be possible to insist that workers are not permitted to work more than a predetermined number of hours each week. This approach could require employers to hire more staff which would have the additional benefit of spreading wage payments amongst a greater number of people. Many construction projects pay workers on a piecework or taskwork system.

Taskwork: Each worker is given a certain task to complete for their daily wages once that task is completed they may leave work for the day. This working system has the advantage that it does not penalise the less able as they will be paid the same amount as a more experienced employee for the same amount of work.

Piecework: Each worker gets paid for every 'piece' of work that they complete. They may decide how many 'pieces' that they wish to undertake each day.

The problem of the piecework system is that it may encourage workers to work beyond their physical capabilities and hence be more likely to have an accident. If the piecework system was discouraged care would be required to balance the likelihood of a worker having an accident through fatigue and the potential need for the only breadwinner in the family to earn sufficient money to meet their family's needs.

6. Promotion of good quality handtools

A large proportion of construction and maintenance work will involve workers using handtools. Good quality handtools reduce worker fatigue and the likelihood of accidents, but cost the employer more money. DFID could promote the use of good quality tools and accept higher project costs where the contractor proposes the use of good quality tools.

7. "Safety Money" in contract.

The costs of safety aspects of a construction or maintenance project should be met from the project overheads. As there is no specific money provided for safety issues it may be overlooked by the small contractors or communities. A specific line in the Bill of Quantities, or project budget, could be included for safety items. This money may be used for the provision of hard hats, other relevant protective equipment and/or safety awareness training. This intervention could be operated in two different ways:

1. Provide a list of safety requirements and allow the contractor to indicate a cost for providing them. (It may be necessary to provide them directly on community contract projects)
2. Provide a blank line in the budget and request that the contractor indicates the safety

measures that will be implemented and their total cost.

The first option is more prescriptive but should ensure that the relevant minimum safety measures are implemented however, the second option would allow a simple assessment of the importance placed on safety by a contractor according to the costs and items specified. If either of these approaches were adopted it would be necessary to carry out some form of inspection(s) to ensure that the money had been spent appropriately before it was paid.

8. Further Reading and References

8.1 Further reading

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