



## SYSTEMS AND PROGRAMMES

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Achieving better safety and health in construction  
Information report



European Agency  
for Safety and Health  
at Work



Achieving better  
safety and health  
in construction  
Information  
report



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for Safety and Health  
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## FOREWORD

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Construction is one of Europe's biggest industries, providing jobs for nearly 13 million people. This represents nearly 8 % of the working population in Europe (only the public sector and retail employ more) <sup>(1)</sup>. The range of professions in the industry is also huge. It includes not only the workers and managers on the site, but also the architects, designers, engineers and other specialist professions. The work carried out includes constructing new buildings, new roads, carrying out demolition, and the maintenance and repair of existing buildings.

It is also one of the most dangerous industries. More construction workers are killed, injured or suffer ill health than in any other industry <sup>(2)</sup>. Every year more than a thousand workers are killed and over 800 000 workers are injured, many seriously, with all having to take time off work. Although there has been a steady decline in the incidence of both fatal and non-fatal accidents since 1994, the estimated 1 200 workers killed at work in construction in 2001 clearly shows that much has still to be done <sup>(3)</sup>.

The effect on workers' health is also of serious concern. It is difficult to be precise about the true scale of the health problem, but all studies indicate the problem is huge. Every year many thousands of workers suffer from occupationally acquired diseases. These include musculoskeletal disorders, noise induced hearing loss, skin diseases, and other diseases as a consequence of exposure to harmful substances. Many construction workers are exposed to asbestos leading to potentially fatal asbestos related diseases.

Additionally, the economic costs of poor safety and health are vast. One national study estimates that they typically account for up to 8.5 % of a construction project's costs <sup>(4)</sup>. The European Construction Industry Federation (FIEC) estimates that the construction investment in the EU-15, in 2002, was EUR 902 billion. The potential saving could be over EUR 75 billion.

The Administrative Board of the European Agency for Safety and Health at Work therefore decided to dedicate the 2004 European Week for Safety and Health at Work to construction.

This report is aimed at all those who have influence on safety and health in construction.

The 16 cases described in this report consider a range of issues that influence standards of safety and health. These include design and planning decisions, effective partnering, training issues, construction site management, risk assessment and monitoring, cooperation with workers, action by enforcing authorities, and measures to address specific hazards.

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<sup>(1)</sup> European Foundation for the Improvement of Living and Working Conditions (2002), *Sectoral profiles of working conditions*.

<sup>(2)</sup> European Agency for Safety and Health at Work (2000), *The state of occupational safety and health in the European Union*, pilot study.

<sup>(3)</sup> Eurostat, NewCronos database: <http://europa.eu.int/newcronos>.

<sup>(4)</sup> *The costs of accidents at work*, HSE, HS(G)96 1993, ISBN 0 7176 0439 X (UK).

We hope the report will be useful to promote good practice throughout the construction industry in Europe, by all those involved with the industry. We also hope it will encourage organisations to get involved in initiatives to improve safety and health in construction. To assist this further the Agency has published a series of information materials, including factsheets and a magazine, that are available on our website at <http://agency.osha.eu.int/ew2004/>.

**European Agency for Safety and Health at Work, June 2004.**

# 1.



## INTRODUCTION



The European Week for Safety and Health at Work 2004 aims to promote action to achieve better safety and health in the construction industry. The high number of accidents and cases of ill health in the industry indicate that action is needed. Every year many construction workers are killed or injured as a result of their work. Many others suffer ill health, including musculoskeletal problems, dermatitis, occupational deafness, and asbestos related diseases.

The main causes of accidents, and ill health are well known:

- falls from ladders, scaffolds, roofs and other workplaces;
- falls through fragile roofs;
- transport, vehicles, construction machinery;
- rock slides and contacts with masses in movement;
- falling objects, equipment and structures;
- poor manual handling practices;
- exposure to noise, and vibrating work equipment;
- exposure to hazardous substances, such as solvents, fumes, dust and cement.

The following factors have been found to play a part in more than half the accidents occurring in construction:

- unsatisfactory architectural options;
- unsatisfactory organisational options, particularly because of inadequate coordination between the different undertakings working on a construction project;
- poor planning at the project preparation stage.

## Legislation

The objective of Council Directive 92/57/EEC of 24 June 1992 is to foster an improvement in working conditions, by taking account of health and safety at the project design and organisation stages. The principle is to prevent risks by establishing a chain of responsibility linking all the parties involved. The directive applies a set of innovative measures including those outlined below.

- For most construction projects prior notice must be given to the competent authorities to inform them that a construction project is about to start.
- A safety and health plan must be drawn up before the start of work.
- One or more coordinators may be appointed to ensure that the safety and health requirements are complied with. Their purpose is to ensure that the general principles of accident prevention are applied.
- Responsibilities for occupational safety and health are shared among the client who procures the construction project, the project supervisor, the contractors and workers, and the coordinator.

These measures supplement the provisions of Council Directive 89/391/EEC of 12 June 1989, the so-called framework directive relating to the implementation of measures designed to promote the improvement of worker safety and health in the workplace. This directive defines:

- an overall approach linking inseparably health and safety and the improvement of working conditions;
- the various obligations incumbent on employers with regard to health and safety in the workplace.

The minimum requirements provided for by the European directives are then incorporated in the national legislation, which may also sometimes provide for additional requirements.

The high number of accidents and cases of ill health can partly be explained by poor levels of compliance with legislation. The Senior Labour Inspectorates Committee (SLIC), via its construction working group, has carried out a coordinated EU (plus Iceland and Norway) inspection campaign. The findings of the campaign are alarming. Inspectors have found a high level of non-compliance throughout Europe.

**However, that is not to say that the construction industry is unaware of the problems. There are many reputable parts of the industry working hard to ensure that standards of safety and health are improved. This report is to demonstrate that there are many examples of good practice making it possible to avoid accidents and ill health.**

## **The report**

This report describes 16 cases of good practice in the construction sector. The actions described are very different from one another. Some of the case studies are project specific or risk specific. Others describe systems that can be used to improve the management of safety and health throughout the industry. All demonstrate what can be achieved with key players taking appropriate action. The 16 cases have been grouped together in three categories: the design stage, the construction phase and the maintenance phase.

## **Aim**

The purpose of this report is to obtain examples of good practice from across Europe and make them available to interested parties. There is much guidance material already available on many aspects of occupational safety and health in construction. Much of this is topic specific, and is provided to meet the individual needs of Member States. This report, by gathering together a collection of very different individual case studies from throughout Europe, aims to stimulate the development of discussion and action to make the industry a safer and healthier one to work in.

## **Target group**

The target audience for this report is all those who have influence in the construction industry. This is a very large audience:

- clients, public and private, who procure construction work;
- architects and designers;
- engineers, surveyors and others involved with the planning of construction projects;
- policy-makers;

- safety professionals and researchers;
- the contractors and employers who work on construction projects;
- intermediaries, such as the trade unions.

## **Methodology**

The 16 case studies included in this report were selected by the Member States, and accession States in the case of Latvia and Poland. They are very varied in their type and subject matter. These include actions on specific construction projects, national coordinated actions, systems for monitoring and assessment of risk, and cooperation between countries.

This enables the report to consider many aspects of the construction process and various parts of this diverse industry.

The report tries to identify, from these case studies, at what stages of a construction project the actions can have the most influence and improve occupational safety and health. In some cases this is not exclusively at one stage, and may be relevant throughout all the stages of the project.

## **Identifying success factors**

With such a varied selection of case studies from 14 Member and two accession States, no single measure of success is possible. Success factors differ between each study. Within each individual study success criteria are identified. They take into account factors including the transferability of the actions to different projects and Member States, and the specific objectives of the study. It is inevitable that differences in custom and practice between countries will have a bearing on outcome and success factors.

## **Structure**

The case studies are divided into three categories.

1. The design stage (i.e. procurement, design and planning)
2. The construction phase
3. The maintenance phase

This structure has been used to emphasise that, to achieve good standards of occupational safety and health, action is required before the construction phase starts. It continues during the construction phase with the contractors, employers and workers. Finally the end users, and maintenance workers, of the building or structure need to be included. Some of the case studies illustrate action taken at more than one of these phases.

# 2.

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## SHORT DESCRIPTION OF THE CASES

## The design phase

### *Clients*

- Effective health and safety management in Egnatia motorway design and construction (Greece)

The Egnatia motorway project involves the construction of a dual carriageway road, 680-km long, to international standards, with a central reservation. The objective of the company managing the project was to have a satisfactory OSH file and plan for each contractor and avoid serious and fatal accidents during the project. The action focused on inspections against a checklist, communication and information, accident analysis, training, and cooperation. The training of contractors and subcontractors before the start of the works was an important initiative that had numerous follow-on effects.

### *Architects/Designers*

- Paternoster Square project (United Kingdom)

Steel framed buildings are very common. During their construction, steel beams and columns have to be lifted by crane and fixed into position. It is customary for this operation to be carried out by wrapping lifting slings around the steel beam or column and then lifting it. There is a risk of the steel slipping out of the slings and falling. However, by designing in lifting attachments such as pre-drilled holes, lifting shackles can be used and the risk eliminated.

- Construction Safety Partnership (Ireland)

An Irish study into fatal accidents highlighted that at least 25 % of these were directly attributable to the pre-construction phase of the project. The Construction Safety Partnership takes this into account by focusing on clients, designers and construction managers. Part of this project involves the setting up of a register of competent project supervisors design stage (PSDS). These have a key role, under Irish legislation, in reviewing the design with the objective of minimising risk during the construction phase.

### *Safety and health coordinators*

- Demolition of large prefabricated standard buildings (Germany)

Many of the large prefabricated buildings of the former German Democratic Republic are being demolished because many people have moved to more attractive buildings. The space created is being used to improve and enlarge green spaces and to make residential areas more attractive. The demolition of these buildings entails specific risks from hazardous substances (such as asbestos), in addition to the usual risks involved in demolition work, such as falls from heights, being struck by falling objects, and slips or trips.

- Tools for risk assessment (Belgium)

The Belgian Committee for Safety and Health in the Construction Industry (CNAC/NAV) has developed several tools to help employers and the CNAC advisers conduct risk assessment on sites. The first tool is called the risk inventory and evaluation method (RIEM). It consists of an inventory of the main OSH risk factors and welfare issues. An evaluation of each risk factor

and welfare issue identified is then carried out. The results are an overview of these issues and the preventive measures to be taken. The second tool is called the Prevention Atlas and aims at helping the CNAC/NAVB advisers in their work on sites. It consists of a comprehensive risk prevention monitoring system and provides a basis for developing specific actions on building sites and in the construction sector.

## The construction phase

### *Safety and health coordinators*

- Actions to improve OSH management at company level: Hława Building Company (Poland)

The Hława Building Company has developed a comprehensive occupational health and safety system covering different issues on OSH, to reduce occupational injuries and diseases. This system includes monitoring OSH on sites, training, coordinating subcontractors, and having a safety and health employee supervising all these actions.

### *Project managers and supervisors*

- The Mourik safety, health, environment and quality management system (Netherlands)

Mourik is a Dutch construction company that has developed a detailed integrated OSH management system covering safety, health, environment and quality (SHE-Q). The goal of the whole SHE-Q activity is to further improve occupational safety, to create a high level of health and safety awareness and ultimately to attain a total safety culture. This includes risk assessment; implementing prevention measures, training new employees, monitoring performance, and cooperation with the workers. As a result of these measures the accident rate has dropped to the very low level of 0.8 lost working days per 100 employees per year in 2003.

- TR safety observation method (Finland)

The TR safety observation method was introduced in Finland in 1992 to measure the safety performance on building sites. Measurement is performed by making a tour of the entire site and entering observations regarding correct/incorrect procedures on the inspection sheet. The aspects covered include working habits, scaffolding and ladders, machinery and equipment, protection against falling, electricity and lighting, and order and tidiness. The method has proved to be both convenient to use and efficient. One important factor of the system is that it is carried out jointly by management and workers. It is now used by many construction companies to measure performance and by the Finnish labour inspectorate.

- Coordinated safety management — The Copenhagen metro (Denmark)

This action describes the safety management system adopted during construction of the Copenhagen metro in Denmark. This public infrastructure project was the first underground rail system ever built in Denmark. Construction management was performed by the consultant COWI A/S. The comprehensive preventive measures adopted for the metro project included: assessment of risks and the working environment, audits and inspection, joint safety management inspections, motivation and a

joint safety campaign. This action was successful, since the accident rate in the Copenhagen metro project was much lower than the average in the sector and no fatalities or serious accidents occurred.

- Health and safety at the restoration works of the Acropolis monuments (Greece)

In 2002, the Hellenic Institute for Occupational Health and Safety (EL.IN.YAE), in cooperation with the Department for Restoration of the Acropolis Monuments (YSMA, Greek Ministry of Culture), carried out a study to assess risk factors and their consequences for the health and safety of workers during restoration work on the Acropolis monuments. The procedure adopted was implemented in three stages. First, all the workers received a questionnaire dealing with matters concerning risks to safety, health and ergonomics. The second stage recorded risks (measurements, etc.). The final stage consisted in medical examinations.

#### *Construction contractors/subcontractors*

- Across the sea between Denmark and Sweden (Sweden)

During construction of the Øresund Bridge between Denmark and Sweden, a campaign was launched by the Danish site owner to reduce the injury incidence rate and promote positive attitudes towards safety and health on the site. This campaign involved active cooperation between the Danish and Swedish labour inspectorates to improve the level of OSH on both sides. It included joint inspections, actions to motivate the workers, communication and information to promote a positive safety and health culture.

- Prevention of falls from a height on construction sites (Latvia) (implementation of Council Directive 92/57/EEC)

This action involved the National Working Environment Authority of Denmark providing assistance to the Latvian State labour inspectorate. Construction projects were inspected, examining work at heights. The purpose of this was to improve implementation of the directive in the Latvian construction industry prior to EU membership. Cooperation took place at four levels: the preparation stage, training of inspectors, the information campaign, and the construction site inspection campaign. A booklet was published and disseminated in Latvia. This campaign was a success.

- Warnow tunnel (Germany)

A 790-m long tunnel was built in north-east Germany, on the outskirts of the City of Rostock, to pass under Warnow River shortly before the river flows into the Baltic Sea. All the construction work was carried out by subcontractors of the main contractor, Bouygues. Due to the large number of subcontractors (between 20 and 25) and the specific site risks, a detailed OSH plan was drawn up. This plan was successful thanks to very close cooperation between the main contractor, the subcontractors and the labour inspectorate.

#### *Workers*

- Union participation and supervision of the 'Terra Mítica' theme park project (Spain)

This case outlines union representation for the prevention of occupational risks during construction work at the 'Terra Mítica' theme park grounds in Benidorm. An agreement signed between two unions (CC.OO and UGT) permitted the establishment of a commission on occupational risk prevention monitoring and the appointment of six union safety supervisors on the site. Their presence on the site enabled direct communication with the workers and effective cooperation throughout the duration of the construction work.

- Effective safety representatives mean safe sites (United Kingdom)

Construction sites are by their nature temporary places of work, with a continually changing workforce supplied by different employers. This action consisted in the appointment of a trade union convenor, on a specific construction site managed by the company Bovis Lend Lease. He was responsible for consultations between management and workers and also played a significant role in promoting and enforcing safe working practices amongst all the workers on the site. The basis of this action's success is effective communication.

## The maintenance phase

### *Maintenance contractors*

- Construction of Stade de France (France)

The construction of Stade de France (a stadium with a capacity of 80 000 people) near Paris for the 1998 football World Cup involved dealing with a major problem of contaminated land. During construction of the structure, there were considerable risks of health damage due to contaminated land, especially risks related to the release of gases in large quantities during the foundation earthworks. Significant measures were taken to counter pollution during both the construction and operation of the structure. Effective control of these health and pollution risks was achieved, demonstrating that accurate information reached all those involved in the work.

### *Building owners*

- Integrated safety project for the installation of special systems in the St Francis complex (Italy)

Works were carried out in certain parts of the old San Francesco monastery, home of the Imola municipal library, Scarabelli Museum and Risorgimento Gallery (province of Bologna in Italy), in order to install safety and lighting equipment. The company Quasco worked out the safety and coordination plan for this project, and acted as health and safety coordinator during the work. It also defined safety measures which could be useful for future maintenance work.





# 3.

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Matrix of the cases

	Cases	Design	Construction	Maintenance	OSH management	Specific risk management
Belgium	Tools for risk assessment	X	X		X	
Denmark	The Copenhagen metro	X	X		X	
Finland	TR safety observation method		X		X	
France	Construction of Stade de France	X	X	X		X
Germany	Warnow tunnel		X		X	X
	Demolition of prefabricated buildings	X	X			X
Greece	Restoration of the Acropolis		X			X
	Effective OSH management in motorway construction	X	X		X	X
Ireland	Construction Safety Partnership	X	X		X	
Italy	St Francis complex	X	X	X		X
Latvia	Implementation of the Council directive to protect against falls from a height			X		
Netherlands	Mourik system	X	X		X	
Poland	Actions to improve OSH at company level		X		X	
Spain	Terra Mítica theme park		X			
Sweden	Øresund link — Labour inspection activity		X			
UK	Effective safety representatives	X	X		X	

# 4.

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## THE CASES

# 4.1. EFFECTIVE HEALTH AND SAFETY MANAGEMENT IN EGNATIA MOTORWAY DESIGN AND CONSTRUCTION (GREECE)



## Key points

- Prevention at the design stages is critical. It must start from the beginning at the conceptual, elaboration and preparation stages of project design and should be continued through the final stages.
- Continuous OSH training of the contractors prior to and during the construction played a key role in prevention.

## Introduction

The company Egnatia Odos AE (EOAE) is based in Thessaloniki and is responsible for the construction of the Egnatia motorway (EM) project, a 680-km long dual carriageway of international standards with a central reserve. Each carriageway consists of two traffic lanes and a hard shoulder, with a total width of 24.50 (or 22.00 in difficult sections). Many long twin-deck bridges are also under construction throughout the Egnatia motorway, covering a total length of 40 km. The total length of twin bore tunnels will cover 45 km, which corresponds to 90 km of single bore tunnel.

Other features of EM are 50 interchanges, 350 crossings and service roads that are under construction, with a total length of 720 km. Another 120 km of vertical axes that are under the responsibility of EOAE must also be added to the above.

EOAE manages the project ('Egnatia motorway') according to Greek public works legislation, i.e.:

- awards the preparation of designs to design offices;
- awards the construction of the project to construction companies;
- and, respectively, awards the maintenance to maintainers.

EOAE supervises the works of more than 36 joint ventures (JVs) with over 5 000 employees.

EOAE staff continuously contribute effectively to the updating of all parties involved in the project, on issues of occupational safety and health (OSH).

## Background of the action

Whereas EOAE staff had substantial experience in design and construction issues, their knowledge regarding implementation of OSH legislation requirements was very limited and their hands-on experience even more so.

EOAE management considers that taking all necessary measures to protect the health and safety of people and safeguard material goods from damage or destruction resulting from activities related to implementing the project is of equal importance to any other procedure.

The health and safety activities had a systematic approach. They basically comprised health and safety training of contractors, drafting a model health and safety plan and file for all works, drafting checklists for inspection, common inspections with site safety engineers, and retraining of contractors. The main health and safety hazards during the works were risk of boring front collapse, use of explosives, risk from falls, risk from passing vehicles, exposure to high levels of noise, dust including silica, vibration, asphalt fumes, etc.

The human resources of Egnatia devoted to auditing procedures were six health and safety experts covering all three regions of technical works.

## Ambitions of the action

Following a Board of Directors' decision, the corporate policy on health and safety issues was determined.

The corporate policy on health and safety is summarised in the following statement.

'The intent of the company is to protect all persons affected by our project activities regardless of whether they are employed by the company or involved in the project or not, and to protect the environment from any possible damage that may be caused by works and actions required for the execution of this project.

For the purpose of implementing this intent, the company has drafted its safety management system specifying all administrative, organisational and operational measures and safety precautions that it requires to be taken at each aspect of its work.'

Egnatia placed great emphasis on the health and safety plan and file. Its first concrete goal was to only accept studies from contractors that had a satisfactory health and safety file and plan. The second goal was to avoid serious and fatal accidents during the construction.

## Scope of the action

### *(1) Safety management at the stage of design*

Pursuant to Ministerial Decision MD/85/01 of the MEPPW, the health and safety plan (HSP) and the health and safety file (HSF) became prerequisites for the



*The tunnel in Dodoni*

approval of all public works designs prepared after 1 September 2001 at the stage of definitive or implementation studies.

EOAE prepared preliminary examples of the health and safety plan (HSP) and health and safety file (HSF) for the health and safety coordinators (HSCs) of designers. These examples are structured in accordance with the requirements of Presidential Decree 305/96, MD 177 No F.266/01 and EOAE design specifications. EOAE has also organised workshops and conferences in Thessaloniki and Athens, where representatives of cooperating design offices and other engineers were updated and trained in the preparation of HSPs and HSFs. In total 100 technical offices with about 500 engineers participated in a five-day training programme.

### *(2) Health and safety file and plan*

Additions to contractor requirements were made on the health and safety file and plan. A model health and safety file and plan was drafted.



*The tunnel in Dodoni Reinforcement positioning in tunnel*

### *(3) Safety management at the project construction stage*

EOAE's project safety management focused from the start on the organisation and infrastructure required by the relevant legislation on worksites.

The situation was very embryonic. This became clear when, at the beginning of 1998, a programme of visits and inspections to active worksites, as well as to the appointed construction manager (CM) JV's staff, was started by the EOAE health and safety division. The staffing of worksites with safety personnel required by the legislation was almost inexistent. The filling-in of this staff became a priority.

There are currently three CM JVs established at the capitals of prefectures crossed by the Egnatia motorway. These JVs are staffed with engineers from all disciplines (Greek and foreign, 50–60 persons). Within the staff of these JVs, there are four safety engineers (SEs) charged with full-time health and safety duties.

Subsequently, based on the comments made during these visits and inspections, the health and safety division of EOAE acted as follows:

- drafted the health and safety management system (i.e. where we are and where we want to go);
- added missing details to the ‘Special conditions of contract’ (SE, HSC, occupational physician (OP), health and safety design measures for tunnels, HSP, HSF, prior notification to the authorities, etc.);
- ensured that new contracts are complete according to the data and requirements of the health and safety legislation;
- drafted procedures that govern the relationships with the CMs and the contractor (design or/and construction), as well as a procedure for the reporting of accidents;
- issued 18 different checklists for the convenience of the SEs of the contractors, including checklists for work in tunnels, bridges, work with explosives, etc.;
- applied a different control system to new worksites versus already active worksites;
- started an intensive information and training programme for worksite staff (site managers, SEs, etc.) where training and explanations were provided regarding the legislation and its requirements and details were provided on the practical application of their duties;
- finally, a control and inspection programme started, together with the SEs of the CMs. In the period 1997–2003, 2 088 inspections were carried out in total. Table 1 illustrates the inspections of the sites for the three regions.

Regions	Number of inspections per year						
	1997	1998	1999	2000	2001	2002	2003
West	5	90	145	175	198	198	199
Central	6	45	53	65	102	158	118
East	9	60	88	143	116	85	30
<b>Total</b>	<b>20</b>	<b>195</b>	<b>286</b>	<b>383</b>	<b>416</b>	<b>441</b>	<b>347</b>

Table 1: Inspections of the sites for the three regions of EOAE, January 1997 to June 2003

Further to the above activities, the basic operations of the health and safety division of EOAE also include:

- management of the health and safety system for the EOAE staff;
- coordination of actions among the CMs’ SEs;
- finding solutions for special situations;
- the transfer of knowledge/experience and information about occurring accidents and ways to avoid them from region to region;
- training; and
- accompanying the local State technical inspectors on inspections and visits to construction sites.



As the main duty of the EOAE safety division staff and the CMs' SEs is to assist the constructors in preventing accidents, their activities can be summarised as follows:

- inspections of works on health and safety issues at all stages of construction with the use of checklists;
- inform, and on occasions train, worksite staff regarding their health and safety duties;
- cooperate with engineers of other disciplines from the CM or the contractor depending on the specialised field they are responsible for (i.e. bridge/tunnel specialist, etc.);
- design and methodology reviewing (if the method is safe or additional measures are required); also HSF/HSP checking and providing the authors with improvement suggestions;
- recording and reporting on non-compliance issues;
- accident analysis/improvement suggestions;
- training of EOAE, CM and contractor's staff;
- cooperation with other CM and EOAE SEs, as well as with local state inspection authorities and engineers of the MEPPW.

An example of a checklist used on a new site is shown in Table 2 on the following page.

## Problems encountered during implementation

The basic problem was to convince contractors, which were big reputable design offices in Greece and abroad, to properly draft health and safety plans and files. Sometimes even the intervention of the Egnatia Secretary-General was needed to solve relevant problems. During construction, safety culture problems were encountered. Although young engineers were more receptive to health and safety principles, older ones were reluctant to accept them and apply them in due time. It must be stated here that if a contractor, with a high accident record, had extremely hazardous work situations to deal with, its sites were shut down by Egnatia until appropriate measures were taken.

## Results and evaluation of the action

The fact that EOAE has been working systematically for four years on health and safety issues has been fruitful for the associated organisation of JVs, whereas health and safety parameters are now starting to play an important role in the design of highway works. EOAE is trying to pass on this experience to all parties interested further in its field of responsibility by organising seminars and conferences. Everybody in the technical world now acknowledges this contribution of EOAE.

The current picture in the health and safety infrastructure and human resources allocated to the Egnatia motorway project, compared with that in 1998, is given in Table 3.

CONTRACTOR: .....	DATE: .....
WORKSITE ENGINEER: .....	
Project type: .....	Location: .....

Issue	Check	Comments
1 Safety measures log		
2 Book of suggestions of SE/OP		
3 Special log book of accidents		
4 Medical exams record		
5 Staff training in health and safety		
6 Staff training in first aid		
7 Pharmacy (existence, completeness)		
8 List of emergency phone numbers		
9 Sufficient water supplies		
10 Potable water		
11 Sufficient waste deposit areas		
12 Sufficient sanitary areas		
13 Measurements/monitoring of agents		
14 Safety helmets		
15 Safety shoes		
16 Ear protectors		
17 Face masks		
18 Safety goggles		
19 Safety harnesses		
20 Protection from falling: nets, harnesses		
21 Fire-fighting equipment		
22 Safe storage — use of inflammable substances		
23 Safe storage — use of explosives		
24 Protection from electricity		
25 Ladders, scaffolding and barriers		
26 Vehicle control: vehicle log books		
27 Vehicle driver's licence for drivers — operators		
28 Vehicle suitability: lights, alarm sound, flashes, brakes (fire extinguisher, triangle)		
29 Worksite risk signing		
30 Worksite traffic signing		
31 Traffic signing outside the worksite		
32 Lighting — installation		
33 Lighting — sufficiency of lighting level		
34 Health and safety plan and file (HSP and HSF)		
35 Emergency plan		
36 Health and safety design measures (tunnels)		
Responsible safety engineer *	Names	
Responsible occupational physician *		
Health and safety coordinator		

Table 2: Checklist of worksite health and safety

Regions	JV		SE of CM		SE of JV		HSC		OP		HSDM		HSP		HSF	
Year	1998	2002	1998	2002	1998	2002	1998	2002	1998	2002	1998	2002	1998	2002	1998	2002
West	6	15	0	2	0	23	0	19	2	9	0	7	0	12	0	5
Central	7	5	0	1	1	9	1	5	1	5	0	5	1	5	0	5
East	7	12	1	1	1	11	0	11	1	4	0	n.a.	0	10	0	4

Legend  
 SE: Safety engineer  
 OP: Occupational physician. No OP is required when there are less than 50 employees  
 HSC: Health and safety coordinators during construction  
 HSDM: Health and safety design measures for tunnels  
 n.a.: not applicable

Table 3: Comparative health and safety data for the three regions of EOAE, January 1998 to December 2002

There is an obvious improvement in the knowledge and actions of contractor staff in the field of health and safety. A brief list of accidents on Egnatia worksites during these years is provided below, combined with the budget of executed works (Table 4).

Year	1998		1999		2000		2001		2002	
Region/Cost	S	F	S	F	S	F	S	F	S	F
West	0	0	3	0	10	1	10	0	13	0
Cost	34.271		46.926		105.165		198.982		224.929	
Central	1	0	2	0	5	2	12	0	6	2
Cost	55.677		123.169		170.635		244.939		203.764	
East	3	0	0	0	7	0	12	1	7	0
Cost	81.065		100.757		177.118		172.200		136.603	
<b>Accidents (total)</b>	<b>4</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>22</b>	<b>3</b>	<b>34</b>	<b>1</b>	<b>26</b>	<b>2</b>
<b>Total cost for design and construction</b>	<b>171.013</b>		<b>270.852</b>		<b>452.918</b>		<b>616.121</b>		<b>565.296</b>	

The budget of works is in thousand euro.  
 Legend  
 S: Serious injury (over 10 days in hospital, fractures, etc.)  
 F: Fatalities

Table 4: Comparative data for accidents — Works budget along Egnatia motorway, January 1998 to December 2002

Extracting conclusions in relation to the impact of health and safety measures on the number of accidents is not an easy task, when viewing the above statistics. Nevertheless, considering the difficulties and the size of the Egnatia motorway project, a comparison with other similar works in the EU regarding serious and fatal accidents would be of great interest. In Egnatia's case, a substantial percentage of accidents relate to subcontractors who are more difficult to control and are still not familiar with applying their main obligations under health and safety issues.

'The six-year systematic efforts of the health and safety department of EOAE SA have greatly raised the level in the areas of site safety management and respective designers' involvement as per [Directive] 92/57/EEC.

Since then, the obtained knowledge and experience in managing health and safety issues for such a big project, by EOAE SA, is being transferred to other public and private organisations within Greece via training and seminars.

Finally, [the] EOAE SA contribution on health and safety is well recognised by all technical institutions all over Greece.'

Mr Sophoklis Tzovarides, Director of Quality Assurance and Human Resources, General Secretariat of Public Works, Ministry of Environment and Public Works

### Identified success criteria

The training of contractors and subcontractors prior to the commencement of works was an interesting and innovative idea that had multiplying effects. The training was extended to 1 500 public servants from the Ministry of Public Works and Development and local municipalities working in public works.

The model health and safety plans and files provided a good knowledge base for the contractors. In addition, these plans and files are at this moment being discussed at the Ministry of Public Works, in order to be published as guides for the public works contractors.

The common inspections of Egnatia experts, with the safety engineers of the contractors, served two purposes: control of the health and safety situation for the client and a didactic experience for the local engineers.

### Is the action transferable?

The method of health and safety training of the contractors and subcontractors can be transferred to other countries. The guide on the health and safety plan and file for road construction works that is also being drafted in English can be transferred to other technical offices across Europe.

### Further information

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## 4.2. CONSTRUCTION SAFETY PARTNERSHIP PLAN (IRELAND)

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### Key points

- Studies indicate that 60 % of site accidents could be attributable to decisions or choices made before work commenced. This initiative aims to improve the design, planning and procurement process to impact on standards of safety and health during the construction phase.
- It builds on the achievements of the partnership to date in improving site worker training and consultation, which has already made a significant contribution to worker safety and health on site.
- The initiative now also focuses on clients, designers and construction managers, with education, training and competency being a key area for development.

### Introduction

The Construction Safety Partnership (CSP) was initiated in Ireland in 1999, and from 2000 to 2002 achieved much in improving safety and health at site level. These achievements included improved consultation with worker safety representation, and training of construction workers. These achievements, however, must be set against a continuing high fatality and serious injury rate. This second phase of the CSP initiative consolidates work to date and focuses on pre-site commencement improvements relating to planning, design and procurement. Among the aims of this second stage are the introduction of a pre-qualification safety system for contractors and the setting up of a register of competent project supervisors at the design and construction stage. The aim of this is to assist selection at procurement. Additionally client best practice guidelines are to be produced, as well as the establishment of an industry specific diploma course in safety management.

### Background of the action

In 1999, discussions were held, and an agreement was reached, between the Irish government, the Health and Safety Authority, the Irish Congress of Trade Unions, and the Construction Industry Federation. The result was the formation of the Construction Safety Partnership (CSP). This tripartite body then had the task of producing a construction industry action plan. The aim of this plan was to achieve lasting improvements in safety and health on construction sites. This initiative followed widespread concern over the high level of fatal and serious accidents occurring in Ireland, and concerns about the standards of health for construction workers.

Progress was made in a number of key strategic areas, most notably in consultation with the workers and training to make work safer. New Irish regulations (the safety, health and welfare at work (construction) regulations 2001) came into force at the beginning of 2002 and they require a worker safety representative on all sites where more than 20 people are at work. This followed a recommendation made in the original CSP plan. A safe pass system was introduced requiring mandatory safety training for all construction workers, developed by An Foras Áiseanna Saothair (FÁS), the Irish training and employment authority. For specified tasks workers have to be assessed under the Construction Skills Certification Scheme (CSCS). This has been made a requirement under the 2001 regulations for workers who carry out specified tasks. The regulations recognise qualifications given by FÁS and additionally those given by other approved bodies in other jurisdictions recognised as equivalent to FÁS.

During the initial part of this initiative, encouraging trends in accident statistics occurred. From 1998 to 2001 the fatal accident rate fell from 15.1 per 100 000 employed to 8.3. However, in 2002 the rate increased to 10.9. The CSP decided to develop a further plan for 2002 to 2005.

Having been successful in steering the implementation of the measures proposed in the Construction Safety Partnership plan 2000–02, the CSP now proposes to have a strategy that impacts on the whole of the construction industry. The plan is to re-invigorate the process started in 2000, and to stimulate the development of further strategies aimed at delivering good practice in construction in line with best international practice and the new Community strategy.

### **Ambitions of the action**

The original goals of the initiative were:

- to provide a structure by which management and workers can cooperate in making construction sites safer to work on;
- to radically change the health and safety culture in the industry;
- to bring accidents into line with other sectors of the economy and with those in the construction sector in those Member States of the Community with the best performance record in this regard;
- to raise standards of health for construction workers throughout their working lives, and welfare and working conditions generally in the industry to those prevalent in other sectors of the economy.

These fall into four main headings:

- safety consultation;
- safety training;
- safety management systems, etc.;
- actions by the Health and Safety Authority.

These original ambitions and goals remain. The ambition now is to involve all of the industry, not just those based at site level. Actions are now required to involve all those who can take action to achieve the overall goals. This means

that clients, designers as well as the contractors, workers and regulators are targeted in this plan.

## Scope of the action

### *Pre-construction/design/procurement*

The CSP recognises that there are a number of high priority issues in the design and planning process that need to be tackled. This process provides a key opportunity for all those who construct, use, maintain, operate and decommission the facility over its life-cycle to address health and safety issues. The cooperation of clients, designers and project supervisors will be sought to agree a strategy to speed up changes within the industry in order to improve safety and health through all stages of the construction process.

Health and safety needs to be seen as a fundamental requirement in order to qualify to tender for a project. To aid this procurement process, the CSP will establish and implement a pre-qualification system with a standardised weighting system focusing on safety. To facilitate this further, the plan requires a register of competent project supervisors design stage (PSDS) and project supervisors construction stage (PSCS) to be established. This will ensure that only those who have the necessary qualifications, experience and resources will be recognised as competent to undertake these key duty-holder positions. There is also a need for new procedures for clearly identifying and resourcing the role of the PSCS when pricing projects.

The plan also proposes a guide on client best practice intended to provide information to clients in both publicly and privately funded projects on the application of best practice from the procurement stage through to the decommissioning stage. In order to protect workers, it is imperative that clients and designers allow adequate timescales for all phases of construction projects. The design stage of construction projects has an important role to play in ensuring that adequate timescales are allowed for projects. The basis upon which these timescales are determined needs to be documented, and this information should be included in the preliminary safety and health plan.

The selection of contractors for the construction phase is clearly an important issue for clients to consider at procurement. One of the successes of the CSP plan from 2000 to 2003 was the establishment of FÁS as the approved body for awarding qualifications to construction workers. The Construction Skills Certification Scheme is now part of the 2001 regulations. Key tasks can only be carried out by qualified workers. The current registration system for specialist contractors will be extended to include other high-risk activities such as roofing, asbestos removal, demolition, and security company operations.

Early intervention by the Health and Safety Authority is often beneficial. If this is to be achieved, notification at the time of appointment of the PSDS and PSCS by the client is envisaged.

The safety file provides valuable information, not only in relation to future ongoing maintenance work on the completed building, but also for future construction work, including decommissioning of the building. The arrangement for preparation of the safety file needs to be fully considered at tender stage to ensure that these points are adequately dealt with and are included in the file.

The CSP will discuss a number of these issues, including timescales for all phases of projects, when projects should be notified to the Health and Safety Authority, and the content of the safety file, as part of the review of the construction regulations.

#### *Construction/management/control/monitoring*

At tender, a safety management system, such as Safe-T-Cert (as developed by the Construction Industry Federation (Dublin) and the Construction Employers Federation (Belfast) for contractors in Ireland and Northern Ireland) should be specified in tender documents. This management system should then be used during the construction phase. It is recognised that construction companies may not have their own health and safety advice. Guidelines will be prepared for selecting a construction safety consultant. A register will be established to ensure that only those who are competent in terms of qualifications and experience, and have adequate resources, will be recognised as fit to undertake the role of safety consultant.

Additional guidance material will be prepared aimed at clients, designers, PSDS, PSCS, and contractors on protecting the public, particularly where projects are located in areas used by the public, and especially in relation to schools; a guide to site welfare facilities will also be prepared.

#### *Consultation/communication*

If workers are positively involved in health and safety issues they are able to contribute positively with regards to site safety management. The success of worker safety representation from 2000 to 2002 needs to be built on. The site safety representative facilitation programme, which promotes and develops consultation between site workers and management, will be continued. The joint certification programme for site safety representatives is to be approved by the CSP and the Health and Safety Authority (joint certification by the Irish Congress of Trade Unions (ICTU); the Construction Industry Federation (CIF); and the Further Education and Training Awards Council (FETAC)). It will also be available to all representatives. Ongoing advice and information for site safety representatives will be provided. Support will be given to develop further site cooperation between management and safety representatives. A code of conduct on safety compliance for site workers to assist management and workers to understand compliance requirements and actions to be considered in the event of non-compliance will be prepared. A central database of trained construction site safety representatives will be established to ensure cost effectiveness, facilitate mobility, and monitor and communicate with site safety representatives. With this in place worker safety representation will be encouraged further, with the benefit of improved management of safety.

#### *Education and training*

The emphasis from 2000 to 2002 was on training of site workers with the FÁS 'Safe pass programme' and the Construction Skills Certification Scheme. This is an ongoing priority. This will now be developed further. There is a need to ensure that the professions and construction project managers are also adequately trained and competent. It is therefore proposed to develop guidance and training for professionals operating in the capacity of project supervisor design stage and a new diploma course in safety management to provide higher level safety qualifications for the construction industry. Additionally, the CSP recognises that health and safety should be included in all



third level construction related courses including architecture, quantity surveying, construction management and civil engineering. Cooperation will be sought from the professional bodies and third level institutions. Health and safety integration in third level courses in construction will be encouraged.

## **Problems encountered during implementation**

The CSP is a partnership with a committee made up of members from the following bodies:

- Construction Industry Federation (CIF);
- Irish Congress of Trade Unions (ICTU);
- An Foras Áiseanna Saothair (FÁS), the Irish training and employment authority;
- Government Contracts Committee (Department of Finance);
- Department of the Environment and Local Government;
- Department of Enterprise, Trade and Employment;
- Health and Safety Authority (HAS).

This plan has therefore been agreed by a large part of the construction industry and those who interact with it. However, it could be anticipated that resistance to it may come from the professions and academic institutions that provide education for them, such as architects. These professions have traditionally seen themselves as outside the construction site activities. They need to be fully engaged in the aims and objectives of this plan for it to succeed. Additionally, there may well be problems in getting the smaller builders and self-employed involved. Too often they have to compete for work based on cost, not quality, timeliness, etc. Allied to this is the need to ensure that clients are fully integrated into this process. If not they will just tender solely on cost. This not only has implications for health and safety, but also the end product that the client gets. With this in mind a media campaign and promotions will take place to emphasise the benefits to all.

## **Results and evaluation of the action**

The overall evaluation will be a reduction in accident frequency rates. More immediately it will be issues such as:

- the establishment and usage of the pre-qualification system at tender by clients;
- the establishment of the register of competent PSDSs and PSCSs;
- the number of qualified persons working in the design and planning stages of a project;
- the usage of recognised safety management systems on site;
- the inclusion of safety and health in academic courses for the construction professions.

### **Is the action transferable?**

The plan is fully transferable. At present there is work in progress with Northern Ireland and the UK with regards to the joint recognition of qualifications.

### **Further information**

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# 4.3. DEMOLITION OF LARGE PREFABRICATED STANDARD BUILDINGS (GERMANY)

## Key points

- Good relation between advice, planning and control.
- Remarkable risk reduction.
- Good example for future demolition works in Germany and new Member States in eastern Europe.

## Introduction



'Plattenbauten'

Large prefabricated standard buildings (in popular German, *Plattenbauten*) were the major form of residential buildings in the former German Democratic Republic. In many urban areas blocks with some thousands or ten thousands of flats of the same size and furnishing have been built.

In the area of Dessau, in two industrial regions (communities of Wittenberg and Wolfen), there are around 7 000 flats for approximately 33 000 people, constructed in the early 1980s. Due to the economic decline of the large industrial complexes of the former GDR, the workforce decreased sharply, as did the

population in these areas. In 2002, less than 16 000 people lived in these types of buildings.

Additionally other building types became attractive and were promoted. Due to this development many tenants left the least attractive buildings and moved to other types of flats in their region or other areas in western Germany. In some of the blocks less than half of the flats are still rented out.

The plan was to raise the living quality by tearing down the least attractive buildings and renovating the others. The free space would be used to improve and enlarge the green areas and to make the living areas more attractive. The whole programme runs for approximately eight years. In 2003 and 2004, more than 1 000 flats with 60 000 m<sup>2</sup> will be demolished.

The demolition of these buildings carries particular risks from dangerous substances, as well as the normal risks of demolition work, for example falls from a height, being struck by falling objects, or slips and trips. Asbestos was used as a building material and the manmade mineral fibre (MMMMF) for insulation purposes is now classified as carcinogenic according to German law.

### **Background of the action**

The owners of the buildings — building cooperatives — were not aware that the demolition carried particular risks due to dangerous substances. The straightforward demolition of the concrete elements is not very challenging from a technological point of view. From the point of view of occupational safety and health issues, noise reduction and dust prevention were taken into consideration.

The labour inspectorate of Dessau was aware, due to its knowledge of GDR construction methods, that asbestos and MMMF, with carcinogenic effects, had been used. They decided to give these demolition works a high priority and to set up good OSH practice for future demolition projects in other areas. They developed together with the owners — large housing cooperatives and the responsible civil engineering company — a procedure on how to demolish these buildings safely.

### **Ambitions of the action**

The goal of the labour inspection was to reduce the exposure of the workers to dust and dangerous substances. The second goal was to separate the dangerous substances from the normal concrete waste to make it non-dangerous waste, which can be used again as recycling material. Waste can be recycled according to the regulations, if the amount of carcinogenic substances is less than 0.1 % of the mass volume of the waste.

### **Scope of the action**

#### *Basic technological information*



*Cautious removal with a gripper-like demolition tool*

The prefabricated standard buildings are connected by blocks 15 to 20 m high (between five and six storeys), a width of 10 to 15 m and a varying length of around 20 to 200 m. The standardised elements are connected by reinforcement iron.

The demolition process was done with a type of large knife removing the side and roof elements. The elements had to be kept as undamaged as possible to keep the formation of dust as low as possible.

### *Dangerous substances*

Asbestos had been used for two main purposes. Firstly, it was a component of the sealings on the outside between the elements (trade name 'Morinol'). Due to weather and decomposition, the sealings became a source of asbestos exposure. Secondly, the separation sheets between the balconies were made of asbestos cement.

At certain places in the building the 'Morinol' sealing mass was used simply because it was an available glue or sealing mass (behind doors, to fix ventilation elements at the bottom, etc.).

The buildings were erected in the 1980s. Manmade mineral fibres (MMMFs) of this period are now recognised as carcinogenic. MMMF was mainly used as insulation material.

The major use was as insulation inside the concrete elements in the outer walls ('sandwich' elements). The walls contained 5 cm thick MMMF between inner and outer concrete tables.

The second main use of MMMF was between the concrete roof and the outer surface materials (roofing cardboard).

### *The action*

In advance of the future demolition work, the labour inspectorate informed the housing cooperative, i.e. the owner, of the risks connected with the demolition. The cooperative doubted that the sealing material contained asbestos. The occurrence of asbestos was finally proved by laboratory analysis.

The working procedure was regulated. The owners and the labour inspectorate decided to remove the asbestos sealing in advance of the demolition. The sealings were chiselled out. The workers also removed the area of concrete close to the sealing to keep the sealing intact, as far as possible. During these operations the workers were protected by complete PPE (full breathing equipment, protective clothing).

If unexpected asbestos sealing was detected during the preparatory work inside the houses (removal of windows, sanitary installations, etc.), the same procedure was applied as with the outer sealings.

Using the same personal protective measures, the MMMF was removed from the roof.

The main problem remained the removal of the MMMF in the sandwich elements in the outside walls.

The labour inspectorate and the owners decided not to remove the MMMF before the demolition work. This technological option would have meant erecting scaffolds to cut the outer elements into pieces and to remove the MMMF. The accident risks would have been very high, including MMMF exposure for the workers cutting the concrete.

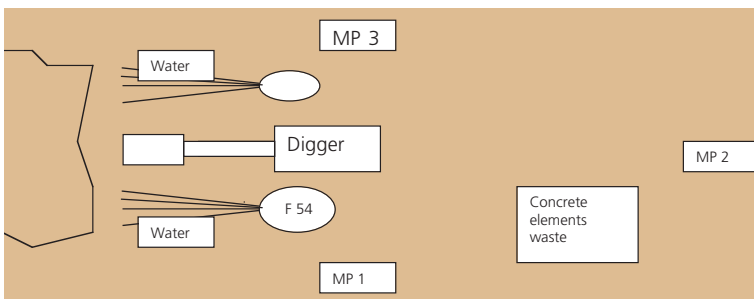
Another technical procedure was chosen. It was decided to pick up the complete elements as carefully as possible during the ongoing demolition works and to remove the MMMF on the ground.

To protect the workers and the neighbours from dust and fibres, watering of the walls was ordered.

The labour inspection controlled the number of fibres during demolition work in the air by measurement. The average number of fibres was around 25 % of the threshold limit value.



Watering of the working area to reduce the emission of dust and fibres



Position of the measuring points

Measuring points	Average concentration in F/m <sup>3</sup>	Threshold limit valueF/m <sup>3</sup>
MP 1 one 15 m from outer wall	91 182	500 000
MP 2 one 30 m from outer wall	40 851	500 000
MP 3 one 15 m from outer wall	89 694	500 000
F 54 Personal sampler watering work	140 607	500 000

*MMMMF measuring results*

The labour inspectorate made the demolition works one of their main working priorities in 2003. A focused action was conducted from January to November 2003.

As a result of this priority setting, control was much stricter than in other areas; the labour inspectors were often present at the building site. A checklist was developed to make control as easy as possible.

The recycling process of the broken concrete was done in two ways. At the start of the works the MMMF was not removed, consequently the whole waste was classified as carcinogenic and filled into an empty lignite mine. In all later cases the concrete was cleared from the MMMF. After the removal of MMMF from the sandwich elements, the mass volume of carcinogenic material, before recycling, was lower than 0.1 % (the limit to classify the whole waste as a carcinogenic substance). This makes recycling and use of the recycled material possible.

**Problems encountered during implementation**

The owners doubted that the outer sealings contained asbestos. This had to be shown by laboratory analysis, by the labour inspectorate. The owners were also not aware that the mineral fibres were classified as carcinogenic. They also did not realise that the outer walls were filled with these fibres.

Different construction companies were contracted by the owners. New construction companies again needed advice on how to conduct the works. Control was still necessary because the removal of the MMMF by hand under full PPE is always a cost factor. Companies tend to avoid these additional costs.

## Results and evaluation of the action

The goals were reached. The exposure of workers was below the threshold limit values. The removal allowed the broken concrete elements to be processed as recyclable material.

## Identified success criteria

The advice to the main actors and the strict control were the key elements of success. The technological solution was sufficient to achieve the goals and to respect the limit values.

## Is the action transferable?

It is highly relevant for other similar projects, namely in many new Member States. The demolition of these types of buildings is expected to be a construction activity in the coming decades.

The checklist and the methods (removal of asbestos in advance, removal of MMMF by cautious demolition) could be a good solution.

## Statements

'Early information and advice to the companies involved in the demolition work is the key to success.' (Ms Jaeger, GAA Dessau)

'Before the activities of the labour inspectorate started I wasn't informed at all about the dangerous properties of the mineral fibres.' (Ms Eger, Geschäftsführerin)

## Further information

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## 4.4. TOOLS FOR RISK ASSESSMENT (BELGIUM)

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### Introduction

The CNAC/NAVVB (Belgian Committee for Safety and Hygiene in the Construction Industry) is an equally represented social security fund whose purpose is to improve working conditions in the construction industry through:

- construction site visits: 20 advisers daily visit large and small sites all over Belgium and give advice on health and safety at work issues to contractors and workers;
- research: the CNAC/NAVVB, in collaboration with experts, carries out detailed studies on technical and regulation aspects of health, safety, hygiene and well-being on building sites;
- publications: the CNAC/NAVVB publishes two quarterly periodicals (one about technical and regulation aspects and one about current events and trends) as well as non-periodical publications (namely monographs);
- documentation: a range of documents dealing with health and safety issues in the construction environment are freely available for consultation at the CNAC/NAVVB's library;
- training courses.

### Background of the action

The Welfare Law and the consequent Royal Arrests state that employers are obliged to make an inventory of the hazards on the subject of occupational safety and health (OSH) and to evaluate them. On that basis, the employer has to take measures to prevent or to reduce these hazards.

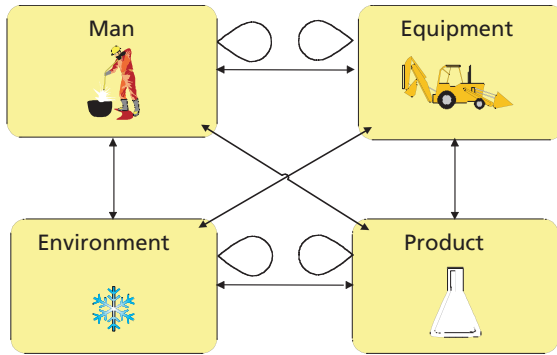
The inventory, the evaluation and the preventive measures have to be laid down in writing. The risk inventory and the evaluation also have to include additional hazards due to employees' personal qualities, such as elder and younger employees, foreign employees, etc.

If the inventory is good, it will point out many risks.

Eliminating or modifying one of these factors will automatically influence the others.

In order to deal successfully and thoroughly with the safety problems, the four factors will need to be examined in depth. The following schedule can serve:

- start making the inventory of all company and site activities;
- make the inventory of the different working posts (environment), the equipment used (equipment), the agents (product) and the personnel concerned (man);



The origin of dangerous situations lies in the interaction between four factors:

- man, carrying out activities,
- the equipment used for the work,
- the environment surrounding the working post,
- the product used for the work.

- track the possible risks these four basic factors can cause;
- decide upon the preventive measures;
- draw up a plan and fix the priorities;
- when drawing up the plan, make sure to already build in certain controls for the execution;
- appoint the person responsible for the execution and determine the necessary means;
- carry out the plan; take care regarding the follow-up, the control and possible adjustments.

The CNAC/NAVb developed several tools to help the employers and the advisers of the CNAC conducting this risk assessment.

The first tool is called the risk inventory and evaluation method (RIEM), and is aimed at helping the employers. The second tool is called the Prevention Atlas, and is aimed at helping the advisers of the CNAC/NAVb.

### 1. The risk inventory and evaluation method (RIEM)

The risk inventory and evaluation method (RIEM) is a technique of analysis to make a systematic inventory of safety, health and welfare risks in the construction industry and of OSH risks on the construction site. The aim of the RIEM is to spur the employer on to a methodical risk assessment in his company. The RIEM method contains two components: the inventory and the evaluation. The inventory records the main risk factors, dealing with safety, health and welfare (SHW) for a certain activity. The risk factors that the inventory puts forward are then evaluated. In this evaluation, the risk per factor is estimated mathematically or otherwise. The result should be an overview of the difficulties and the preventive measures to be taken.

### Key points

The RIEM consists of:

- an inventory of the main sticking points with regards to safety, health and welfare;
- an evaluation of the risk of each sticking point identified.

The result is an overview of the difficulties and the preventive measures to be taken.

Making a risk analysis and a risk evaluation is, however, not a once-only operation. The techniques and the working conditions do not stand still. This will also alter the risks, which makes a regular repetition of the RIEM procedure essential.

### Method of working

Before starting a risk analysis, it is important to have a clear idea about the project to be undertaken. This information can come from various sources, particularly the construction specifications. The main activities and sub-activities should be identified at a level that can be addressed.

When analysing the main activities and sub-activities:

- make a survey of the main activities that will take place at the construction site, for example, demolition works, earthworks, or bar bending;
- divide the different main activities up into smaller sub-activities such as tearing down roofs, bulldozer earthmoving, or reinforcement welding;
- ask yourself if these sub-activities can be further divided up, for example, into electric welding; autogenous welding, MIG welding, or TIG welding.

Once the sub-activities are specified, it is possible to start filling in the standard analysis forms. While this may take time at first, the results can be the basis of other, later work later, so saving time in the long run. For this reason, good labelling and documentation procedures are important.

Having identified a discrete sub-activity, go through the equipment and products used, along with the human and environmental factors. To simplify this process tables of standard factors are provided. By verifying by each factor and risk, a matrix is built up that identifies risks connected with certain tasks and activities.

The risk analysis forms allow the degree of risk to be determined, and also identify areas where there are specific preventive measures required under relevant legislation. If material preventive measures are not possible or if they are not sufficient, you can state whether or not specific instructions should be given. Those can be a supplement to the legal instructions. It also includes identification of information on the worker's profile, mostly with regard to his education, equivalent experience or specialities.

The system can be integrated into existing company safety management schemes where required.

**Standard equipment factors**

1	Type of equipment
2	Degree of protection of the equipment
3	Degree of automation of the equipment
4	Operating concept
5	Design characteristics
6	Realisation of the equipment
7	Readability of the instructions
8	Thoroughness of the inspection of the equipment
9	Degree of maintenance of the equipment
10	Working rate of the equipment
11	Nature of the energy that is used
12	Existence of an emergency stop
13	Existence of a deadman control
14	Existence of a bridging or a sabotage possibility

**Standard human factors**

1	Physical condition
2	Family situation and possible difficulties
3	Health
4	Mentality with regard to work and safety
5	Personal motivation and application
6	Information the person gets
7	Build
8	Milieu of origin
9	Training
10	Age
11	Reflexes
12	Maturity
13	Acquired skills
14	Experience
15	Failings in the working method
16	Mistakes in the order of assembly
17	Distraction by fellow workers
18	Human errors in leading, planning or organising
19	Human errors in controlling or adjusting
20	Deliberate unsafe acts

**Standard physical and natural environmental factors**

1	Specific environmental requirements		
2	Climatic conditions		
2.1	Fog	2.5	Black ice/rime
2.2	Heat	2.6	Wind
2.3	Sun	2.7	Rain
2.4	Cold	2.8	Snow
3	Nearby mains, pipes or cables		
3.1	Gas	3.3	Water
3.2	Electricity	3.4	Others
4	Noise		
5	Light		
6	Gases, vapours, smoke, etc.		
7	Radiations		
7.1	Infrared	7.3	Ionising
7.2	Ultraviolet	7.4	Others
8	Vibrations		

**Standard environmental factors in connection with working post location**

1	Nearby water
2	Working post access
3	Traffic
4	Polluted soil/air
5	Working in excavations
6	Working at height

Standard risks	
1	Incisions
2	Bumps
3	Squeezing
4	Burns
5	Crushing
6	Slipping/Turning over
7	Coming off
8	Flying off
9	Falling objects
10	Falling
11	Production of vapours, gas or dust
12	Fire/heating/explosion
13	Blinding
14	Electrocution
15	Radiations
16	Vibrations
17	Noise
18	Suffocation
19	Poisoning
20	Drowning
21	Being buried
22	Medical complaints
23	Physical/psychological burden

## Results and evaluation of the action

There was no evaluation made of this method. Some modifications were, however, realised to integrate the factors in relation to the organisation in the man factor.

It is difficult to evaluate the number of users of this method. However, a survey on the basis of the files received by the advisers during their visits of sites shows that about 75 % of companies use this method.

Some difficulties were faced by users at the beginning, mostly concerning the time schedule. Once used to the method, they would discover that many partial analyses could be reused, which is a big time saver.

Training was not necessary for the users as a specific notice was published. The methodology of the RIEM is, however, introduced during training given by the CNAC for the coordinators on temporary or mobile worksites.

The results can be considered as positives, and the method is more and more used.

### Statement

'The RIEM is an effective method that allows the user to detect each hidden risk in order to take the appropriate preventive measures.' (Carl Heyrman, CNAC)

## 2. The Prevention Atlas

### Key points

The Prevention Atlas consists of:

- a complete monitoring system of risk prevention;
- a basis for developing specific actions on the building sites and in the construction sector.

The CNAC/NAVb conducts different actions, including construction site visits by specialised advisers. During these visits, these advisers often find several situations that are dangerous for the workers' safety and health, which can lead to industrial accidents or occupational diseases.

With a view to reducing the risks of industrial accidents and occupational diseases, they give practical advice to the person in charge of the construction site or to the contractor.

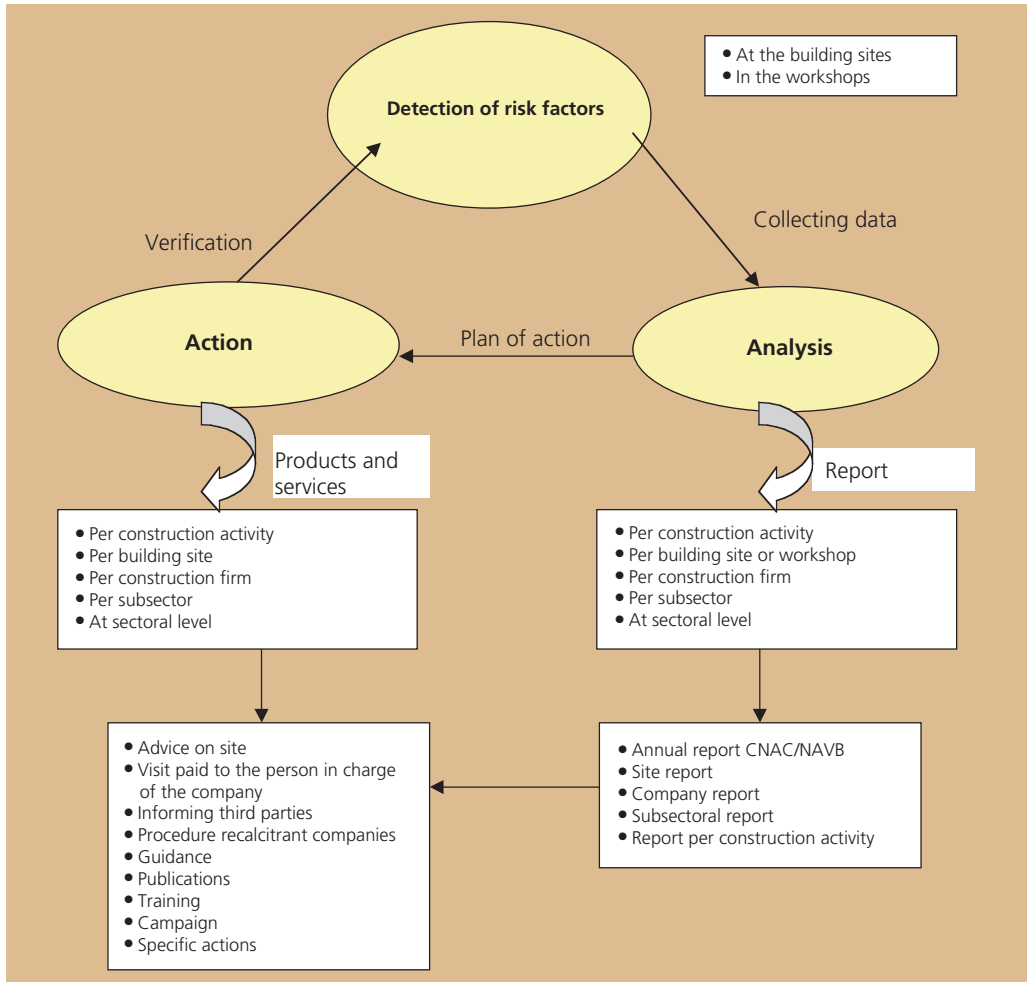
In order to increase the impact of the 12 000 construction site visits the advisers do each year, a powerful computerised building site report was developed and named 'Prevention Atlas'.

The Prevention Atlas aims to:

- structure risk identification on the construction site;
- formulate appropriate advice for each risk that was found on the site, substantiated by examples of good practice and taking into account the applicable regulations;
- instigate efficient and correct reporting to the persons in charge of the building site;
- follow the prevention policy of a construction company, based on real situations found at its construction sites;
- make analyses with regard to well-being in the construction industry per construction activity, per geographical place, per type of work equipment, per environment, per product, per subsector and for the construction industry as a whole;
- measure the impact of actions set up after the analyses mentioned above.

In brief, a complete monitoring system was developed to watch over safety and health in the construction industry on a permanent basis. It also serves as a basis for developing specific actions on building sites, in construction firms and on a sectoral level.

**Systematics**



A complete system was set up to detect the risk factors for all aspects of safety and health on building sites and in workshops of building companies. This system relies on the four factors presented above, which are:

- man, carrying out activities,
- the equipment used for the work,
- the environment surrounding the working post,
- the product used for the work.

Extensive databases were developed for each of these factors. Dangers and preventive measures to reduce the OSH risks for the workers were linked to each part of the database.



## Results

The application is operational since early 2002 and has since led to:

- uniform and structured detection of risk factors and reporting to the construction firms and the sector;
- thorough analyses per risk factor;
- setting up specific actions in companies and at sectoral level.

Thanks to its reliability and its completeness, the Prevention Atlas has also drawn the attention of some large companies that consider it a useful instrument for internal use. The CNAC is investigating if it can be adapted for this type of use.

Although today the instrument is complete, it needs continuous adaptation, for instance when new products or equipment come onto the market.

It also has to be checked whether it is possible to link the instrument to databases on industrial accidents and occupational diseases, which may confer a predictive character on the instrument.

The CNAC advisers have received a complete training on data processing and a specific training linked to the Prevention Atlas.

### Statement

'The Prevention Atlas allows the construction sector to take care of prevention of risks in a proactive way. This should lead to a new decrease of victims of occupational accidents and diseases.' (Carl Heyrman, CNAC)

## Is the action transferable?

Both instruments can be easily transferred to other national and international organisations that want to set up similar actions.

The methodology of the RIEM is universal and could be used in other industries as well as in foreign countries.

At present, the Prevention Atlas exists in Belgium's three national languages: Dutch, French and German. If the instrument is to be used outside Belgium, only the references to the respective regulations have to be changed.

## Further information

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# 4.5. ACTIONS TO IMPROVE OSH MANAGEMENT AT COMPANY LEVEL: IŁAWA BUILDING COMPANY (POLAND)

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## Key points

The Iława Building Company has taken into account several key issues such as:

- developing an occupational risk management system;
- monitoring OSH on construction sites;
- training the workers;
- coordinating subcontractors' work on sites.

## Introduction

The Iława Building Company (IPB Sp. z o. o) is a flourishing business entity which is shaping the modern landscape of towns in north-eastern and central Poland, thereby becoming the construction leader of the Warmia and Mazuria region.

In 2000, an ISO9002 based quality management system was implemented in the company.

Apart from a comprehensive execution of investment projects, the company also pursues development activity, trade in construction materials and the production of carpentry, based on the state-of-the-art Foris window profile, and aluminium in Lubawa.

Currently the company has 282 employees working in respective branches of the company's activity, as follows:

- basic production: 180 people;
- production of PVC window: 10 people;
- trade: 4 people;
- accessory production: 6 people.

In total, 213 people are employed in manual jobs.

In 2003, an integrated quality management system based on ISO9001:2000 was implemented in the company. An occupational safety and health management system according to Polish Standard PN-N 18001:1999 was also implemented.

The implemented system makes it possible to take a number of actions in the company aimed at improving working conditions, and eliminating or diminishing — on an ongoing basis — exposure to harmful, dangerous or strenuous factors.

## Background of the action

The company has been on the market since 1959. Since then, it has built over 30 000 new flats with a total area of 900 000 m<sup>2</sup>, 32 schools, numerous shopping centres, industrial facilities, hospitals, banks and other important investment projects. It was also involved in renovations of historic buildings and in repairs aimed at improving the standard of existing buildings.

The year 1991 was a breakthrough for the company. It was the first building company in the Olsztynskie Voivodship to carry out a property transformation. As a result of a general privatisation, the employees and management staff became the company's owners. This helped the company weather the most difficult period of a downturn in the construction industry and adjusted the company's structures to the requirements of the market economy.

## Ambitions of the action

The company has developed a global occupational health and safety system covering different issues of occupational safety and health (OSH) in order to reduce occupational injuries and diseases.

## Scope of the action

There is an OSH employee who exclusively handles occupational safety and health issues, and who is also the OSH management system officer.

This position directly reports to the vice-president who is the technical manager.

The OSH employee has been in the company for 26 years and holds all the qualifications required for an OSH services officer, as well as teaching qualifications, and qualifications in running OSH training. The officer is qualified to introduce and implement an OSH management system, to act as OSH management system auditor, to run courses on occupational risk assessment, and to organise and administer first aid before the ambulance arrives.

The OSH officer in the company has the following responsibilities:

- to make out and store documents related to injuries at work and occupational diseases;
- to document records related to occupational risk analysis and assessment;
- to keep a general list of chemical substances and preparations used in the company and to store material safety data sheets;
- to keep and update the register of OSH training for individual employees;
- to work out and update syllabi for OSH training courses;

- to plan OSH training and to keep track of the required occupational skills as set out in legal regulations;
- to draft a safety and health protection plan for new construction sites in cooperation with the building foreman;
- to monitor OSH in respective organisational units and to submit relevant reports and requests to the company's president;
- to analyse annually OSH and the company's injury rate;
- to regularly brief employees on changes introduced to legal regulations on OSH;
- other responsibilities as per OSH employee job description.

When monitoring OSH in the company, the OSH employee is qualified to remove from work any worker who does not have current medical examination results, who has not completed OSH training courses, or who does not have qualifications required for a given task. Current lists are supplied by the department of human resources

The OSH officer is authorised to halt work at worksites which pose a threat to employees' lives or health. He/she has the final say when consulting with a manager of an organisational unit on the use of personal and collective protection.

The OSH officer also takes part in tenders for the supply of overalls and safety boots. Current OSH issues arising in respective organisational units are discussed at periodic operating meetings with managers of organisational units.

The OSH officer, acting in the capacity of OSH management system officer, takes part in internal audits of respective units as an observer and adviser.

In order to improve the smooth operation of the integrated quality and OSH management, the same person acts as an internal auditor. These are the managers of organisational units. When planning internal audits, auditors are selected in such a way as to make it possible for construction foremen to be auditors at other construction sites. This is efficient for the system's operation.

The company's key OSH issues are set out below.

### **Occupational risk management system**

A procedure for managing occupational risk was developed in the company. Employees at every level take part in analysing and assessing the occupational risk.

When developing a workstation data sheet, activities that are — or might be — part of the production process are established in detail with lowest-level employees, including: time of exposure to harmful, dangerous and strenuous factors involved in the work process, details of the means of production used, i.e. machines, equipment, tools, materials and working conditions. Employees are consulted to identify sources of risk and harmful, dangerous and strenuous factors involved in work processes.

The assessment process is carried out as per PN-N 18002 using a three-grade scale. When assessing the likelihood of unwelcome events taking place, an

annual analysis of injuries at work — which is made by comparing data for the past four years — is taken into account.

For the purpose of analysing occupational risk assessment, a general register of occupational risks involved in workstations across all organisational units of the company is kept. It specifies not just those significant hazards that are actually present but also those that are possible. Proper corrective actions have been determined. As concerns environmental measurements, a plan for conducting future measurements and studies for individual workstations is being prepared.

### **Monitoring OSH on construction sites**

The frequency of monitoring by a unit manager is specified in the procedure for monitoring OSH in all organisational units. Construction foremen monitor OSH once a week; they make appropriate records in OSH monitoring reports.

These reports are handed over to supervisors of respective organisational units. The reports list issues to which an organisational unit manager should pay attention while monitoring.

They particularly take account of the following:

- requirements as to employees' valid medical examination results;
- requirements as to professional skills, including qualifications to operate construction equipment, assemble and disassemble scaffoldings, etc.;
- requirements as to the use of chemical substances and preparations in construction processes (material safety data sheets for hazardous materials to be held and made known to employees; detailed principles are specified in instructions on hazardous materials' use);
- requirements as to conducting periodic inspections of the machines, equipment and tools used; conformity certificates for machines, inspection logs;
- other requirements as set out in legal regulations.

At present, to enhance the system, the company is pursuing work on an operational safety and health log in which a unit manager could record results of monitoring, specify individuals responsible for correcting the detected defects, and confirm they have indeed been corrected. Such logs used to be kept by the company in the past. However, as they were not distributed, they were abandoned.

### **Training**

When implementing the quality management system in 2000, an employee training system was prepared within the human resources procedure.

The system includes both training in OSH regulations and qualification training. The responsibilities of respective organisational units for planning and holding training sessions were established. These actions are included in the annual plan of training courses.

As concerns OSH training, detailed training paths were prepared for individual workstations. Organisational unit managers are responsible for carrying out on-the-job training as per training paths. They report it in training logs to be found

in each organisational unit. A training log like that is used to report employees' progress in learning occupational risk assessment, instructions and guidelines.

Basic and periodic OSH training courses are run by employees who are properly qualified to conduct such training courses, who are highly knowledgeable in OSH regulations and who are familiar with work processes involved in respective organisational units.

### **Coordinating subcontractors' work on sites**

The company has thoroughly enhanced the system for coordinating subcontractors' adherence to OSH at construction sites.

The president's internal regulation specifies that the construction foreman coordinates OSH at construction sites. Once a subcontractor has been selected from a shortlist, before a contract is signed, guidelines on OSH requirements to be met at the company's construction sites are presented.

Before proceeding to work at the same construction site, the OSH coordinator and the subcontractor prepare a special document on the precautions used by the subcontractor.

The company periodically evaluates subcontractors. This includes an evaluation of how the subcontractor meets OSH requirements when carrying out tasks.

### **Problems encountered during implementation**

The main problem encountered during the project concerned risk assessment or, rather, the development of an impartial method of assessment.

Success in developing such a method in the company was only achieved after exhaustive consultations with the Central Institute for Labour Protection/National Research Institute in Warsaw. However, this method is not fully satisfactory due to the specificity of work in various construction sites and the variety of tasks. The functions of workers in construction sites change and it is not always the same person who has a specific function. Usually, for workers working in squads, there is a fixed division of labour. It can be changed, depending on the building, though. Therefore the analysis and risk assessment carried out include the maximum number of recurring factors for which hazards have been evaluated. The actions have been identified in specific organisational units, with the participation of workers.

The analysis and occupational risk assessment are updated according to a fixed procedure of managing risk assessment.

In general, it has not been difficult to implement the OSH management system in the company, because most problems connected with OSH management are regulated by the quality system ISO9002 and by in-house normative acts. On the basis of those procedures — within the scope of OSH management — four new procedures have been implemented:

- in case of an accident or an injury at work (detailed instructions have been developed additionally, as enclosures);
- for highly hazardous work (additional instructions have been developed for individual tasks);

- for managing occupational risk;
- for monitoring OSH.

The problems of OSH have been added to existing management procedures.

### **Results and evaluation of the action**

It is still too early to evaluate the task as a whole as the OSH management system has been operating only since 2003. At the beginning of 2004 a report will be made on a survey of the system whose operation is being analysed now. On the basis of in-house audits carried out in the organisational units it is possible to comment only on the effectiveness of the undertaken actions. The corrective and preventive actions resulting from the audits are carried out correctly. These actions particularly concern the observation of safety rules at construction sites, which unfortunately still remains — to a certain extent — a problem.

As far as changes in the attitude to work are concerned, there has been a noticeable increase in workers' awareness of occupational risks. The workers themselves say the managers have improved their working conditions and they provide them with both personal and collective means of protection. The obtained results, nevertheless, have not caused a total elimination of occupational accidents. However, most of these accidents are relatively minor. However, they highlight remaining issues such as workers' behaviour, and slips, trips and falls on untidy sites.

### **Identified success criteria**

It has been recognised that attitudes have changed, and the actions taken at construction sites have raised awareness of safety and health issues. The construction foreman is obliged to register all inconsistencies in an OSH log. Further, corrective actions are proposed and thus a record is made, appointing people responsible for carrying out a required action. This means that workers become jointly responsible for creating correct work methods. This kind of attitude brings perceptible results in improving working conditions and ensuring observation of and compliance with safety rules.

Considering the extended activity of the enterprise, i.e. carrying out construction processes, purchases, trading in building materials, there was a need to have data sheets for hazardous substances and preparations. The OSH management system made it possible to obtain these data sheets from distributors and to use them. At present the enterprise has all data sheets for hazardous substances and preparations, and the workers have been familiarised with them.

### **Is the action transferable?**

The system method used should not be difficult to introduce in other companies, even those operating in another culture, economy or social environment.

Specific elements of the system can be easily applied provided that the system is integrated with the quality system standard. If the company has implemented a management system, it is easier to apply elements of other systems.

As to implementing the system, it is worth advising other companies to use a similar method of analysing and assessing occupational risk. This method is compatible with the remaining legal requirements, which means that:

- it includes — in full — an analysis of the accident rate;
- it includes — in full — data from registers of hazardous substances present in work processes;
- when preparing a repair plan for risk assessment, it is possible to plan environmental studies for individual work situations, based on this method;
- workers acquainted with occupational risk assessment (in particular new employees) have a full picture of their workstations.

Besides, the proposed undertaking does not cause as much bureaucracy as other methods.

### Statements

‘The implemented system makes one aware at each level of the enterprise that by carrying out specific processes one should ensure the worker’s safety, because the worker is the key figure who carries out those processes and his/her efficiency is the basis of the organisation’s success. If care is taken to ensure appropriate working and decent social conditions, the worker, too, will approach the actions planned in the process with full responsibility. The only obstacle in a full execution of the actions aimed at improving working conditions is the limited financial means for buying some devices. This, unfortunately, results from the limited means for the realisation of tasks at construction sites (low prices at tenders). If occupational safety were the basic condition of tenders in Poland, I think that such a system would have long been implemented in all construction companies.’ (A construction foreman)

‘I am glad that the system has been implemented because it has resulted in an increase in the workers’ awareness at different levels of the enterprise, thus facilitating my work — the work of an occupational safety and health officer. In the past it wasn’t so difficult to carry out my OSH tasks, but I often noticed workers’ disinclination towards the actions I proposed to improve safety.’ (A chief OSH specialist in an enterprise)

‘We, as workers, feel that after the system of managing the occupational safety our managers try to appoint actions aiming at improving the working conditions together with us. I have been working in the enterprise for many years and, like most of my colleagues, I think that all of us would like to work in good conditions and free of hazards.’ (Statement of a labourer on a building site)

### Further information

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## 4.6. THE MOURIK SAFETY, HEALTH, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM (THE NETHERLANDS)

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### Key points

- The Mourik safety, health, environment and quality management system is a successful and reliable method to improve the safety level on a building site and to reduce drastically the number of accidents.
- It is an approach that also considers human behavioural aspects.
- Its tools can be easily transferred to other construction companies in other countries, but its success depends on a trustful and open minded company culture.

### Introduction

Mourik is a Dutch construction company with a number of services related to construction, such as environmental technologies and industrial cleaning. Mourik has developed a detailed integrated OSH management system including safety, health, environment and quality (SHE-Q). Due to these measures the rate of accidents has fallen to the very low rate of 0.8 lost time accident working days per 100 employees per year in 2003. In 1987, the rate was around seven lost time accident working days per 100 employees. This means the reduction is around 90 %. The branch level for contractors working in the petrochemical industry is approximately 2.0 accidents per 100 workers and in general it is 3.5 for constructional contractors in the Netherlands for VCA certified contractors (safety checklist contractors' certification scheme). All incidents with lost work time above 24 hours are listed in the Dutch registration systems.

The Mourik group consists of a number of specialised subcompanies for certain services. The SHE-Q is a central department which organises these activities for a total of 1 100 employees in the Mourik group.

## Background of the action

The action can be described as a systematic long-term approach to reduce accidents in high-risk jobs, such as those in the construction industry. The development started in the early 1990s after the introduction of the VCA safety organisation systematics and has been extended into a very detailed and practice-based system at present.

The reason for these intense and extraordinary efforts is partly the large economic losses that can be caused by accidents and lost working days. Although many other construction companies did not react in this way, Mourik decided to improve the HSE management to an extremely high level.

An external factor was certainly labour shortage in the Dutch construction industry and the rise of safety requirements and demands by the petrochemical industry in the middle of the 1990s.

## Ambitions of the action

The goal of the whole SHE-Q activity is to further improve labour safety, to create a high awareness concerning health and safety and to finally reach a total safety culture. To cite Mourik, 'Safety is for the Mourik companies the most important condition in the execution of any company activity'.

Quantitative criteria are defined yearly in the annual health and safety environment programme; Mourik's accident rate is already far below the branch level. There was, however, a rise in the accident rate from 2001 to 2002 and consequently Mourik set out to reduce the frequency rate of lost time incidents by 20 % in 2003 as compared with 2002.

The HSE-Q includes a set of certain subgoals:

- safe equipment;
- safe organisation (checklists, records, for example for near accidents);
- training programmes;
- instructions;
- improvement of safety communication (toolbox meetings, etc.);
- improvement of personal safety behaviour (self checklists, observation cards);
- motivation by incentives and rewards.

## Scope of the action

### *Quality management and HSE*

Mourik is certified according to ISO9002 and has now been certified according to the new ISO9001:2000 certificate. Quality management of this type includes a permanent detection of faults and the appropriate measures to improve the organisation, the communication, health and safety and the environment, and finally the output. Quality management is a tool to organise all business processes effectively. In this way it also supports the effectiveness of OSH measures. Mourik is also certified according to the VCA certification (safety checklist contractors), which is a generally required standard for safety in the Netherlands.

In general the quality documents provide a comprehensive base assuring that the laws and ordinances are followed. The steps defined in the QM documents are:

- planning;
- risk assessment;
- determination of measures (a checklist of major risks supports the appropriate determination of risks; see Figure 1);
- carrying out of measures;
- instruction of new employees;
- issuing safety equipment;
- inspection report;
- incident summary;
- toolbox meetings to discuss the inspection report and the incident summary.

#### *Planning and control of planning goals*

Mourik has written procedures describing all necessary measures on how to plan the work operations in relation to safety, environment and quality. All the actions have to be planned for every project (and year contract or department or complete company). Responsibility is with the project leader or manager. In all cases a project safety or SHE-Q plan is written, where the setting of goals for SHE-Q forms an essential part.

In practice the preparation of a goal setting form is the minimum required safety plan for every project. In many cases extra targets from customers are included. General goals for a project might be:

- no lost time incidents or accidents;
- no disease related to the work;
- no pollution of the environment.

During a project, a progress report has to be sent every month to the responsible manager. When a project is finished a final report has to be provided. Every target or goal which is not fulfilled in line with the planning, on a given reporting point, gives a decrease of 5 % on a start figure of 100 %. If a project supervisor has a score of 75 % or below, the responsible manager is obliged to take corrective actions. He also needs to report these actions to the managing director of his company.

#### *During the work*

During the work operation the responsibilities are clearly defined. The foremen are responsible for warning employees who break the rules and guidelines. The project leader is responsible for giving written warnings (reprimands) to the employees. The project leader is also responsible for carrying out the inspections and recording them. He defines an activator who is responsible for carrying out and supervising the correction measures. Finally, the project leader is responsible for organising the toolbox meetings.

**Figure 1**

**List to help in the determination of risk**  
**Risk value = chance x effect**

Chance	Effect
1 = Unlikely	1 = Limited (first aid/nuisance)
5 = Possible	5 = Important (sick leave)
10 = To be expected	10 = Very serious (permanent)

**Points of concern with risks**

A — Risks involved in the work	B — Risks involved in the working conditions	C — Risks due to complexity
1. Empty and pressure-free opening Equipment Filling/degassing Demolition/disassembly Piercing/plug removal	1. Vibration Working posture Heavy work, overstrain	1. Planning Awareness of each other's risks
2. Self-ignition product temp. > 80 ° C Spark creation Filling/degassing Oxygen Gases under pressure/inflammable products	2. Snow/ice Wind/storm Thunderstorm Rain	2. Work/rest time Too many people
3. Inflammable products Gases under (high) pressure Excess dust creation	3. Obstacles Limited space	3. Escape routes
4. Steam Gases under pressure or cooled	4. On/alongside the road	4. Training Work instructions Procedure New tools
5. Toxic materials Insufficient ventilation Lack of oxygen/nitrogen	5. Day and night Confined space	
6. Empty and pressure-free opening Equipment Filling/degassing Demolition/disassembly Piercing/plug removal	6. Surroundings Work method	
7. Unprotected moving parts Accessibility Limited space	7. Close to equipment Safeties Over water	
8. Working on revolving equipment	8. Hot equipment Very cold equipment Cryogenic products	
9. Collapsing excavation work Cables/pipes Ground pollution	9. Work at night Deserted areas Help in case of an accident	
10. Working above and below each other Travelling work, transport	10. Escape routes Falling Access Temporary lifting equipment	
11. Unprotected electrical parts Static electricity Electrical equipment > 1 000 volts		
12. Radioactive sources		

The toolbox meetings are used to discuss the HSE situation regularly. Toolbox meetings are safety meetings with all employees at a department or construction site. Lists and documents are needed, such as the attendance list, the factory act and environmental checklist, the general factory and environmental checklist, the environmental checklist and a management checklist, the checklist on the observation of dangerous and unsafe behaviour (see next page) and a record of the oral warnings.

#### *Training measures for HSE*

Quality management alone is not enough to organise HSE well. Of course all employees have got the necessary safety instructions and safety training. Training courses at Mourik support instruction in the qualified use of:

- breathing protection;
- basic breathing protection;
- inert entry;
- forklifts, flange fitters;
- high pressure cleaning;
- asbestos work (removal);
- fire extinguishers;
- manhole guard;
- observation of unsafe behaviour;
- job safety analysis; and
- gas detection.

#### *Behavioural safety programme*

In addition to a well-organised safety analysis, recording and instruction, Mourik introduced a BSP (behavioural safety programme) to achieve a total safety culture (*Volledige veiligheidscultuur*).

Mourik developed this programme to overcome a relevant problem: wrong or non-communication as one reason for unsafe behaviour and accidents. For 2000 and 2001 the analysis of the incidents produced the following results:

Of all accidents:

- 15 % are due to general disorder;
- 10 % are due to lack of internal communication;
- 17 % are caused by problems with techniques or buildings;
- 5 % by too short training;
- 6 % by too short instruction in the work operation;
- 23 % caused by the conditions at the construction site;
- 14 % by work instruction not followed;
- 10 % by unsafe behaviour.

In total, 55 % of the reasons (all the underlined figures) can be identified as relating to human behaviour.

### Checklist on observation and unsafe behaviour (OUB)

OUB is signalling unsafe behaviour and encouraging safe behaviour.

An OUB round consists of the following stages:

- Preparation
- Stopping
- Observation
- Inform and take action
- Report

Take immediate action in order to:

- Prevent accidents
- Find ways of preventing unsafe behaviour in the future!

Observation of unsafe behaviour with reference to:

#### Incorrect or unused protective equipment

- A helmet
- Safety glasses or other eye protection
- Hearing protection
- Breathing protection
- (Chemical-resistant) gloves
- Protective clothing
- Safety shoes
- Fall protection

#### Position/handling and workplace

- Possibility of striking, being hit or becoming trapped
- Possibility of falling, tripping or slipping
- Possibility of touching high temperature objects
- Risk of contact with electrical current
- Danger of inhalation or swallowing
- Danger of strain due to reaching, pushing, pulling or lifting
- Lack of order and cleanliness

#### Use of tools and materials

- Unsuitable for the work
- Not in a safe condition
- Not used in the correct manner

#### Procedures

- Insufficient
- Not known or not understood
- Not followed.

Part of the BSP is a checklist and an observation form. It is obligatory to fill in the checklist for self-control. The observation card should be used to record the unsafe behaviour of others.

The self control checklist is mainly designed to check personal behaviour and to determine improvement possibilities. It includes questions like: Are the equipment and the procedure appropriate? Is the construction appropriate? Did I control the equipment? Do I have the necessary PPE? Is the workplace in good shape? Did I check the risks? Do I know the emergency procedures?

## **Incentive programme for safety**

In 2002, the number of reports, for example about unsafe behaviour, went down, whereas the number of accidents doubled, although they remained on a low level compared with the branch figures. Mourik therefore extended its incentive programme to improve this situation.

The incentive programme includes:

- a reward to all employees for 100 days without lost time through accidents;
- a reward for every fifth reported near accident;
- a reward for the near miss of the month;
- rewards for positive contributions to the safety culture;
- the 'Gert' alert for the use of appropriate PPE which helped to avoid a serious injury.

## **Problems encountered during implementation**

The 2003, annual health, safety and environmental plan includes an open view of the problems.

The rise of the worsening accident rate, from the very low level in 2001 of 0.4 to 0.8 per 100 working days, is explained by Mourik as being a consequence of workload and the poor availability of qualified personnel. Mourik will try in 2003 to reduce the incident rate by 20 % compared with 2002.

The number of near accident reports also went down.

Some SHE-Q supervisors lost track of the complex system of necessary instruction due to the high complexity of instruction rules and time schedules.

The BSP programme is reported to have a slow effect. To overcome this situation the authors of the monthly safety newsletter request an open and positive manner.

## **Results and evaluation of the action**

At Mourik there are quantitative data available about accidents and near accidents. The qualitative situation is also discussed and described in newsletters.

The low accident rate is very impressive. It is 90 % below the European average for the construction industry. The lost time due to sickness was, for the year 2002, 6.7 % and in 2003 until today approximately 5.4 %.

The well-developed HSE system profits from the connection with the quality management system. The obligation to fill in forms to hold meetings (toolbox) delegates some duties down to the workplaces.

The slight worsening of the HSE situation from 2002 to 2003 is interpreted by the HSE department as a result of the lack of qualified personnel and a high workload.

The involvement of the workforce — project leaders and workers — is key to the programme and the reason for its success.

### **Identified success criteria**

In those industries where there is a high risk of accidents, good health and safety management is a large economic advantage. It reduces losses of working days. It gives confidence to the customer that his equipment is treated with care and by experts.

This means that the central management has good reasons to support this approach. However, there must be a certain internal company culture that makes the programme effective. In Mourik this culture seems to exist.

In particular, the open approach towards problems, also in written papers, suggests that openness and truthfulness are part of the company culture. Otherwise the observation card in the BSP would not be accepted by employees, because it requires the recording of faults and the unsafe behaviour of colleagues. In many company cultures this would very probably be seen as disloyal to other workers.

### **Is the action transferable?**

The tools such as checklists and report requirements can be transferred easily. Success depends on the commitment of the management, the capacities of the HSE department and their ability to motivate the whole staff to use the opportunities available for safety improvement. Generally speaking success depends on the overall company culture.

To duplicate the method requires a start perhaps in one or two areas (such as near accident reports) and a commitment from all parties. Management and employees have to support the system, otherwise it will not work.

### **Statements**

'All materials and work methods are available. Safety is a normal part of our work. Sometimes all the paper work make the execution of the work less flexible if we want to change work methods to improve the execution.' (Hans Hoek, vacuum-truck driver/operator)

'Safety is well organised and a normal work practice. The personal feedback after reporting problems or situations can improve. You do not always know what actions are taken after you reported an improvement point.' (Jeroen ten Have, operator/truck driver)

'Dealing with safety in work preparation and execution is integrated in our work practice. Due to the safety organisation materials and tools, personnel is better prepared and informed to execute the job. The increasing amount of documents and forms which need to be filled in in relation to all the certification



schemes is sometimes an undesired increase of the workload but seems to be essential to operate on this high level nowadays.' (Maurice van der Woude, mechanical construction project leader)

'Safety is very important for us, every employee has the right to return home in good health every day. The management of Mourik is obliged to realise this every day. Nothing is so important that it has to be executed in an unsafe way. One of our main company goals is to belong to the best in business; safety is the most important tool to reach this goal. If we can manage safety, we can manage the whole business.' (Jelle Kramers, Managing Director, Mourik International)

### **Further information**

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# 4.7. SAFETY OBSERVATION METHOD (FINLAND)



## Key points

- The TR observation method is an easy-to-use and reliable method for measuring the safety level of a building site.
- It can also be used as part of the conventional weekly maintenance inspection.
- The measurements are carried out by touring the entire building site and making entries for correct/incorrect observations on the inspection sheet.

## Introduction

For a safe building site, the state of the working equipment, machinery, scaffolding and access ways plays a very important role. Site management and all workers should have the proper knowledge and skills in correct and safe working methods. Attention should also be paid to collaboration between the main contractor and subcontractors.

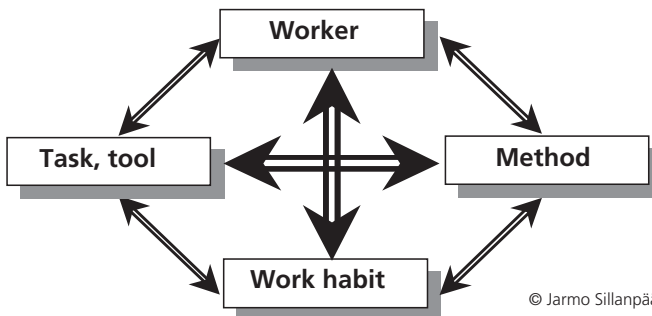


Figure 1. Worker-task system

In the worker-task system (Figure 1) all elements should be in good shape. Workers' knowledge and skills may be adequate, work methods proper, and

task and tools correct, but even then problems appear. In these cases faulty attitudes and a lack of motivation are often blamed. The real reason may be deeply ingrained work habits, which might be difficult to change even if workers are trying hard.

The TR <sup>(1)</sup> safety observation model assists not only in putting technical conditions in order but also in altering ingrained, incorrect working methods and habits.

## Background of the action

The TR safety observation method is a cooperation tool for building site safety. It helps to show objectively which items are in good shape and which require improvements. The feedback board helps to put things right and to change working methods in practice. When the results and orderliness can be seen on a site, a positive change in attitudes also develops.

The TR safety observation method came into being in 1992 to meet a practical need in Finland: something tangible was needed to measure the safety level of a building site. Inspectors of the Occupational Health and Safety Inspectorate of Uusimaa and the occupational health and safety officers of building companies also took part in drawing up the method, in addition to the researchers of the Finnish Institute of Occupational Health.

## Ambitions of the action

Tough requirements were set for the method: it had to be simple enough for it to be suitable for weekly use on the site, with the shortest possible training period. It also had to be a reliable and valid safety observation method, the results of which could not be overly dependent on the person making the observations, and the results had to forecast the site's incidence of accidents. The TR safety observation method was planned to measure the site's real time safety level as a whole.

## Scope of the action

The TR safety observation method is an easy-to-use and reliable method for measuring the safety level of a construction site. It can also be used as part of the conventional weekly maintenance inspection. The measurement is carried out by touring the entire site and making entries for correct/incorrect observations on the inspection sheet, using the five bar gate system. For a precise and reliable result, a great many observations are made. It is recommended to make over 100 observations on a single round on the site.

The TR safety observation method is used to monitor all the main aspects bearing on construction site safety. The aspects are grouped under the following six headings on the evaluation form.

1. Working habits
2. Scaffolding and ladders
3. Machinery and equipment

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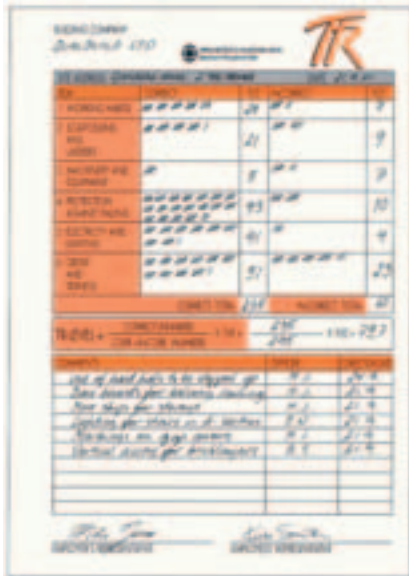
<sup>(1)</sup> TR is an acronym from the Finnish words meaning 'Building construction'

- 4. Protection against falling
- 5. Electricity and lighting
- 6. Order and tidiness

For the purpose of measuring, there is a ready-made form and guidelines for observations. Observations are made on a correct/incorrect basis. An item is marked correct if it meets the approved safety level in the occupational safety inspection, otherwise it is marked incorrect. For reasons of simplicity, each observation carries equal weight when calculating the TR level. However, important points are emphasised, as more observations are made on them than on less important points when the measurements are performed according to the instructions. The people performing the measurements need to have sufficient knowledge of construction safety regulations, but there is no need to learn new rules for the purpose of measuring. The people performing the measurements agree amongst themselves the level that they will accept for each point.

After the measurements are made, the totals for correct and incorrect observations and a site's safety level are calculated. The formula for this is as follows:

$$\text{TR level} = \frac{\text{correct observations}}{\text{correct} + \text{incorrect observations}} \times 100 (\%)$$



When the main contractor has decided to use the TR safety observation method in the weekly maintenance inspection on the site, it means a little extra work in the beginning. The initial stage is that the representatives of the main contractor and the workers' representatives together prepare the ground rules

to be followed on the site. The management and the safety delegate must also make themselves familiar with performing the measurements. They must carry out a couple of practice rounds together in order to identify common rules for acceptance. When using the TR safety observation method during the weekly maintenance inspection, the main contractor is able to follow the development of the site safety level. In addition also the solitary deficits are observed and amended immediately.

### Ground rules



Common ground rules are first agreed on the site. These are clear-cut guidelines on working methods and procedures; by complying with them, the site will be kept safe and in good order. The aim of the ground rules is for everyone to know what is expected of him or her. Good ground rules must be accepted by everyone. Long sets of rules will not stay fresh in people's minds, so the maximum number of guidelines should remain at 10. They must be easily understood. Instead of prohibitions, written guidelines and correct actions are preferred.

It must be possible to comply with the rules. There must be agreed and marked storage locations for tools, if returning them to their place is a guideline. Someone must be allocated responsibility for emptying waste receptacles if there is a rule on putting waste in these.

Good ground rules are important not only for safety but also for orderliness and quality issues for the site. The examples shown here may be used as a basis for agreeing on the ground rules for a site.

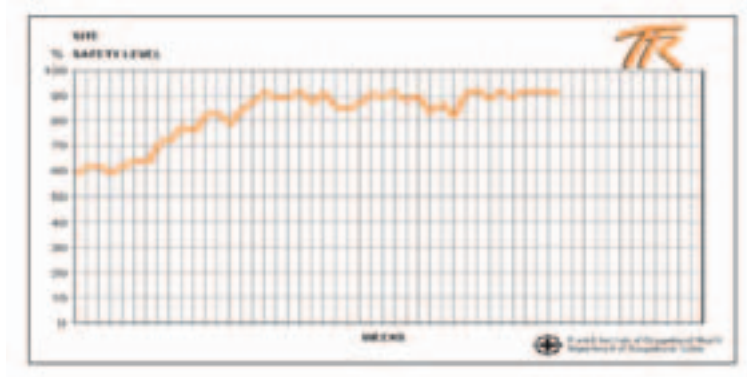
### Consultative meeting

When the ground rules have been prepared and the performance of measurements is up and running, a consultative meeting is held for all staff on the site. This deals with the ground rules and approves them jointly. The meeting also includes a presentation of the manner in which measurements are carried out and how feedback is to be given. Finally the results of completed

measurements are reported and a possible common goal is discussed, such as raising the level by 15–20 percentage points during the first two months. A small reward for achieving the goal may also be announced. One easily remembered reward might be coffee and buns for everyone.

After the meeting, TR feedback boards are put up on the wall for everyone to see. Measurements to date and the weekly results of subsequent observation rounds are posted on these boards.

### *Weekly rounds*



The TR safety observation method is used to monitor compliance with the ground rules reliably and fairly. The TR safety observation method is also the weekly safety supervision (a part of the maintenance inspection) of the site. During the inspection, the entire site is toured and observations are made of every item bearing on occupational safety. The tour is performed by the employer's and employees' representatives together. A representative of the subcontractor or similar may also be included. The results obtained represent the site safety level in the form of a percentage figure. The average site level is roughly 75 % while the perfect level is 100 %. The safety level obtained from the measurement is posted on the feedback board.

### **Performing the observation round**

The inspection tour covers the entire building site. A good order is, for example, to go by lift to the top floor, to start with the roof and descend in order, floor by floor, and finally to inspect the grounds, stores and staff facilities. The inspection route is divided into zones or inspection grid squares as one advances, and observations are made one square at a time. The size of a square is determined when the inspection is carried out. The rule of thumb is that the inspector has to be able to see the entire square from where he or she stands. Small squares generally provide more reliable results than large ones.

The building site is divided into squares according to dependable 'landmarks'. A suitable size for a square might be 50 m<sup>2</sup>, for example. A suitable square in the frame-construction stage might be, for example, the distance between columns or two such spans. During the indoor construction stage, each room, corridor and stairway could be a separate square.

When the borders of the first square have been decided on, the recording of the observations begins. A good way is to go through the monitoring form in order from the top down.

1. Quick observations are made on a worker in the area of each square, one observation per worker. If the worker is wearing the required safety gear and is not taking obvious chances, a line is entered in the correct column. If a piece of protective equipment is missing or if obvious risk-taking is seen, a line is entered in the incorrect column.
2. Entries are made separately for each catwalk, scaffolding and ladder in the grid square. If the structure is secure and in good shape, an entry is made in the 'correct' column.
3. Observations are made on each item of machinery and equipment, complying with the weekly requirements set for inspection.
4. In the item for protection against falling, an observation is made separately on each individual, unenclosed edge and gap. For example, a column breaks an unenclosed edge, so the railing between each span between columns is assessed separately.
5. One electrical observation is made from the area of the grid square, and this should be entered in the correct column if the distribution boards and cable are properly placed and protected. One entry is also made for the general artificial lighting of the square. Also, an entry is made for the square on each workstation-specific artificial lighting in the area. Entries for lighting are not made if daylight provides sufficient illumination.
6. Finally, the order and tidiness of the square is assessed. A separate observation is made for each waste receptacle. It is 'correct' if there is still room for waste in it. Their own observations are made on orderliness for the workstations in the square. One observation is made for overall orderliness, taking access routes particularly into account.

Observations on lighting and orderliness are made for workstations, etc. Workstations include the reinforcement station, the immediate environs of the construction saw, and the plumber's movable working location with equipment. A workstation may, if desired, also be any location where work is being done at the time of the observation.

When the monitoring form has been gone through for the first grid square, move on to the next one. Entries are made in the same manner, after the previous ones. Advance in this way throughout the tour, without interruption, to the end. The tour should last at most one hour. The first time, it may last longer.

This order of making observations should be complied with as precisely as possible, particularly during the learning stage. After learning, the stages need not be brought back to mind separately and the order of observations may also be altered according to the situation without prejudicing the reliability of the results. Experienced observers will complete the tour in 30–60 minutes.

## The record

The completed monitoring forms also serve as the record and they are stored in the TR file. They also show more detailed results: which items are in good order and which could be improved. The monitoring form also has a comments section for recording defects in more detail for remedial action, as required by the rules. In this section, enter only those defects during the tour which cause immediate danger and which cannot be corrected immediately in other ways. For other items, the feedback replaces the comments in the record.

## Problems encountered during implementation

The use of the TR safety observation method may be unreliable:

- if the measurer has not adopted the evaluation criteria;
- if the measurer is not able to observe the things that are in order on the site (most often people are used to observe negative things);
- the amount of observations may be too low on small sites.

## Results and evaluation of the action

On the pilot building sites, the TR safety observation method proved to be convenient in use and efficient as a method. The consultative meeting, weekly site observations and posting the results on a feedback board raised the safety level of the building sites from 60 % to over 80 % in a few weeks. The change was also easily visible, for example protection against falling was in place and the sites were in good order.

Occupational health and safety inspectors in Uusimaa province began to use the TR safety observation method as of 1993. Since they had carried out measurements on more than 300 sites by 1997, it was possible to investigate the correlation of the TR level with the incidence of accidents on sites. The result was actually surprisingly unequivocal. The sites with the best TR levels, over 80 %, experienced an average of only about 80 accidents per 1 000 work-years, whereas sites with a lower TR level suffered three times as many accidents.

- The TR safety observation method has been proved to correlate with the accident frequency of a group of construction sites.
- The Occupational Health and Safety Inspectorate of Uusimaa has achieved a 5 % statistical observation deviation.
- The TR safety observation method has been used successfully as a criterion during safety competitions held between construction sites.
- The use of the TR safety observation method is still increasing among the safety authorities and construction sites.

## Identified success criteria

The use of the TR safety observation method is constantly growing among Finnish companies. Companies use the TR safety observation method not only as a weekly inspection technique but also as a means of comparing safety standards at their building sites and thus for improving the whole company's safety level. The first guide to the TR safety observation method was written in Finnish in 1994 (Laitinen, H., Rasa, P.-L., Ruohomäki, I: TR -mittari,



Rakennustyömaan työturvallisuuden auditointi. Työterveyslaitos 1999. 16 s). This updated guide has been translated into English, Swedish and Russian. The instructions used as the basis for assessment in the guide are based on Finnish law, regulations and good practice.

The use of the TR safety observation method has been successful, among other things, because:

- it is easy to learn;
- the measurements are not time consuming;
- the TR level correlates with the accident frequency;
- it is possible to give objective feedback to the site;
- it is possible to follow reliably the real time development of working conditions.

### **Is the action transferable?**

The TR safety observation method is suited as a technique for use in any country when the principles for assessment are derived from the relevant national safety regulations. The common directives in EU countries facilitate the application.

To date the method has been used with success in the UK, as well as in Finland. It is used by Wates Group Ltd and HBG Construction Ltd, both members of the UK's Major Contractors Group (MCG). Additionally, it has been used by a number of companies, with success, in Scotland. The UK use of the system has also proved to be of much benefit in improving cooperation with the workers.

Recently, the Finnish labour inspectorate has trained both employers and workers in the use of the system.

### **Further information**

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# 4.8. COORDINATED SAFETY MANAGEMENT — THE COPENHAGEN METRO (DENMARK)

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## Key points

- The accident risks on the construction sites, where seven main contractors from different countries and cultures operated with 1 200 workers, were high.
- An orchestration of safety efforts was made, including a joint 'Safe Sites' campaign launched by the employer and the contractors, in order to keep a low accidents' record during construction of the metro.
- The action was successful as the accident frequency during the last years of the construction period of the Copenhagen metro was much lower than the average in the sector and no fatalities or catastrophes occurred.

## Introduction

The Copenhagen metro is a joint venture ownership consisting of the Danish State and the two municipalities of 'traverses', Copenhagen and Frederiksberg. The owner has established Ørestad Development Corporation to implement the project.

The design and construction for the major part of the civil works were carried out by a consortium consisting of Danish and international companies. The construction management was carried out by the consultant COWI A/S.

The first phase of the Copenhagen metro commenced in 1996 and was inaugurated in October 2002. Phase 2A was inaugurated in May 2003 and phase 2B will be inaugurated in October 2003. A third phase is planned to commence construction in October 2003.

The safety efforts described below cover the period November 1996 to September 2002.



*The tunnel-boring machine*

### Background of the action

The Copenhagen metro is the first metro ever built in Denmark. It links Amager island to the rest of Copenhagen. In the inner city the metro runs underground and is excavated in the Copenhagen chalk layers (20–30 m below ground level.) In the outskirts the metro runs on viaducts and embankments. The construction included 25 locations along the metro line, stations and shafts.

Figure 1 shows the Copenhagen metro line, stations, ventilations/emergency shafts in phases 1 and 2A, which is currently in operation. Beside this there is a phase 2B (running mainly in the Frederiksberg municipality). Phase 3 will be built in the period 2003–07.



Figure 1: Illustration of the Copenhagen metro

The civil works of phases 1 and 2A were carried out by a joint venture, COMET, the Copenhagen metro construction company.

The transportation system, including permanent way and rolling stock, was made by the Italian company, Ansaldo.

Both were turnkey contractors. Another five main contractors were involved:

- joint venture Pihl/Aarsleff,
- Skanska.Danmark A/S,
- MT Højgaard A/S,
- joint venture Dano Rail and,
- joint venture Aarsleff/Petri Haugsted.

The human resources for the health and safety works engaged by the employer, Ørestad Development Corporation, for the project were as follows: a supervisory safety engineer (100 % employment), two experts on quality, environment and work environment (33–50 %), one technical manager (10 %) and 20 technical experts for supervision on the construction sites (10 %). The contractors had allocated resources according to their size. Turnkey contractors had two to three health and safety experts (100 %), whereas other contractors employed one person for health and safety aspects (25 %). The internal cost for the health and safety experts has not been calculated.

During the period November 1996 to end 2002 almost 12 million working hours were spent on the metro construction sites. The peak number of employees was reached in 2000 when approximately 1 200 persons were working on the metro construction sites.

The external cost for the Safe Sites campaign (newsletter, information leaflet and posters, T-shirts and awards) was approximately EUR 40 373 per year (1999–2002).

### **Ambitions of the action**

Initially the general goals set for the working environment were that construction works should be executed with a good standard of safety and without unnecessary unhealthy exposure of the workforce. Effective safety organisations were to be established to ensure that the demands from the employer concerning the working environment could be met. This effort was based on the principles of prevention.

After the launching of the Safe Sites campaign in 1999, a more quantitative goal was set as to obtain a lower accident rate than the average of the construction industry.

Zero fatalities was not a written goal, but was of the utmost importance to the employer, of course.

### **Scope of the action**

The totality of the safety efforts has basically targeted accident risks and involved all contractors in the project. However, the contractors should include in risk assessments other hazards such as: dust, chemical substances, noise and vibrations, and ergonomics.

Examples of major risks to health (besides accidents) identified and controlled during construction of the metro are outlined below.

Excavation by road header in shafts, bifurcations, cross-over and some places in the deep stations in the Copenhagen chalk layers generates dust containing alpha quarts. The risk had been identified already in the tender documents and the contractors were obliged to control the risk. The measures to minimise the risks were ventilation and compressed air supplied masks used during work.

In the tendering documents the contractors were instructed to establish systems for environmental and working environmental management. They were instructed to:

- establish health and safety plans (the obligation was turned over from the client to the contractor);

- establish procedures, the contractors especially, for train control during construction and test, control of dust and gases during underground works;
- establish smoothly functioning safety organisations with the participation of workers' representatives and with a prerequisite for a satisfactory and up-to-date working environment;
- design and plan the construction and transportation system with the intent to obtain a safe and healthy working environment during operation;
- assess all relevant operations prior to commencement of the construction and describe relevant safety precautions to meet identified health and safety problems. The assessment was to include the impact on the working environment from: chemicals, ergonomic conditions, psychological conditions, noise and vibrations, cold, heat, wind and accident risks. The assessment should also include design phases, construction and operation of the Copenhagen metro.

Another airborne chemical was exhaust gases from locomotives used for transportation of muck and tunnel rings during tunnelling. The contractors were obliged to monitor exhaust gases and to apply relevant technology to meet the health problems from the exhaust gases. Ventilation was established in tunnels and shafts. Other measures were catalysts and particle filters, but the measures were not all the time adequate to meet the problems. For a period the air quality was not good enough. The problem was assessed throughout the construction period and the air quality improved during the tunnelling period.

The problem of heavy lifting occurred during reinforcement work in shafts and stations. To ease lifting operations, where tower cranes could not be used, overhead travelling cranes were placed in the ceiling of the deep stations.

Contractors had to control the risk of chemical substances by substituting their products for less hazardous products. Safety data sheets for chemicals used on the metro sites were available for all users. Persons working with epoxy and polyurethane had undergone special training.

Noise is a significant working environmental problem in shafts, stations and tunnels. The contractors were obliged to find low noise emission machinery, but a good deal of noise prevailed on the construction sites. An example is the tunnel-boring machine (TBM). The hydraulic pressuring systems generate a lot of noise. As the machine could not be modified on site, workers on the machine were provided with ear protection moulded on the shape of their ears. The hearing protection was made so that the frequencies of human talk could be heard whereas the noise from the machinery was reduced. TBM crew and supervision underwent medical checks, including hearing ability.

The orchestration of preventive measures adopted on the metro included:

- dialogue with interested parties;
- risk and working environmental assessment;
- audits and inspection;
- joint safety management inspections;
- motivation;
- joint safety campaign, increased management efforts activated from the middle of the construction period.

These are described in some detail below.

### **Dialogue with interested parties about the working environment**

The employer decided to involve the interested parties in a mutual dialogue about the working environment. A reference group on the working environment was established for this purpose at the metro.

The group consisted of:

- the Danish Working Environment Service for Copenhagen Municipality (Arbejdstilsynet);
- the Cartel of Unions in the building, construction and wood sectors in Denmark (BAT);
- the National Association of Danish Contractors (Danske Entreprenører);
- the General Workers Union (SID), Building and Construction Copenhagen local branch;
- the National Union of Electricians, Copenhagen local branch;
- the seven contractors and their environmental services;
- the construction management represented by COWI and the employer represented by the construction manager.

The group met four times a year to discuss working environmental problems during construction of the metro. The goal of the meetings was to discuss actual working environmental problems and coming works on the project. The group had its first meeting in spring 1997 and held its 20th meeting in April 2002. The 20th meeting was dedicated to a general evaluation of the working environmental efforts on the metro.

### **Risk and working environmental assessment**

The contractors used different methods to meet the contractual requirement for establishing working environment assessments: workplace assessments, audits and inspections.

The contractors used the method of the 'Model workplaces'. This method was developed by the Danish Contractors Association (Danske Entreprenører) and the General Workers Union (SID). The system includes identification of risks made by the site-based crew and follow-up on the problems by safety inspections. All metro contractors working with civil engineering used the method for their internal follow-up on the safety on the sites.

During the construction period, the metro contractors established approximately 600 assessments of risk and the working environment prior to the commencement of work.

### **Audits, inspections and joint safety management inspections**

The inspections were performed jointly by the contractors' safety group, the contractors' management representative and the employer's safety engineer or other employer representative.

The goals of the inspections were:

- to identify and eliminate immediate risks,
- to follow up on the contractors' safety planning and compliance with the health and safety plan;
- to identify and discuss safety problems that could be foreseen in the near future due to new work operations.

The results of each inspection were discussed with the participants of the inspection and, if necessary, with the site management. The results were also used in the process of finding the best crew for the period in the safety campaign.

Safety representatives were involved in the joint safety inspections. After assessment it was found that construction sites with active safety groups — where safety meetings were held including subcontractors, and internal safety inspections were performed frequently — the standard of the safety work was much higher compared with sites where the dialogue between the site management and safety representative was not good. This leads to the conclusion that safety organisations with safety representatives elected by the workers help establishing and maintaining good safety standards.

The inspections were frequent: 359 documented inspections and approximately the same number of non-documented ones. The project manager from the largest contractor, COMET, and the construction manager from Ørestadsselskabet performed joint safety inspections approximately every eight weeks from the end of 1999 to the beginning of 2002.

## **Motivation**

The motivation of the employer was to comply with his own policy of having good and sound workplaces. When the number of accidents increased, a special activity — the Safety Campaign — was established on the employer's initiative in 1999.

The motivation of the contractor was to have few accidents among his crew and to meet the requirements of the employer. The contractors were constantly imposed by the employer to meet the requirements of the contract regarding planning and establishing relevant safety precautions. The contractors were encouraged to allocate necessary resources to establish safe and sound workplaces.

The workforce was motivated by the Safe Sites campaign encouraging them to establish a good safety standard on sites as well as to not take risks but to take the necessary time to establish relevant safety precautions.

## **Joint safety campaign**

The joint campaign was initiated by the employer as a response to an unacceptable high number of accidents in 1999, three years after commencement of the works. The motto of the campaign was 'Every accident is preventable'.

The contractors responded positively to the invitation and an organisation consisting of a steering group and a working group was established. The ant was selected as a logo for the campaign as it is known to be an organised and hard working creature below and above ground level.

The Safe Site campaign made use of a number of tools such as flags, posters, information letters and a newsletter called *Safe Sites*.



*The first issue of the Safe Sites newsletter*

All documents were published in Danish and English. The highest profile activity was the Safe Sites competition between work teams led by a foreman. Three times a year a joint inspection team consisting of the metro contractors and the employer evaluated the work teams and recommended the winner and the runner-up from a shortlist of five to eight teams to be decided by the steering group. The shortlist was elected among 30 crews that had all been inspected by the construction management more than once prior to the election. The metro contractors performed regular safety inspections themselves.

### **Problems encountered during implementation**

The basic problem that was encountered during the joint safety campaign implementation was the different safety cultures existing among contractors from different countries. The safety campaign contributed to establishing a 'common safety culture' involving all persons from top to bottom. Also the group of interested parties was proactive and dealt with such problems during meetings.

The Manager of the Danish Working Environment Service, Copenhagen, Ole Honoré, criticises the beginning of the construction phase:

'A lot of pressure had to be put on the processes before it worked well. Part of the problems lay with the many different nationalities represented in the construction. We saw that some kept very much to their own cultures and were very difficult to influence. A more direct and leading role from management could in many instances have solved the problems.'



The representative from the General Workers Union in Denmark, Construction Section, Copenhagen, Michael De Geir says:

‘At the beginning I was very concerned. The sites were not well organised. At that time we also met difficulties from the contractors when we addressed safety problems to them. There were problems due to the many nationalities. A contractor coming from another country might not be familiar with our system and legislation. The conditions improved, however, during the construction period and at the end it was above middle standard. This is among other things due to the group of interested parties. In the group we discussed problems of the day and sometimes problems that we could foresee coming.

The safety campaign contributed to making it prestigious to have a good building site. I found that the workers accepted the campaign. The crews accepted the invitation for the competition among them and wanted to be the best ones.

I would though have liked to see the unions being invited as a more active part of the campaign.’

At the end of the action all interested parties expressed their satisfaction but still:

- the authorities asked for a more direct and leading management style on the safety matters from the start of the project; and
- the unions asked for deeper involvement in the safety campaign and involvement of management from the start of the project.

Finally, the persons involved in the action believe that tools for establishing safety precautions already in the design phases need to be implemented throughout the construction industry. These tools are far less developed at the present stage.

### Results and evaluation of the action

The goal of the metro project was to have fewer accidents than the average stated for the Danish construction industry. This goal was met as the accident frequency for the period 1996–2002 was 30, whereas the frequency of the industry over the period was approximately 36.

The metro accident frequency rate differs from year to year, reaching its top peak in 1999. Not until 2001 did it succeed in ‘bending the curve’ by a 28 % decrease, from 93 accidents in 2000 to 67 in 2001.

When launching an action with quantitative goals such as to reduce the accident frequency, one should tackle an important problem in order to achieve data reliability: under-reporting. The employer has put effort into establishing a trustworthy record. The subsequent efforts are listed below.

- The employer’s supervision staff (20–25 persons) had a by-weekly meeting about environment and working environment. At the meetings, near-misses and occupational accidents on the 25 metro construction sites were discussed. If an event had not been reported to the employer’s safety

	1997	1998	1999	2000	2001	2002	Total
Reportable accidents (metro) (*)	22	57	105	93	66	27	370
Working hours (metro)	659 249	2014 037	2657 833	2874 129	2559 678	1221 017	11985 943
Frequency (metro) (**)	33	28	40	32	26	23	30.1
Accident frequency in building industry in Denmark	36	37	38	37	34.1	32.1	35,7
Injuries with absence of three days or more (metro)							226
Accidents where the absence duration was not announced (metro)							16

(\*) Reportable accidents to the Danish authorities: events that lead to injury with absence of one day or more than the day on which the event took place.

(\*\*) Accident frequency: number of reportable accidents per 1 000 000 working hours among the metro contractors.

(Note: The frequency here is different from the incidence rate that is calculated according to the Eurostat method: number of reportable accidents/number of employed persons in the studied population x 100 000).

*Numbers of reportable accidents and working hours, during the construction period*

function, the case would be traced in the contractors' organisation to complete the record.

- At each meeting of the group of interested parties, the accident record for the period was discussed.
- In 2000 and 2001, the accidents of the month were described and put on notice boards in the workers' huts. During this period the employer never heard any non-compliance between the record and reality on the construction sites.
- The accident recording was part of each safety meeting on the construction sites. The minutes, which were available to all workers, were also forwarded to the employer. Non-compliance between the minutes from safety meetings and the contractors' recording was never detected during the construction period.
- To prevent under-reporting of accidents from the contractors, the occupational accidents were not competitive criteria in the safety campaign to find the best crew.

The accidents 'spoken about' on the construction sites were recorded.

However, from different studies it is known that not all events leading to injuries in the construction industry and other industries are reported. It is assumed that non-reported accidents have also taken place on the metro project. Some of these accidents can be 'hidden' as sick leave, which is not reported to the employer.

Technical Director Torben Johansen, of Ørestadsselskabet, assessed the campaign and concluded:

'I find we have achieved our objectives. The accident rate is lower than the industry standard. The metro workplaces have been improved by the Safe Sites campaign.'

Mr Johansen continues:

'One shall always be careful when relying on statistics. Nevertheless, it is worth mentioning that although we have had severe accidents like fractures:

- there have been no fatalities;
- only one person fell more than 2 m even though excavations of 20-30 m were open for four to five years (he fell 3 m with a falling ladder);
- no accidents by collapse of soil or ground;
- no accidents by fire or explosion in tunnels; and
- nobody was hit by a work train or metro train.

The vast majority of accidents were relatively minor accidents such as sprained ankles, cuts and strained backs during lifting.

This is to be seen in the light of the main figures of:

- 715 000 m<sup>3</sup> of soil excavated;
- placement of 1 000 secant plies;
- placement of 66 000 tunnel segments;
- a large number of lifts in deep stations and shafts; and
- 40 km of track laying.'

A safety representative for more than three years on the metro, Jens Henrik Petersen says:

'The biggest effect of the safety campaigns is to be found in the fact that through the campaign the management has focused on safety. The management focus has made it easier for safety representatives like me, when we pointed out safety lacks.'

### Identified success criteria

The success criteria are multifold and can be tracked in isolation, namely the application of different policies and methods (monitoring group of interest parties including trade unions and authorities, safety risk assessments prior to commencement of work, frequent audits and inspections, use of the 'Model workplace' method, commitment of the management, vivid joint safety campaign, but also very carefully selected coordinated actions with complementary effects in terms of prevention).

Aage Poulsen, Project Manager for Solbjerg metro station from MT Højgaard, contractors, says:

'The way Ørestadsselskabet communicated their interest in safety efforts was very good. Through the frequent safety inspections, the workers discovered that Ørestadsselskabet did care about the safety on the sites.'

The inspections have raised the campaign's effect as it was not merely paperwork. The combination of the contractors' own weekly inspections using the method of the 'Model workplaces' and the clients' inspections have created enthusiasm among the workers towards safety issues. Next time I would like to see more effort put on the safety meetings so that they could be used more actively.'

### **Is the action transferable?**

The Copenhagen metro project was international, both in terms of management and workforce. Consequently, many of the methods can be used in other countries.

The risk and working environmental assessment and description of safety precautions prior to commencement of work has proved to be a very effective tool, which can be transferred also to other projects and locations.

The follow-up on safety by safety groups and safety representatives elected by the workers has proved to be an effective tool for establishing safe building sites. The principle of having safety representatives elected among the workforce can be transferred to other countries.

Openness and dialogue in interested party groups monitoring the project can be transferred to other countries.

The motivation of the workforce from top to bottom, by establishing a common safety campaign, can be transferred to projects in other countries.

Involvement of the employer's supervision team and construction management in establishing a safety culture has proved to be an effective tool for prevention of severe accidents. This can be transferred to other projects on other locations.

The Director of the Italian contractor for rolling stock, Mr Andrea Cozzani, says:

'Health and safety during the construction of the metro has been a positive experience. I have seen that the safety work is well organised in Denmark which is also due to the joint safety campaign. When, or if, I come back to Italy, I will establish a joint safety campaign inspired by the Danish model. It worked well.'

Top management involvement is of the utmost importance in accident prevention and should be highly prioritised in all projects, at all locations.

### **Recommendations for application of the action elsewhere**

In major construction works, one type of prevention activity is likely to be insufficient and coordinated safety efforts applying different actions involving all actors are needed.

Records are an important source of information about risks at work and the quality of the record should be high. The benefits of having a reduced number of accidents must be encouraged so that the contractors are not tempted to suppress reports.

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# 4.9. HEALTH AND SAFETY AT THE RESTORATION WORKS OF THE ACROPOLIS MONUMENTS (GREECE)

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## Key points

- Restoration works have significant health and safety risks for a number of workers involved, from workers in the scaffolds to marble artisans.
- A holistic risk assessment highlighted the importance of taking into account health and safety risks when designing and executing the work.

## Introduction

The Hellenic Institute for Occupational Health and Safety, in collaboration with the service for the restoration of the Acropolis monuments (YSMA, Greek Ministry of Culture), carried out in 2002 a study to assess the risk factors and their consequences on the health and safety of workers at the restoration works of the Acropolis monuments.

The Hellenic Institute for Health and Safety (Elinyae) is a bipartite, non-profit organisation established in 1992. Its purpose is to provide scientific and technical support to all those involved in occupational health and safety, as well as to contribute to the improvement of occupational health and safety by advising the policy-makers and legislators in Greece. Apart from the central Athens branch, at the moment there are three regional branches in operation: one in Thessaloniki, one in Tripoli and one in Ioannina.



The service for the restoration of the Acropolis monuments (YSMA) manages all restoration works on the Acropolis and falls within the jurisdiction of the Greek Ministry of Culture. A total of 233 people are employed at YSMA and comprise engineers, archaeologists, conservers and technicians.

This project was initiated after YSMA requested Elinyae to contribute to the risk assessment.

### Background of the action

The restoration works began in 1975. For the restoration of the Acropolis monuments five worksites have been set up: one at the Parthenon, one at the Propylaea, one at the Temple of Athena Niki, and a conservation site and a site for the marble parts. The restoration works include dismounting parts of the monuments and transferring them to conservation laboratories where new parts are constructed. These restored parts are then replaced on the monuments where finishing touches are made, *in situ*.

The restoration works of the Acropolis monuments often present many complexities and particularities. In particular, the worksites are operating concurrently in an area of the archaeological site that is visited by thousands of tourists. In addition, the total work area is limited in space given the fact that it is on the rock of the Acropolis. Also, due to the fast corrosion of the monuments, it is necessary to set up a worksite in a hasty manner, which may result in safety measures not being taken. Because it is prohibited to intervene on the monuments, it becomes difficult to improve safety measures at scaffolds as is commonly done on conventional construction projects.

	Number of accidents	Working population	Incidence rate
Construction	4 266	208 029	20.51
Total (all sectors)	16 822	1 553 647	10.83

Comparison of accident statistics in the construction sector and all sectors for the year 2000 in Greece

No accident was reported during the restoration works of the Acropolis monuments. A major factor for this was the skills and experience of the workers employed on this project. The workers' main concern was the marbles themselves. As extremely valuable archaeological artefacts a great deal of importance was attached to preventing any damage being caused. This had consequences on safety and health in that many modern preventive measures could not be used.

### Ambitions of the action

The study was initiated following an enquiry from YSMA addressed to Elinyae on how to apply health and safety legislation at the Acropolis monuments given their particularities. Elinyae suggested a comprehensive OSH study should be implemented. The objectives of the study were the recording and assessment of OSH risks at restoration works with hygiene monitoring and safety audits as well as medical examinations.

Initially the main aim of YSMA was to prevent serious accidents, especially falls from scaffolds. Following this it was conceded to broaden the study to encompass more aspects of health and safety. YSMA's interest in this collaborative effort was that at the end of the day they would acquire a 'custom-made' 'OSH plan and file' and risk assessment data.

## Scope of the action

The study was conducted in 2002 and lasted for the entire year. There was no financial obligation on YSMA for the study since Elinyae provides its services free of charge. The procedure followed was conducted in three phases.

First, questionnaires were distributed to all workers that addressed risks for safety, health and ergonomic risks as well as symptoms. This not only involved the participation of the workers but also provided a first overview of the hazards. The results of the questionnaires revealed that the basic risk factors were slippery floors, work at great heights, handling of hazardous equipment, dust, noise, manual handling and bad postures, and high temperatures especially during the summer period. Musculoskeletal disorders and stress were the most prevalent symptoms. The complete lack of training in health and safety matters became obvious.

The second phase included documentation of risks. Measurements were carried out for noise, dust, the presence of BTEX compounds (benzene, toluene, ethylbenzene, xylenes), lighting, microclimate and static friction. Also safety audits were made at all workplaces. These findings confirmed the existence of risks.

Finally, medical examinations (audiometry and spirometry) were conducted on a sample of workers exposed to noise and dust (108 workers with an average of 10 working years).

For the purpose of the study five worksites were investigated, together with the plaster cast laboratory, the electromechanical workshop, the blacksmith forge and the dyer's shop.

The workers were classified according to the following homogeneous groups: marble artisans, conservers, mould-makers, technicians and engineers.

The risk factors identified were safety issues for work at great heights and the use of cutting and grinding machines in the workshops, noise, marble dust and manual handling.

From the results of the study several safety oversights and omissions were noted. According to industrial hygiene monitoring, almost all noise levels in the marble works exceeded 90 dB that is the limit value for an eight-hour exposure. Similarly the values for airborne dust at the marble laboratories exceeded the daily limit value. Given the fact that the concentration of crystal silicon dioxide (SiO<sub>2</sub>) in the Parthenon marble was determined to be 2.5 %, the limit value for inhalable dust was 2.2 mg/m<sup>3</sup>. There were no findings for BTEX compounds and metals in the dust (Ni, Cd, Fe). In all cases the relevant limit values were obtained from national legislation. The limit values set by the American Governmental Industrial Hygienists (ACGIH) were also considered as additional references (usually with lower limit values).

The risk for slips and falls was high since static friction was found on almost all worksites below the safety value set by the Americans with Disabilities Act and Architectural and Transportation Barriers Compliance Board.

With regards to the medical examination those workers with significant reduction in their acoustic ability (proportional to years of exposure) were the marble artisans. In Figure1 we can conclude that the group of marble artisans presents a significant reduction in acoustic ability in 2000 and 4000 Hz. The normal acoustic ability is around 0–10 dB.



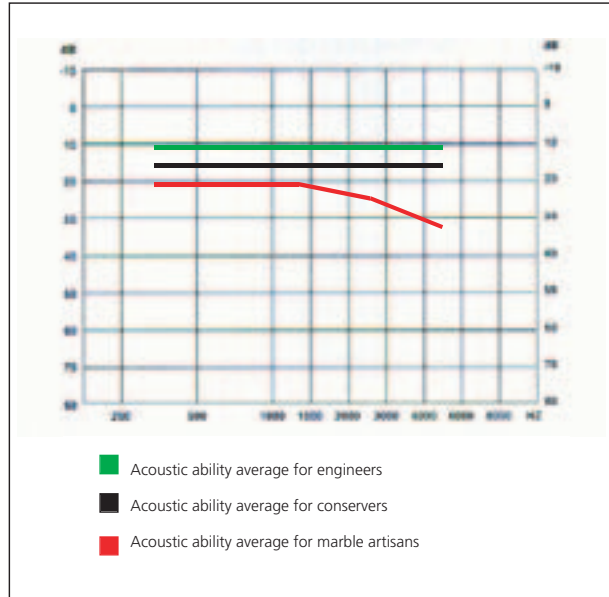


Figure 1: Audiometry curves representing the acoustic ability of the groups of engineers, conservers and marble artisans

Marble artisans manifested respiratory problems due to the exposure of particles and other airborne pollutants associated with the work environment.

At the end of the project, measures were suggested to YSMA to improve the safety and health of the workers. A special 'safety and health plan' and 'file' for restoration works were developed.

### Problems encountered during implementation

The main problems encountered during the study were the difficulty to change aspects of safety culture and inherent technical problems associated with archaeological monuments. For example, the erection of scaffolding was extremely difficult due to adverse conditions, namely the morphology of Acropolis rock and the position of Acropolis monuments.

Measurements on industrial hygiene were difficult to conduct since no vehicle could reach the Acropolis and all equipment had to be carried manually to the top. Another problem discerned was during the restoration works where the different types of activities and the pace of work varied from day to day. This made it difficult to record the actual risks.

Due to the historic nature and the artistic value of the Acropolis monuments the workers (supervisors, engineers, artisans) did not consider the restoration worksites as being hazardous since their attitude towards the work was more that of artists or sculptors. Any attempt to imbue YSMA with a new safety culture was difficult given the sense of priority they had towards the marbles. However, the results of the study alarmed YSMA enough to take action to improve health and safety.

Since YSMA at that time did not have a health and safety committee it was difficult to mobilise workers to participate in the study. For that purpose a general assembly was held with all workers aimed at informing them about the project and motivating them on matters of OSH.

### **Results and evaluation of the action**

A large number of employees participated in the study. This enabled the data obtained to be statistically significant. Most important is that the study actually paved the way to study the work conditions of conservers and maintainers of archaeological marbles and the associated exposures and risk factors.

Following an Elinyae evaluation of the impact of such activities on health and safety, YSMA is starting to apply some OSH measures. However, a great deal still needs to be done in this area. After the project more human resources on OSH were engaged for the restoration works (a new safety engineer has been appointed). Also a stricter PPE (personal protective equipment) policy has been applied. The safety culture seems to be changing in direction from top management to workers practices.



*Work on the historic Acropolis monuments*

As a follow-up to this study Elinyae, in conjunction with YSMA, is currently elaborating the Internal health and safety regulations concerning dangerous restoration works. On completion, a conference will take place to train employees of YSMA on the new policies and regulations.

Another positive outcome, although not planned, was that the Federation of Conservers in Greece, having been sensitised on matters of OSH by the study, requested the cooperation of Elinyae for further collaborative studies in other restoration works in Greece.

### **Identified success criteria**

The holistic approach to the problems of health and safety at the Acropolis site enabled Elinyae to properly integrate the safety and health issues that came to the fore.

The active participation of the workers was crucial to the success of this project.

### **Is the action transferable?**

This study was the first of its type to be conducted on an archaeological site in Greece. The methods involved in the study and its findings can be transferred to similar conservation and restoration works within Greece and Europe.

Also a model 'OSH plan and file' that was drafted for the purposes of the study can be used on other restoration works using similar techniques.

### **Further information**

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# 4.10. ACROSS THE SEA BETWEEN DENMARK AND SWEDEN — SUCCESSFUL MANAGEMENT OF OCCUPATIONAL AND HEALTH RISKS IN CONSTRUCTION ACTIVITIES (SWEDEN)

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## Key points

- Multinational project
- Application of the temporary and mobile construction sites directive (92/57/EEC)
- Multi-contractor risk assessment
- Very large construction site
- Effective worker safety representatives
- Inherent hazards — working above water
- Coordination between different employers and enforcing authorities

## Introduction

The campaign 'Across the sea between Denmark and Sweden — Successful management of occupational and health risks in construction activities' was implemented by the Danish site owner midway during the construction of the railway and road line across the Sound, Øresund, between Denmark and Sweden. The safety campaign was multi-faceted and aimed both at promoting positive attitudes towards safety and at the behavioural aspects of safety at work.

## Background of the action

It has been a dream for more than a hundred years to connect Sweden and Denmark across the sea. The agreement on the project was signed in 1991, and the construction work started in 1993 on the Danish side. The work with the bridge and offshore started in 1996 and ended three years later, in 1999. Construction of the Danish land works for the Øresund link began in 1993 and was completed in 1998.



This very large construction project contains the following:

- motorways,
- railways,
- approach bridge,
- an artificial island,
- tunnels,
- 2 300 tonnes of cables,
- 87 000 tonnes of steel (12 times the weight of the Eiffel Tower!),
- 310 000 m<sup>3</sup> concrete (15 % of the volume of the Great Pyramid of Cheops),
- 60 000 tonnes of reinforcement steel,
- 1 000 workers.

The first meeting between Danish and Swedish labour inspection authorities and representatives for contractors was held in August 1993. At this time, there were construction activities only on the Danish side.

The health and safety works focused on special risks, such as:

- coldness,
- great number of subcontractors,
- new risks while carrying out the construction work,
- difficulties because of different laws in Denmark and Sweden,
- difficulties when Sweden implemented/started to use Directive 92/57/EEC,
- workers from different countries have different safety cultures,
- stress.

### **Ambitions of the action**

The objective of the multi-faceted campaign, as defined by the Danish site owner, was to reduce the injury incidence rate to at least half the average injury incidence rate of the building and construction industry in Denmark (45 injuries per million working hours). Additional ambitions were promoting positive attitudes towards safety and the behavioural aspects of safety at work.

### **Scope of the action**

To deal with the risks on the sites, different activities were established.

- (a) Swedish–Danish cooperation on safety work, carried out by the labour inspectorate:
- twinning of EU (= Danish) and Swedish requirements;
  - twinning of inspections;
  - twinning and comparison of statistics;
  - special focus on coordination on site.

(b) Some activities from the Swedish labour inspectorate:

- a special project group formed by inspectors, led by the regional director;
- high prioritising (Swedish inspectors worked more than 160 days during 1997 with the project);
- information was produced and spread constantly (*News from the Bridge*);
- some weeks were used for concentrated inspection activities;
- occupational medical control related to stress was carried out (long, up to 12-hour working days, followed by one week's time off work).

(c) Activities affecting workers' attitudes:

- a safety campaign mascot placed on large banners at the entrance to all Øresund construction sites. Leaflets were distributed to all new employees during their introduction period. The leaflets explained the purpose of the campaign, and gave examples of proper safety practices in various working situations;
- a newsletter, *Øresund Site News*, issued quarterly to all employees. The newsletter provided information on occupational safety initiatives, and described specific accident cases in order to avoid similar accidents in the future;
- notice boards placed in meeting rooms, receptions and offices were used to keep employees informed about the general results of the campaign and the result of the specific site.

(d) Activities affecting behavioural aspects:

- an award of DKK 25 000 was presented twice a year and shared by the employees at the safest site. The sites were assessed during a great number of safety inspections. Points were awarded for safe handling of the working environment, planning, training, housekeeping, etc.;
- specific theme campaigns aimed at employees during working hours, focusing on accidents and injury risks of particular interest, e.g. crane accidents.

### Problems encountered during implementation

Denmark is a member of the European Union, and accordingly the temporary and mobile construction sites directive (92/57/EEC) was in use in Denmark. Sweden was not a member of the European Union at this time, and thus had to comply with national but not EU requirements.

### Results and evaluation of the action

A special pilot project was created for following up the results of health and safety at work. A site for concrete manufacturing, with 200 Danish and 200 Swedish workers, was chosen. The requirements and the management were the same.

At the start the figures from national work injury statistics in both Denmark and Sweden were looked at, and it could be established that the accident rates were much lower in Sweden than in Denmark. The identified national statistics from both Denmark and Sweden were compared with the figures for injuries at this site. The comparison showed that while the Swedish injury rates just followed

the Swedish national figures, the Danish made very good improvements. The results were studied and used for improvements.

Another study dealt with Danish land works, where the labour force comprised approximately 100 % Danish citizens. The construction work comprised a 9-km motorway and an 18-km railway from Copenhagen airport to the existing motorway and railway in central Copenhagen. The total number of working hours was 6.8 million hours.

Assuming the exposure to be directly proportional to the number of working hours, the effect of the Øresund campaign for the Danish land works was a 21 % reduction in the observed number of injuries. However, this effect was not statistically significant. Allowing the exposure also to depend on the type of construction work (light or heavy), the effect of the campaign was a statistically significant 25 % reduction in the number of injuries. Heavy construction work was associated with a statistically insignificant increased injury rate of 41 % compared with light construction work.

To some extent the modest results of the safety campaign might be explained by the fact that the site, like any construction site, was a temporary workplace: working routines were not sufficiently affected by the safety campaign. On the other hand, the campaign might have been too broad in its multi-faceted nature, focusing too much on attitude change and too little on behavioural aspects.

### A view from Denmark

From the Danish side it is important to emphasise that the accident rate for this project was only half of what is normal in the construction industry — and in reality only a quarter, if one takes into consideration that, with the interest there was in the this project, almost 100 % of the accidents were reported compared with the average 50 % normally reported in the construction industry.

It is important to emphasise that this campaign, partly the first of its kind, formed the basis for a further planning project. The campaign put specific demands on the firms selected and there was an innovation in that the working environment demands were written directly into the contract agreement with the contractor. Further, the differences between Swedish and Danish accidents had been a subject of great discussion. A consequence of this was that a conference was held to discuss experiences, and lessons learnt. Another part of the project — overnight accommodation in camps — resulted in further research projects in Denmark.

The result from all this work has demonstrated that the Øresund project in Denmark is an important milestone for improving the way safety and health is managed on all construction projects.

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### Identified success criteria

The accident frequency during the project was equal to the accident frequency of the construction sector on average, which can be considered a success considering the complexity of the project.

The meetings of the project group were short and informative, if sometimes insufficiently prepared, because all the group members had many other work tasks at the same time. However, it was considered that this kind of construction project would best be carried out when working in a project group.

One reason for the generally low accident rate may have been the builder's concern with occupational safety. This concern can be illustrated, among other things, by a safety award given every six months to the 'best contractor'. Furthermore the leaders of the project participated in the safety inspections, in order to increase the activities of the labour management in safety improvements.

The safety authorities cooperated with the top management of the project and emphasised that the builder and the persons responsible for cooperation are liable for safety matters, whereas area managers and foremen have more limited responsibility. Safety matters should not be left solely to safety engineers or occupational safety management.

### Is the action transferable?

This case was an example of dealing with safety matters during a big construction project. The action is transferable to other branches and smaller projects concerned with handling safety matters, where the actors have enough power of decision.

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## 4.11. PREVENTION OF FALLS FROM A HEIGHT ON CONSTRUCTION SITES (LATVIA)

(implementation of Council Directive 92/57/EEC)

### Key points

- Specific conclusions have been made regarding the safety of construction work in Latvia.
- A booklet containing recommendations on the application of safe working methods and equipment has been prepared.
- The usefulness of such types of campaigns was confirmed.
- Specialists from Denmark acted with an understanding of the local situation, and provided extensive and competent information about the use of good practice in EU countries.

### Introduction

The project was executed as foreign, non-reimbursable assistance to the State Labour Inspection of Latvia, between January 2000 and October 2002. The provider of assistance was the National Working Environment Authority of Denmark, whose specialists had accumulated considerable experience and knowledge in undertaking such activities.

The project was executed in the framework of the cooperation between Latvia and Denmark, taking into account the experience of Danish colleagues.



## Background of the action

The purpose of the project was to draw the attention of employers and occupational safety and health representatives working in the construction industry to labour protection requirements.

A specific theme was selected in the area of labour protection in the construction industry: 'Protection against falls from a height on a construction site', with the following sub-themes:

- the risk of falls and falling through on construction sites:
  - work in buildings, building constructions,
  - the risk of falls while working on the roofs,
  - safety equipment;
- mobile ladders and scaffolding:
  - mobile ladders and their application,
  - scaffolding and their application,
- separate work platforms and safety nets.

The relevance of the above issues is confirmed by an analysis of the causes of injuries incurred as a result of accidents conducted by the State Labour Inspection over the course of several years. This shows that falls of various items or employees from a height on construction sites constitute about 50 % of all accidents.

Implementation of the project covered the whole country with the participation of all regional state labour inspections, the Labour Department of the Ministry of Welfare and the Trade Union of Constructors.

## Ambitions of the action

The project aimed at informing and controlling employers on the subject of work at a height in the construction industry in Latvia, in order to better implement Council Directive 92/57/EEC on the implementation of minimum safety and health requirements at temporary or mobile construction sites.

## Scope of the action

The action consisted of several stages:

- the preparation stage;
- the training of inspectors;
- the information campaign;
- the construction site inspection campaign.

## Preparation stage

The preparation stage lasted until 1 July 2001. The following activities were undertaken:

- an agreement was reached between specialists from Denmark and Latvia on the cooperation module and planning of specific tasks by stage and timeframe;

- the examination of Latvian and Danish legislative acts concerning falls from a height on construction sites that resulted in the selection of the required information material given for translation;
- further improvement and collation of information material for the design of booklets; the methodological material included in booklets is intended for employers of construction companies and employees working in the industry;
- editing of the text in booklets and the development of the visual layout together with the printing house; coordination with Danish specialists and the Work Group on Construction;
- a list of individuals that would undergo training was created, a plan of lectures was drawn up, and themes were divided among specific lecturers.

### Training of inspectors

The theoretical training of inspectors was held for two study groups with 12 trainees in each, from 3 to 7 September 2001. Training was provided according to the plan of lectures and the chosen themes on labour protection in the case of work at a height, on the roof, on ladders and on the scaffolding.

Inspectors from all regional state labour inspections were delegated for training so that they could inform their colleagues about the knowledge they had acquired and would be able to participate in the following project stages.

Each lecturer was entrusted with the task of preparing visual aids for his/her respective theme and to present it to inspectors for further use when meeting with employees of construction companies.

### Information campaign

The timeframe for the information campaign was 1 October to 1 December 2001.

The purpose of the campaign was to inform the community and employees involved in construction about labour protection issues within the framework of the Latvian/Danish project, with the assistance of mass media and when meeting with entrepreneurs. Activities were undertaken taking into account the strategy proposed by Danish colleagues.

- The press secretary of the State Labour Inspection (SLI) prepared a press release for the national mass media. It was sent to regional state labour inspections (RSLI) where it was disseminated among local district newspapers, TV and radio.
- Inspectors disseminated the booklet *Construction* during their visits to enterprises or during meetings with local contractors. The booklet was also placed on the website of the State Labour Inspection (<http://www.vdi.lv>).
- A press conference was organised on 1 April 2002 prior to the beginning of the construction site control campaign. It was attended by representatives from five national newspapers, one magazine on construction, two photo and news agencies, Latvian radio and the Internet portal on construction (See Table 1).

	Press	Radio	TV	Internet
Central Office of the SLI	5	3		2
Riga RSLI	1			
Dienvidi RSLI	1		1	
Kurzeme RSLI			1	
Latgale RSLI	2			
Ziemeļvidzeme RSLI	1			
Zemgale RSLI	1			
Ausrumvidzeme RSLI	3			
Total	14	3	2	2

Table 1. Information in mass media

### Construction site control campaign

The timeframe for effecting the construction site control campaign was set for 15 April 2002 to 20 June 2002. This timeframe was chosen because of specific types of work that were planned in the project and that had a seasonal character.

Inspectors received inspection questionnaire forms that were filled in by the inspectors during the site inspection visit. The respective member of the Work Group on Construction undertook the planning and coordination of control activities in each regional state labour inspection. Their duties also included drawing up the summary and delivering it to the project coordinator.

During the campaign inspectors imposed the following sanctions:

- 100 orders;
- 15 administrative penalties;
- 6 warnings on the suspension of the operation;
- 12 orders on the suspension of the operation.

The largest number of inspections were undertaken by the Riga Regional State Labour Inspection, which in part can be explained by the economic activities in the country at that time.

The results of the control campaign can be seen in Table 2, while the distribution of inspections to construction sites by region is presented in Table 3.

In total, 275 construction sites were inspected, of which 85 were new construction sites, 85 were reconstruction sites and 105 were sites where repairs were being undertaken.

Working conditions were assessed from the labour protection point of view in:

- 106 cases of work on the roof;
- 689 cases of work on mobile ladders;
- 282 cases of work on scaffolding.

Insignificant imprecision may appear in the results acquired as a result of the control campaign as not all inspectors in various regional inspections interpreted the quality of work equally.

A repeated inspection of construction sites has been required for about 8 % of sites, the inspector himself/herself taking the decision on the need for such an inspection depending on the results of the first inspection.

	Working conditions		Reprimands/R/	Recommendations/R/
	Comply	Do not comply		
<b>WORK ON THE ROOF – 106 ROOFS</b>				
Safeguards against falling through openings in the roof.	93	13	10	14
Type of roof laths, interval between laths (max 0.46 m).	96	10	5	8
Safeguards against falling through the roof covering	92	14	11	14
Fastening at the lower edge of the roof.	64	42	35	42
Fastening at the ridge of the roof.	74	32	27	32
<b>Total</b>	<b>419</b>	<b>111</b>	<b>88</b>	<b>110</b>
<b>LADDERS – 689 CASES</b>				
Sufficient height (length) of the ladder.	654	35	35	40
The ladder has been mounted safely on a stable foundation	603	86	99	104
Work on the ladder can be performed safely.	560	129	101	107
Work must be performed at a height below 5 m.	592	34	25	28
Work must be performed at a height above 5 m.	63	7	7	7
The ladder is used in the assembly of construction elements.	108	46	41	42
The technical condition of the ladder and its maintenance in working order.	569	120	108	119
<b>Total</b>	<b>3 149</b>	<b>457</b>	<b>416</b>	<b>447</b>
<b>SCAFFOLDING – 282 CASES</b>				
Handrails of the protective fencing (min. height 1 m).	243	39	39	47
Middle handrail of the protective fencing at the height of 0.5 m.	182	100	86	100
Foot paths (height 0.15 m).	143	139	112	114
Sufficient safeguard fastenings at constructions of building	226	56	45	50
Stability (foundation, foot-mounted, pallets).	240	42	53	58
Work platforms (stability, width).	229	53	45	51
Access to work platforms	230	52	45	54
Upper covering of walk-through frames	140	29	18	29
Scaffolding elevators.	22	5	5	5
Existence of notices.	23	259	28	214
<b>Total</b>	<b>1 678</b>	<b>774</b>	<b>476</b>	<b>722</b>
<b>Total</b>	<b>5 246</b>	<b>1 342</b>	<b>980</b>	<b>12 798</b>

Note. The column Reprimands/R/ = violations of regulations and user instructions issued by the manufacturer. The column Recommendations/R/ - deviations or failure to comply with recommendations contained in the booklet 'Protection against falls from a height'

Table 2. Summary on inspections of construction sites

The main violations of labour protection requirements by specific type of activity are described below.

1. In work on roofs (106 roofs inspected):
  - safeguards at the lower edge of the roof in 42 cases;
  - fastening at the ridge of the roof in 32 cases;
  - safeguards against falls through the roof covering in 14 cases.
2. In work on mobile ladders (689 ladders inspected):
  - work on the ladders cannot be safely performed in 129 cases;
  - unsatisfactory technical condition of ladders and their maintenance in working order in 120 cases;
  - the ladder has not been mounted on a safe and stable foundation in 86 cases.
3. Work on the scaffolding (282 scaffoldings inspected):
  - the middle handrail on the protective fencing is missing in 100 cases;
  - footpaths have not been installed in 139 cases;
  - there are no notices of warning on the scaffolding in 259 cases (although at present this requirement is not prescribed as compulsory by Latvian legislation).

Regional inspection	Total number of construction sites	New construction sites	Reconstruction	Repairs
Riga RSLI	146	56	53	37
Dienvidi RSLI	13	2	7	4
Kurzeme RSLI	23	7	3	13
Latgale RSLI	21	4	2	15
Ziemeļvidzeme RSLI	39	11	7	21
Zemgale RSLI	17	2	11	4
Ausrumvidzeme RSLI	16	3	2	11
<b>Total</b>	<b>275</b>	<b>85</b>	<b>85</b>	<b>105</b>

Table 3. Number of inspected construction sites by region

## Problems encountered during implementation

The project was initiated before the national legal act (regulations of the Cabinet of Ministers), worked out according to EU Directive 92/57/EEC, came into force after the preparation stage of the project. It did not affect the implementation of the project negatively, but it would have been advisable if these regulations of the Cabinet of Ministers had already been in force for a certain time.

## Results and evaluation of the action

The project has increased the knowledge of the actual situation in Latvia as concerns the safety of construction work. In addition the booklet was prepared

in two languages (4 000 Latvian, 2 500 Russian booklets). The booklets have been developed and published with the financial support of the Danish FEU programme, and contain recommendations on the application of safe work methods and equipment. The booklets have given the desired results, as there was a high demand from employers.

The usefulness of such types of campaigns was confirmed by the summary of the data relating to inspections and specific references from cooperation partners in Latvia.

Inspectors of the SLI acquired more extensive knowledge in the given industry and acquired skills in organising campaigns.

In the course of the project implementation, specialists from Denmark acted with an understanding of the local situation, and provided extensive and competent information about the use of good practice in EU countries.

Special note should be made of the work of Mr T. Modest, the project manager on the Danish side in planning activities and the advisory work undertaken by Mr J. Andersen in the course of the training process.

## Identified success criteria

- Involvement and cooperation of all seven regional SLI
- Campaign as inspection method
- Employers' and workers' support
- Selection of the theme: 50 % of all accidents in the construction sector are related to falls from a height
- Information available to the public

## Is the action transferable?

The method is transferable to other national and international organisations, if the following is taken into consideration:

- choose a very specific theme;
- set a shorter timeframe for the control campaign;
- use a campaign as one of the inspection methods.

## Statements

Danish partners:

- more informative materials and guidelines;
- more attention paid to construction sites;
- organisation of similar campaigns in the future.

SLI:

- necessary to involve other institutions/organisations responsible for construction sites (for example, municipalities);

- development of guidance manual for inspectors in view of the information summarised during the campaign, paying special attention to working equipment and occupational hygiene (sanitary equipment, rest rooms).

## References

Council Directive 92/57/EEC on the implementation of minimum safety and health requirements at temporary or mobile construction sites.

The booklet prepared during the project (Darba droieba un veselebas aizsardziba bevnieceba, Aizsardziba pret krišanu no augstuma, Riga, 2001) can be found at:

<http://osha.lv/publications/docs/buklets.pdf>

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# 4.12. WARNOW TUNNEL (GERMANY)

## Key points

- High quality of OSH management in a complex building project.
- Remarkable accident reduction.
- Intense cooperation between general contractor, subcontractors and labour inspectorate.

## Introduction

The building of the Warnow tunnel was a large construction project in north-east Germany on the outskirts of the city of Rostock. The tunnel underpasses the River Warnow shortly before the river meets the Baltic Sea. The length of the tunnel is 790 m. The realisation of this project required detailed cooperation between different elements of construction work, namely on-site concrete fabrication of tunnel elements, hydraulic engineering, diving work, road building, etc. The tunnel and the interchanges to the existing roads were built in a three-year period with a financial volume of approximately EUR 220 million. The tunnel itself accounted for approximately one third of this sum.

The main contractor was the construction company of the multinational French-based Bouygues Group, which acted as manager of the whole construction process. In total between 20 and 25 subcontracted companies worked at the site. For most of the companies the construction of such an immersed tunnel was a new experience. The main contractor applied its detailed HSE-Q system (ISO9000) to all contractors.

Main accident risks for the workers were as follows:

- falls from heights;
- being struck by falling objects;
- carbon monoxide intoxication inside the tunnel;
- drowning;
- accidents caused by moving devices and machines.

A significant OSH issue was the extended working time for some parts of the project — shift work, work on Sundays and public holidays.

## Background of the action

All construction work was carried out by subcontractors. The main contractor Bouygues did not have either a manual labour workforce or equipment on site.

They were present in the form of a management team of about 60 people, approximately 15 French and 20 German engineers, German accountants and secretaries.

The work was divided into 21 batches. The subcontractors for the most important works were German or international companies with their German subsidiaries, for example Groth for bridges, Peri as a supplier of formwork and scaffolding systems, Strabag for the tunnel elements, Heinrich Hirdes for the dredging work and, together with Volker Stevin (the Netherlands), for the immersing operations of the tunnel elements. Due to the importance of the project, the lack of experience with this type of tunnel and the necessity to control all the subcontractors in a foreign country, this construction site was a special organisational challenge for the prime contractor.

In accordance with European law (Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites)<sup>(2)</sup>, a safety and health coordinator was appointed.

Additionally the main contractor and the larger subcontractors employed OSH personnel, working only on this construction site. Due to the expected high number of subcontractors and certain special risks a detailed OSH plan was created.

### **Ambitions of the action**

The goal of all parties involved (main contractor, subcontractors, labour inspectorate) was to minimise the risks and to reduce the number of accidents as far as possible. At construction sites of this size a number of serious accidents could be expected. In many cases different companies had to work closely together, which generally causes additional risks.

Due to the lack of experience with this type of tunnel building, a more thorough planning was considered to be a sensible course of action.

### **Scope of the action — Basic technological information**

The tunnel is a so-called immersed tunnel, i.e. prefabricated tunnel elements or caissons are immersed into a trench at the bottom of the river. The tunnel consists of six prefabricated elements (caissons) of a length of 120 m, height of 8.30 m and width of 22.5 m. The weight was approximately 22 000 tonnes per element.

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(<sup>1</sup>) Article 3:  
Appointment of coordinators — Safety and health plan — Prior notice

1. The client or the project supervisor shall appoint one or more coordinators for safety and health matters, as defined in Article 2(e) and (f), for any construction site on which more than one contractor is present.
2. The client or the project supervisor shall ensure that prior to the setting up of a construction site a safety and health plan is drawn up in accordance with Article 5(b).

These tunnel elements were made in a dock, which was excavated at the edge of the River Warnow. The river and the dock were separated by a lock.

Due to the high requirements for stability of the hardened concrete, the flow of concrete had to be permanent. This required shift work and work at weekends.



*Prefabrication of two tunnel elements in the dock beside the river (courtesy of Heinrich Hirdes GmbH)*

When two elements were ready, the lock was opened and the dock area was flooded. The tunnel elements could be transferred to the river and stored until all elements were ready.

In the river a trench had been dredged by bucket dredgers, backhoe dredgers and other special equipment. The tunnel elements were positioned over the trench with the help of tug boats, supported by GPS. Ballast tanks (10 water basins per caisson) inside the tunnel elements were systematically filled with water, until the caissons started to sink step by step. The immersion process was carried out by an immersing pontoon and a floating crane.

After immersion, the elements were put together in the trench one after the other. It reached a maximal depth of 23 m (at the bottom) beneath the sailing channel. The elements were put on a temporary foundation in the bottom of the trench. They were fixed together with a chin-nose construction. After immersion, the elements were covered with sand, etc. to avoid any upwards buoying. A solid foundation was achieved by reclamation with sand under the tunnel elements through pipelines in the bottom of the elements.

Afterwards the construction workers had to enter the already immersed tunnel elements, which were closed at one end. Welding work and work with chain saws was performed. Diesel driven engines were used to transport the huge ballast basins away.



Divers were necessary for certain specialist works, such as unlocking the dock, fixing the floating reclamation pipelines at the pipelines in the tunnel elements, controlling the positioning of the connection between tunnel elements, etc.

*Immersion of the tunnel elements (courtesy of Heinrich Hirdes GmbH)*

## The main contractor

The main contractor was the French multinational group Bouygues. Bouygues introduced a number of strict measures to apply their safety, health and quality management standards to the construction site.

1. Bouygues appointed a coordinator for safety and health, as stipulated in the applicable European legislation, assisted by two safety specialists (later one).
2. Bouygues required a plan for health and safety from each subcontractor. This plan was integrated into a larger common OSH plan.
3. During the whole construction period Bouygues applied specific rules for detailed documentation. The contractors had to report how they fulfilled their obligations and which breaches of the OSH rules were registered.

Each subcontractor had to write a site diary including mainly general information about issues such as weather conditions, number of workers and equipment, duration of the work, the executed tasks, etc. If more than two weeks' delay occurred, the general contractor refused to countersign them, so that the subcontractor could not use them as proof in case of conflict. Based on the subcontractors' site diaries, Bouygues made its own integrated site diary for the contracting authority.

4. Bouygues demanded a technical risk analysis for certain tasks from all contractors. The following example shows the structure.

Description	Effect	Classification	Risk value (1–10)	Probability	Verified through	Prevention	Counteractive measures
Water leakage through the bulkhead	Stop all work	Damage to the construction	5	Very low	Pump alarm	QM	Injection

Risk analysis for the sinking process.

This risk analysis could also be used for OSH purposes.

5. Bouygues demanded a meeting of the safety personnel of all contractors and the labour inspectorate every four weeks.
6. Bouygues demanded, in some cases, standards that were higher than the German legal standards (wooden ladders instead of aluminium ladders, safer circular saws). In cases of doubt the labour inspection was asked for advice or decision.
7. Bouygues threatened to terminate the contract if contractors broke the rules repeatedly.
8. A detailed documentation in line with ISO9000:2000 was applied to all work.

## The subcontractors

The subcontractors were obliged to follow the rules issued by the main contractor Bouygues. For their own work they had to create an OSH plan, a risk analysis and the technical site diary. These obligations from the main contractor required in some cases the employment of additional OSH personnel.

### **The labour inspectorate**

The labour inspectorate was involved in the whole OSH organisation of the construction project. It supervised the existence and permanent adaptation of the OSH plans.

At critical points they were asked to decide about the measures to be taken.

Such cases were the extension of the working time (shift work and work on Sundays and public holidays) in the cases of permanent concrete work and for dredging work. Both applications by the contractors were accepted as being valid due to technological reasons.

The labour inspectorate also applied strict rules for emergency measures in the tunnels during work. The tunnel elements were equipped with safety equipment such as evacuation signs, extinguishers and first-aid kits.

A special problem was the air ventilation in the tunnel elements during work. There was a permanent control device applied to keep the oxygen content over 19 %. The air ventilation system was extended according to the progress of the tunnel.

Fungi growth was detected on the roof of the tunnel elements during storage in the river. The labour inspectorate ordered an analysis of the type of fungi. It was, however, found not to be dangerous. The fungi could be avoided by using a different mould release oil.

Bouygues regarded some of the practices at the construction site as unsafe in comparison with their own standards. One example here is the use of aluminium ladders instead of wooden ladders. Wooden ladders are more stable than aluminium ladders. These ladders, although not as safe as wooden ones, can be used according to German regulations.

### **Problems encountered during implementation**

For most of the subcontractors, the project was their first experience of this type of construction, which meant that there was a learning and adaptation process. Additionally, there were issues relating to the documentation demanded by the principal contractor: Some subcontractors who were involved in the less risky activities on site did not follow the strict documentation rules, while another highly specialised subcontractor was reluctant to record too much as it was seen as a threat to commercial confidentiality.

### **Results and evaluation of the action**

All interview partners were highly satisfied with the organisation of safety and health, although there was significant resistance at the beginning to fulfilling all the detailed documentation requirements.

The number of accidents could be limited to one serious accident: an employee of a subcontractor, who was struck by falling objects. A number of iron bars were incorrectly lashed together before being lifted with a crane. They fell, causing head injuries to a worker.

## Identified success criteria

The quality management and the strictness of the main contractor seemed to be one of the basic success factors in the view of the participating contractors.

The labour inspectorate was also successful in intervening in certain situations and in applying the existing legislation to the situation at the construction site. Their activities seemed to have a very positive effect on safety and health, particularly for the work in the closed tunnel elements.

## Is the action transferable?

In similar cases many of the solutions can be used again. This applies to the documentation management, the monthly meetings, the risk analysis, the emergency measures in the tunnel elements, the ventilation measures in the tunnel, and the control of oxygen,

## Statements

‘We liked the ambitious OSH approach of Bouygues, which brought all contractors up to a high level.’ (Mr Markgraf, Labour Inspection Rostock)

‘We needed some time to realise the high demands for OSH and risk analysis. But a good preparation was useful in order to realise the complex tasks.’ (Mr Plantholz, Fa. Heinrich Hirdes GmbH)

## References

A completely separate study about the work organisation was made by Thierry Cerisier for an examination at a Swedish university. Some information from this document has been used for this case study.

Cerisier, Thierry: *Works foreman assistant — Assistant to the engineer responsible for the maritime work at the construction site of an immersed tunnel in Rostock* (Germany), Examensarbete 443 Kungl. Tekniska Högskolan, Avd. för byggandets organisation och ekonomi, KTH 2003.

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## 4.13. UNION PARTICIPATION AND SUPERVISION OF THE 'TERRA MÍTICA' THEME PARK PROJECT (SPAIN)

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### Key points

- An agreement enabled the creation of alternative figures to represent workers in the field of occupational risk prevention on the worksite.
- These figures monitored the effectiveness of the preventive measures and proposed action.
- Their presence on the worksite was constant.

### Introduction

The case presented in this report refers to the union representation for the prevention of occupational risks during the construction work of the 'Terra Mítica' theme park grounds, located in Benidorm (province of Alicante, Valencia region) from 1998 to 2000. The development enterprise Terra Mítica Parque Temático de Benidorm SA was established by the Valencia regional government to build the park infrastructure together with private companies.

This was large-scale works which included the building of auditoriums, elevated walkways, water channels, gardens and so forth, and covered over 1 000 000 m<sup>2</sup> of land. A peak of 2 000 workers was attained, and the usual figure of 100 companies present on the site at once, including contractors and subcontractors, was often surpassed.

### Background of the action

One of the construction industry's characteristics is that, while prevention plans are usually designed according to legislation, they are normally extremely general and are not complied with. Because the plans lack specifics, there is a consequent lack of control of what contractors and subcontractors actually do. Furthermore, coordination of tasks leaves much to be desired.

In Spain, the absolute majority of workers in construction have precarious (very short-term) employment contracts. This makes choosing representatives for exercising their right to participate in prevention very difficult, and is especially serious as it weakens their ability to refuse to work when there is a serious or imminent risk. They should be able to exercise their right to stop work on the project.

The tremendous growth in activity experienced in this sector has meant that workers have been recruited with very little training in general and nearly no

training at all in prevention. This reduces their ability to evaluate risks and propose preventive alternatives. In addition, the large numbers of recently arrived immigrants on worksites add communication difficulties to this problem.

In Spain, workers' health and safety representatives on the worksite are chosen among workers' representatives. In practice, there are no representatives in the workplace on many construction sites, meaning that one of the essential preventive mechanisms of the framework directive for ensuring an effective preventive organisation is actually lost. In this context, in order to exercise the functions foreseen for prevention delegates, unions have demanded to seek alternative means to ensure this function of controlling the conditions on the worksite, including the use of the stipulations in Article 35.4 of the Spanish Occupational Risk Prevention Act providing for other forms of worker representation. Thus, if so decided in a collective agreement, workers can choose representatives within a sector, a geographical scope, or even for a given project, which is what was done in this case.

Given the foreseeable scope and complexity of the Terra Mítica project, the General Directorate for Labour of the Valencia regional government, as promoter of the project, decided to accept this idea and develop it through an agreement between the Comisiones Obreras (CC.OO.-PV) and Unión General de Trabajadores (UGT-PV) unions in Valencia <sup>(3)</sup>.

### **Ambitions of the action**

The agreement enabled the creation of the Commission on Occupational Risk Prevention Monitoring and Follow-up (*Comisión de Control y Seguimiento en Materia de Prevención de Riesgos Laborales*) and of the figure of Union Supervisor for Prevention and Occupational Health (*Supervisor Sindical de Prevención y Salud Laboral*), also a member of the commission. Both of these mechanisms were aimed at implementing union participation in prevention management, thereby '...ensuring the best application of the prevention measures in the project'. Both of these figures were given the power to exercise direct control and monitoring in the working area so that risk situations could be identified and corrected as soon as possible.

The commission's specific task was that of advising and putting together a programme to follow up on working conditions and risk prevention, defined as:

- establishing procedures for evaluation and control, setting dates in order to monitor the various plans and propose control methodologies;
- coordinating the actions of union supervisors and safety officials from Terra Mítica,
- issuing reports; and
- performing actions tending to improve the framework of industrial relations.

<sup>(3)</sup> 'Cooperation agreement between the unions UGT-PV and CC.OO.-PV and Terra Mítica Parque Temático de Benidorm SA on occupational risk prevention'.



The supervisors' functions were defined as:

- (a) ascertaining knowledge on the safety plans;
- (b) proposing preventive alternatives;
- (c) implementing action aimed at prevention in the focal points of risk;
- (d) reaching consensus on the priority of collective prevention intervention;
- (e) ensuring that individual protection material is distributed and used;
- (f) dynamically monitoring and following up on the effective application of preventive measures;
- (g) ensuring the participation of workers in the monitoring of the plan;
- (h) worker training on prevention measures to be adopted in the various phases of the project.

Although the main motivation for signing the agreement was initially to reduce the rate of accidents, the scope of risks addressed was not initially limited.

### Scope of the action

In order to be recruited, supervisors had to be technical experts in prevention and specialised in the sector. According to the agreement, there was to be a total of two and an additional supervisor was to be added for every 250 workers hired. Later, the advisability of having two supervisors on every shift meant that there were finally a total of six supervisors.

In order for the supervisors to exercise their function, that is the direct control of the safety conditions, and to facilitate their direct and continuous presence on the worksite and the direct communication with the workers and intermediate managers, the supervisors were provided with material means (an office with two rooms and a meeting room, transportation in order to move about the worksite, and fixed and mobile phones and other communication devices).

During their visits, on which they wore identifying garments, the supervisors observed the working conditions and issued monitoring reports serving to demand solutions to risk situations whenever the situation observed did not warrant stopping the project. When a stoppage was warranted, the presence of the safety coordinators was required on site.

The Monitoring and Follow-up Commission was made up of the supervisors on the union side and, on the side of the developer, of the legal project supervisor (who presided over the commission), the technical management, the prevention service, the safety and health coordination (hired from specialised companies). In all, there were eight members, four representing the developer, and two designated by each of the two signatory unions. The commission met every 15 days to evaluate the preventive situation and the problems encountered.

The host of companies and self-employed workers intervening in the project meant that a strict control system for monitoring the entry into the worksite was implemented in order to ensure both that the machinery met the requirements and that the workers entering the site had been properly hired and all had received the necessary training in prevention.

### Problems encountered during implementation

Because this control intervention came on top of the usual preventive management mechanisms on the worksite (i.e. safety coordinators and prevention services) and on top of quality management (which in this case was not integrated into prevention), tension could potentially have reduced the preventive effect of the mechanisms in place. In practice, what actually usually led to tension was the supervisors' demand for the immediate intervention of the safety coordinators, when their presence was actually required to dictate the pertinent orders. However, the developer's clear determination that everyone cooperate in eradicating risk factors meant that all of the players involved did cooperate, facilitate, and take advantage of the supervisors' work.

There was also an atmosphere of great tension at certain meetings. In order to reduce this tension and steer the work in the right direction, on one occasion, the Valencia region's Director-General of Labour was called in to bolster the preventive will of the developers.

### Results and evaluation of the action

One of the Monitoring and Follow-up Commission's tasks was to evaluate the situation on an ongoing basis. The quantitative figures were monitored throughout the work and, upon finalisation, a summary report was drafted detailing two grave and traumatic accidents having occurred during the project. This is considered to be a low figure.

From a qualitative standpoint, all of those participating were very pleased to have contributed to the implementation of this initiative. For instance, in the report issued upon the finalisation of the project, the safety and health coordinator stated that 'this project can be considered emblematic and can be taken as a reference for all large-scale projects'. This model has in fact been used in other public development projects both in the Valencia region and elsewhere, although without the same patently positive results obtained here.

One method for improving this type of intervention, suggested by the union side, was to bring the union participation forward to the planning phase when both improvements in preventive planning and express prohibitions can be made. In this case for instance, requisites for contracting machines and scaffolding could have been stiffened during the planning phase.

### Identified success criteria

The first-hand presence of the supervisors on the worksite enabled direct control of the real working conditions. However, for the true effectiveness of this function, activism is required with an independent opinion based on technical capability.

The fact that the supervisors were not dependent on either the developer or the prevention contractors but rather on their respective unions meant that the prevention standards were raised for all of the players involved.

Also, the fact that these tasks were performed by persons from the union sphere probably allowed for feedback thanks to fluent communication with the workers.

But none of this would have been enough to bring about the appropriate level of prevention on the worksite had a technically sound prevention organisation

not been provided for. On this occasion, the prevention services and project coordination had been contracted, although the company chosen was well known (Bureau Veritas). Lastly, it must be noted that the entire preventive organisation reflects the firm preventive will of the developer.

### **Is the action transferable?**

In view of the transposition of the framework directive and of the collective bargaining tradition in the different European Union countries, we believe that this experience is perfectly exportable and can be taken on board and implemented in any other EU country.

### **Further information**

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### **Statements**

‘We need to act and intervene in novel ways that protect workers on the worksite by applying a culture of prevention.’ (Román Ceballos, Director-General of Labour and Labour Safety in the Valencia region)

‘If you don’t actually get right into the working area, everywhere on the worksite, right at the foot of the work, then the benefit of the whole preventive flowchart doesn’t get there either.’ (Francisco Velasco, Fecoma CC.OO-PV)

# 4.14. EFFECTIVE SAFETY REPRESENTATIVES MEAN SAFE SITES (UNITED KINGDOM)

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## Key points

An active safety representative can:

- improve communication between employer/principal contractor and worker;
- assist management in raising awareness of health and safety issues and help in training;
- work to reduce risks by reviewing and investigating incidents to ensure lessons are learnt.

## Introduction

Construction sites are by their nature temporary places of work, with a continually changing workforce from many employers. This can lead to a lack of effective worker safety representation on building sites. This case study shows how effective worker representation can be achieved and its benefits to both workers and employers.



The area of Paternoster Square, located close to St Paul's Cathedral in the City of London, is becoming a pedestrian plaza, with the adjacent buildings also being developed. Bovis Lend Lease, one of the world's leading companies in the project management and construction services industry, began work on the project in October 2001, with it being completed in March 2003. At the peak of construction activity there were 1 250 workers on site. Other Bovis Lend Lease sites surrounding Paternoster Square included Juxton House (100 workers), Queen Victoria Street (95 workers), and 10 Gresham Street (248 workers).

Pat Dowling worked for Bovis Lend Lease on the Paternoster Square development. He is also a worker safety representative under UK legislation, and belongs to the Union of Construction, Allied Trades and Technicians (UCATT). So successful has he been in the role of safety representative that he received the accolade of 'Number 1 Worker 2002' at the UK construction industry's Working Well Together (WWT) 4Cs awards.

### **Background of the action**

In 2001/02, 79 construction workers (including 20 self-employed persons) were killed in the UK, a fatality rate of 4.2 per 100 000 workers. This figure of 4.2 compares unfavourably with the all-industry average of 0.88. In 2001/02, it is estimated that 137 000 people whose current or most recent job was in the construction industry in the last eight years suffered from an illness that they believed was caused or made worse by this job.

Safety representatives in the United Kingdom have specific rights under law. The main rights are:

- to investigate potential hazards and dangerous occurrences and examine the causes of accidents;
- to investigate complaints by members;
- to make representations to the employer on health, safety and welfare;
- to carry out inspections;
- to consult with, and receive information from, health and safety inspectors in representing their members;
- time off with pay for the investigation of potential hazards and members' complaints;
- the right to publicise actions to be taken following inspection;
- the right to consult with members, Health and Safety Executive (HSE) inspectors and employers;
- the right to attend designated training courses;
- the right to attend safety committee meetings; and
- the right to be consulted in good time on relevant health and safety matters.

### **Ambitions of the action**

On a large job such as Paternoster Square, the goal of all involved is the efficient completion of the job while avoiding harm to workers.

UCATT was able to negotiate with Bovis Lend Lease and secure the appointment of a Trade union convenor for this project who would be responsible for consultations between management and workers and also be someone who plays a significant role in promoting and enforcing safe working practices amongst all the workers on site. The convenor is not an employee of the trade union but undertakes a full-time union role while continuing to be paid by his or her employer.

In addition, Bovis Lend Lease encourage good safety and health practice on site by planned activities and incentives, ranging from a 'Contractor of the Month' award, the monthly 'Safe Person' award, with a prize of GBP 100 in vouchers, and a monthly safety quiz with GBP 100 in vouchers as the prize.

### Scope of the action

Pat Dowling was present on site throughout the whole period of the contract from start to finish. Bovis Lend Lease is a major employer in the construction industry and has a good relationship with UCATT. They have a commitment to safe working practices and are prepared to demonstrate that commitment through the appointment of worker representatives as well as other practices. While Bovis are generally considered to be a safety conscious employer, the degree of commitment does vary from site to site, depending upon the attitude of the site management and especially where there is no convenor.

Mr Dowling's actions as safety representative for UCATT on the Paternoster site have a number of facets, covering the whole scope of worker safety representative activity.

#### *A spokesperson for the workers*

Successful organisations actively encourage and support consultation, and Mr Dowling's first role is to act as a spokesperson for the workers on site. Mr Dowling has acted as a facilitator by encouraging workers to raise safety problems with him. This has been effective for the reasons outlined below.

- As someone who is a tradesperson who has worked on construction sites all his life, he understands the issues that confront workers every day.
- He is seen as one of their peers and has quickly gained a reputation for getting problems sorted out with management.
- New workers meet him at the induction sessions he runs and know that he is on site all the time.
- He advertises his mobile telephone number on posters around the site and makes it clear that he is happy to deal with queries and concerns from workers outside working hours.
- He is able to correct unsafe working practice as he goes around the site and if management are failing in their duties he will take the issue up with them. This ability to pass on his knowledge about safety and a reputation for getting problems resolved soon gave workers the confidence to raise issues with him.
- Pat held a weekly meeting in the canteen which workers were invited to attend. The meeting was also attended by a member of the management team and workers were able to raise safety issues directly with management with the confidence of having Pat there and knowing that they would not be penalised for doing so.

This approach has led to an increased awareness on site of the issues that can cause accidents. By then taking the matters raised to site management and getting them resolved, he not only reduces the risk of accidents and ill health, but has also earned the trust of both workers and management.

As this was a large site with several separate buildings, there was a separate management team for each building. Pat attended a weekly meeting with the site management for each building where he raised issues relating to health and safety and a joint audit was undertaken of the issues from the previous week. In cases where the safety issue was more urgent, Pat would speak to management on an ad hoc basis to ensure the issue was resolved promptly. On the whole the relationship was good, especially with the Bovis Health and Safety Officer but there were odd occasions when the threat of enforcement action by the HSE was needed.

#### *Contact with the enforcing authorities*

Mr Dowling looks to work in partnership with site management. However, he remains independent of the management structure, being a union safety representative. In this position, he can look to involve the HSE, the enforcing authority, where necessary. This step was not necessary on this site, but Mr Dowling's position allows all workers on site, whether employees of another contractor or self-employed, to have confidence in his independent position. Whenever an HSE inspector visited the site they always asked to see Pat before seeing the site management. This way they could be sure that they were aware of any issues that needed their intervention. As a result of the safe way in which the site was operated, HSE used photographs they had taken for a guidance booklet on using tools safely.

An occupational safety and health problem encountered on site was the late arrival of adequate welfare facilities. However, Pat was instrumental in achieving a solution to this problem — his position as worker safety representative ensures that action is taken when he raises issues from the workforce and also with the enforcing authority. Site management soon recognised that they would have to remedy the problem or else Pat would keep chasing them and ultimately call in the enforcing authority, an outcome to be avoided.

#### *A mentor for safety*

Knowledge of occupational safety and health can come from a variety of sources. It can come down from the contractor, be brought on site by workers, and it can be shared on site. Mr Dowling carries out a valuable role in informing and reminding workers of safe working practices by being on site, being aware and undertaking toolbox talks. The workers know that he is approachable and has the information to be able to advise them of the correct safe practices for any particular work they are doing. He can also arrange for appropriate training through UCATT for CSCS or other skills.

Because there were a large number of companies on site, Bovis in conjunction with Pat insisted that each company carried out a toolbox talk each week and specified the topic to be covered. Pat was responsible for talking to the workers and questioning them about their toolbox talk to ensure that it had been carried out and that the information had been absorbed.

Pat also carried out his own toolbox talks whenever it was appropriate and had a range of both UCATT and HSE leaflets to distribute to the workers.

### *Reviewing progress and investigating incidents*

The HSE assessed the cost of accidents at work. On a construction site studied, losses on a GBP 8 million construction project were calculated at about GBP 700 000, or about 8.5 % of the tender price. Had some 'damage only' incidents caused injury, then this would have been even higher. It seems that, in the construction sector, there are many incidents that have the potential to kill but may end up causing only material damage.

This lesson has been taken on board by Mr Dowling, who was active in investigating incidents, even though there were no significant injuries on this site. On one occasion, some pallets fell which could have resulted in crushing injuries to workers, and the safe stacking of pallets and other materials was used as the topic for the toolbox talk that week.

On another occasion, there was a potentially fatal near miss incident when a steel beam was being lifted onto the third floor by crane. It had to be swung into position so it could be bolted but this was an illegal procedure. While it was being lifted it caught on one of the steels and the crane driver tried to lower it down to free it, but this process loosened the chains, the beam slipped through the chains and fell down three floors. There were four men in the vicinity when it hit the floor and they were very lucky not to have been hit by the beam.

This was close to the perimeter of the site and it hit the hoardings and made them collapse. There had been a pedestrian walking past there immediately before the collapse. While investigating the incident Pat noticed a CCTV camera on a nearby building and was able to obtain the footage from a third party and is now using that to educate workers of the devastating consequences of not following correct safety procedures. The footage was made into a video to show the consequences of not carrying out a risk assessment and following the method statement. If the pedestrian had been in that location 25 seconds later she would have been killed. The video was shown to all the workers on the site and has been used throughout Bovis Lend Lease sites. It carries a very clear message that cutting corners can cost lives.

### **Design issues**

The investigation of this accident also highlighted an important aspect of design, and the impact on health and safety it can have.

The steel beams, such as the one involved in this accident, had been specified with pre-drilled holes. This was to enable lifting shackles to be fitted through the holes and enable them to be lifted without the need for chain slings to be wrapped around the beams. This made the lifting operation easier, and consequentially safer. Hence health and safety had been 'designed in'.

However, the steel beam that was dropped was delivered with no pre-drilled holes. The resultant lift was carried out using chain slings alone. The beam slipped out of the slings and fell to the ground. This would not have happened had the beam been pre-drilled, and lifting shackles used.





### **Problems encountered during implementation**

A worker representative in the UK construction industry faces many obstacles, not least being recognised by the employer as someone who can make a significant contribution to improving the health and safety record on site. There is a long tradition of many employers dismissing workers who become active in their trade union and this is a real barrier to measures to improve health and safety in construction. Pat Dowling himself said that in the 1980s when work was scarce he did not feel able to become a worker representative as he would have found it very difficult to secure work.

One of the difficulties is that there are many employers on site as the work is subcontracted, with different areas of expertise being undertaken by smaller and smaller subcontractors. They may not have the resources or the inclination to promote safe working practices, as they are perceived as costing money.

### **Results and evaluation of the action**

The success of Mr Dowling's actions can be judged by the fact that he received the 'No 1 Worker' award at the WWT 4Cs construction awards. These awards recognise best practice in health and safety across the construction industry, and are made in the areas of cooperation, communication, competence and commitment. The No 1 Worker is for an individual who has made a significant contribution to health and safety in construction. A special award in this category was made for the first time this year.

The Working Well Together (WWT) campaign is the country's largest construction health and safety campaign, with over 4 000 participating organisations. It was launched by the HSC's Construction Industry Advisory Committee (CONIAC) in 1999. WWT aims to improve performance in four key areas for health and safety: cooperation, communication, competence and commitment.

UCATT have long recognised that, by having trade union trained safety representatives on site, the accident rate can be halved. To have someone as committed and knowledgeable as Pat is a credit to the union and we were

extremely pleased that Bovis were able to overcome their initial concerns and that they now welcome the opportunity to have Pat as a convenor on their site. They have demonstrated this by transferring Pat to a new site at Regent Street London now that the Paternoster Square job has finished.

### **Identified success criteria**

Bovis Lend Lease management pride themselves on being safety conscious but they cannot be on site all the time. The workers have some knowledge of health and safety but on many sites this is not enforced and they need to learn more. Pat is able to act as a facilitator between workers and management and works very closely with the Bovis health and safety officer to ensure that both workers and management are fully aware of their health and safety responsibilities and are able to contribute to safe working conditions.

### **Is the action transferable?**

The basis of Mr Dowling's success is effective communication. Mr Dowling successfully acts as a conduit for information, both from management to workers and vice versa. This apparently simple action is dependent on Mr Dowling being seen by the workers as someone with credibility and knowledge, and by the employers as a reliable communicator, able to prioritise risks.

### **Statements**

Colleagues from the Paternoster development, when nominating Mr Dowling for the WWT award, said: 'Pat is always thinking of his fellow workers. Building sites would be a lot safer if there was someone like Pat on each of them. He makes you think about safety and how your family would cope if you got injured. He is one of the best. It would be good to see him get a reward for all the good he does on site.'

UCATT are proud to have provided Pat with the training needed to undertake this important role. However, many other dedicated UCATT safety representatives throughout the country replicate the work he does. UCATT are committed to working with employers to improve safety on construction sites and were delighted when his contribution to improving safety was recognised at such a prestigious event as the WWT awards.

Paul Sims, the Project Manager for Bovis Lend Lease, at Paternoster Square states: 'We had an excellent relationship with Pat and he contributed significantly towards the development of a positive health and safety culture on this project. I am happy to say this is continuing at another project where Pat is working with us now.'

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### **Web links**

<http://www.ucatt.org.uk/>  
<http://www.wvt.uk.com/>  
<http://www.tuc.org.uk/>  
<http://www.bovislendlease.com/>  
<http://www.hse.gov.uk/>

# 4.15. CONSTRUCTION OF STADE DE FRANCE (FRANCE)

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## Key points

- The risks of damage to health during construction of the structure, due to a contaminated land, were considerable, especially risks related to the release of gases in large quantities during the foundation earthworks.
- Important measures were taken to combat pollution during both the construction and operation of the structure.
- The project was successful as no health problem, psychosis or exploitation of pollution risks emerged, thus demonstrating that accurate information reached all those involved in the work.
- A structure maintenance plan was allowed for, as of the stadium design stage, in order to prevent falls from a height during roof maintenance work.

## Introduction

The football World Cup, one of the most widely watched events in the world, has major implications for the country hosting its organisation.

The construction of Stade de France (a stadium with a capacity of 80 000 people) near Paris for the 1998 football World Cup was therefore of prime importance to meet all the obligations involved in organising such a one-off event. There was also a concern for the permanent benefits of such an expensive investment for the national budget.

The Saint-Denis site, 1 km away from Paris, offered numerous advantages for construction of the stadium (near to Paris, numerous means of transport). On the other hand, major problems of soil pollution and groundwater pollution, to which can be added the release of toxic gases, were revealed by the initial soil reconnaissance studies in 1993.

Given the exceptional nature of this environment and the high level of media coverage, measures were taken to combat pollution during both the construction and operation of the structure.

The implications, the numerous players involved and the constraints of the project (very tight deadlines, high cost, technical constraints) underlined the difficulties encountered in solving occupational health and environmental problems.



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### Background of the action

Of the two or three possible sites near the capital, Saint-Denis offered numerous advantages (located 1 km north of Paris, linked by two suburban train lines, one underground rail line, buses to Paris and Roissy Charles de Gaulle international airport, as well as two motorways). In addition, the site selected represented no land problem (large area, public property and derelict site), which limited the impact on work completion times. The decision to choose Saint-Denis was also supported by a political desire to rebalance the Paris urban area, which is more disadvantaged in the north and east.

However, the first soil reconnaissance studies in 1993 brought to light major pollution problems. The site was occupied, between 1882 and 1969, in succession by production and storage activities relating to gas, coal, chemical products, coke and then road tar. The origins of this pollution are apparently related to the infiltration of solvents and hydrocarbons into the ground during operation of the factories.

These pollutants were trapped in the calcareous marls of the subsoil, at the same time as the groundwater level was rising (end of exploitation of the underground aquifer after the departure of the industrial firms).

The pollutants identified by this study in 1993 took the form of various polycyclic aromatic hydrocarbons (slabs of tar), gaseous traces of white spirit, ammonia and sulphur dioxide.

Moreover, the detection of hydrogen sulphides (H<sub>2</sub>S) and benzene compounds in addition to the pollutants already identified (when sinking pollution reconnaissance wells at the start of the works in 1995) alerted the safety and health protection coordinator (CSPS), the works management and the OSH department of the Île-de-France regional health insurance fund ('Caisse Régionale d'Assurance Maladie d'Île-de-France', the official social security organisation for occupational risk prevention) before the earthworks commenced below the groundwater level.

The risks of damage to health during construction of the structure were considerable, especially risks related to the release of gases in large quantities during the foundation earthworks.

This is because, apart from risks of explosion, the gases present on the site can cause:

- acute intoxication (H<sub>2</sub>S);
- anoxia (hydrocarbons);
- occupational diseases through contact with the skin (benzene compounds).

Furthermore, the hydrocarbons and benzene compounds are carcinogenic substances.

The peak number of employees working on construction of the Stade de France exceeded 1 600 people. To this must be added over 500 workers working on the other projects adjacent to the 'ZAC' mixed development zone of Cornillon North (stadium annex, shopping centre, 165 000 m<sup>3</sup> retention basin, road access).

The risks for the operational phase were the same as those for construction of the stadium. This is because the foundations, and especially the perimeter ditch which enables the configuration of the stadium to be changed (clearing the athletics track), went down below the level of the polluted aquifer.

The lifetime of the foundation concrete would therefore be highly compromised in the case of conventional concrete, without special pollution treatment. Moreover, the toxic gas exhalations would pose serious problems over a long period of time both for the users and for the structure itself.

A structure maintenance plan was allowed for, as of the stadium design stage, in order to prevent falls from a height during roof maintenance work. The stadium architects opted for a very high roof.

The risks related to falls from a height on the roof are obvious, whatever the work performed on it. It is for this reason that the designers examined upstream (at the initial design stage) the roof's construction and maintenance and operating procedures.

The coordinator initiated and coordinated, with the support of the OSH organisations, the study of risks during work on the roof.

The principles for work performed on the roof (maintenance) are:

- access and movement on the same level;
- rapid dismantling on the site, with repair in workshop;
- access control and accompanied site visits;
- systematic accident prevention plan.

### **Ambitions of the action**

Given the extent of these various sources of pollution and the risks they represented not only for the health of workers during construction of the stadium but also for the public during operation of the stadium, a land decontamination strategy was therefore put in place.

### **Scope of the action**

#### *1. Land decontamination strategy*

Preventive measures were put in place. The working out of these measures coincided with the introduction of the new regulations transposed from the European directive on 'Temporary or mobile construction sites' which provides for management of the activity of all the contractors on the site by a safety and health protection coordinator and for allowance of safety measures during subsequent maintenance work as of the design stage.

These measures are outlined below.

- Risk assessment: Risks related to chemical products, which are not very well known on civil engineering sites, require unflinching discipline and speed of reaction.

The contracting authority therefore had a map of site pollution established (types and quantity of pollutants). The OSH department of the regional health insurance fund specified the associated risks and helped determine the preventive measures appropriate to the project configuration.

- Preventive measures: The earthworks (until the end of work) were subjected to atmospheric measurements (O<sub>2</sub> and H<sub>2</sub>S contents) before each work shift and at each start of excavations by the contractors, combined with permanent detection monitoring performed by an employee of the main contractor responsible for construction. The mobile fans provided were used only once.
- Extension to the entire site and coordination: The regional health insurance fund extended the pollution prevention measures taken on site to the other projects in the zone.

The developer of the 'ZAC' mixed development zone, representing the State, was also called on to coordinate management of these risks on the site.

The meetings between contracting authorities and coordinators enabled coordination of work and harmonisation of preventive measures against these hazards.

- Information for all those involved in the work: The analysis of risks and preventive measures, summarised in an addendum to the PGC (general coordination plan), acquired contractual value. This information was presented to each contractor and to each worker on the site. 'Mr Pollution', in charge of atmospheric monitoring, also helped to keep the threat at an appropriate level.

The sick bay on site and the emergency aid service were associated with this site supervision and with the alert measures.

Then, three types of treatment were employed to treat the hazards at source and enable the construction and operation of the stadium:

- surface decontamination of the land by the last operator (Gaz de France utility company);
- isolation of the zone for treatment of the aquifer (peripheral confinement wall);
- gas drainage network under the structure.

#### ■ *Surface decontamination of the land*

The land is polluted by the residues of industrial activity. It was therefore treated by incineration of the most heavily impregnated earth (approximately 55 000 m<sup>3</sup>) and by forming a biological mound with the remainder (approximately 15 000 m<sup>3</sup>). Its last occupant restored it to its owner (the City of Paris) following this decontamination of the surface ground.

#### ■ *Isolation of the polluted zone for treatment of the aquifer*

The aquifer could not be decontaminated in localised fashion on this site and in a permanent way. It was therefore decided to build, before the foundation works, a hydraulically sealed confinement wall around the structure in order to prevent displacement of the water and the hydrocarbons floating on the roof of the aquifer. This wall of grout and bentonite (1 100 m long, 14.5 m high, 60 cm thick) goes down to 6 m below the mean upper level of the aquifer. Inside the enclosure, the pollutants are extracted and treated.

#### ■ *Treatment of toxic gases*

Finally, a venting system for gas decontamination was installed to eliminate the pollutants released in gaseous form.

A network of drains was installed under the field, rendered tight by a PVC diaphragm under the stadium slabbing. It collects the constant gaseous exhalations and conveys them to a treatment centre on the site (two catalytic oxidisers) via a suction system (eight booster pumps). This gas decontamination venting system provides for the establishment of a permanent slight vacuum in the drains. Sensors installed under the structure, divided into 24 protected zones, measure the gas concentrations and are linked to an external remote supervision system. The treatment of the 24 zones can thus be adapted individually.

## 2. *Structure maintenance plan*

The roof is in the form of an elliptical disc perforated in the centre, having the cross-section of an aircraft wing. This surface area of 60 000 m<sup>2</sup> is suspended from 36 steel tower masts, more than 30 m above the ground.



Risk analysis led to the adoption of three roofing zones, in which maintenance methods were designed to eliminate risks related to falls from a height:

- under the roof covering ('velum') by cradle;
- in the roofing ('plenum');
- on the extrados of the roof ('tectum').

The flow of people going to their workstations at the roof level was organised in such a way as to give priority to protected routes. Likewise, the physical locking of roof access points is the principle adopted to avoid exposure to falls.



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### Problems encountered during implementation

The main problem encountered during construction of the stadium was the underestimation of gas emissions and hence of the process of gas treatment by venting. The gas present on the site was four to five times greater than expected. The treatment of these gases was therefore not optimised and the technique used could have been more efficient and rapid if the forecasts had been accurate.

### Results and evaluation of the action

Following a World Cup whose success reflects the success of the stadium, the result of the measures taken to prevent pollution affecting the health of workers during construction work is highly satisfactory.

In particular, although two alerts during the project ( $O_2$  content below the threshold set on the detectors) made it possible to confirm that everyone understood and complied with the measures specific to pollution risks, no health problem was reported throughout the work on the site as a whole.

As a corollary, no psychosis or exploitation of pollution risks emerged, thus demonstrating that accurate information reached all those involved in the work.

The contracting authority fulfilled its role well, deploying major resources in a very short lapse of time. The risks targeted were thus controlled, and the deadline was met despite the constraints set (confinement wall, venting, etc.).

The current operator of the stadium has a structure in which pollution of the site does not adversely affect operations. At the same time, the maintenance of decontamination systems is provided for in the DIUO (documents for subsequent operations on the structure) drawn up during the project.

The application of safety and health protection coordination therefore made it possible to face up very efficiently to a major risk that was underestimated at the start of works. This coordination continues to prove its effectiveness.

The programme factored in, as of the structure design stage, the prevention of risks — especially those related to falling — during subsequent maintenance work and operation.

The safety and health protection coordinator was active during the design phase. He initiated and coordinated risk analysis. He ensured that appropriate preventive measures were allowed for during design.

The *Dossier d'interventions ultérieures sur l'ouvrage* (file for subsequent operations on the project) served as a joint tool to identify risks, record the measures taken and commit all those taking part in the work.

The project management process enabled all those involved in the work to exercise their responsibilities knowingly. The risk analysis supported by the coordinator, as of the structure design stage, involved the consulting engineer in technical and aesthetic decisions, the owner in the economic options and the contractors in solving the safety problems posed, especially for work at a height.

And everyone gave extra thought to risk prevention in their work.

The second highly positive aspect of this experience was to show the value added by the safety and health protection coordinator. Neither a constructor nor an OSH institution, throughout the project's life he supports the preparation of maintenance operations and reduces very markedly the scope for imprecision in the area of safety.

His presence during the design and construction stage, and the authority assigned to him and reasserted by the owner, were two important factors of success in his assignment.

These are fundamental aspects of the procedure to allow for risk prevention as of the design stage.

### **Identified success criteria**

The risk assessment performed and the coordination of the various players on the project (owner, OSH department of the regional health insurance fund, various contractors performing the works, etc.) made it possible to clarify the risks and to apply the appropriate measures for the project configuration. The involvement of the contractors working on this site should also be emphasised, especially the information and training measures that they developed for their employees.

The role of the coordinator, especially on such large projects, should also be underlined: these joint risks were taken into account as soon as they were identified, and they were managed under his vigilant supervision.

### **Is the action transferable?**

This action is transferable to other sites that are heavily polluted. However, the technique of complete isolation of the aquifer is very costly and can be reproduced only in urban or densely populated areas.

The importance of comprehensive risk assessment should again be emphasised, and the involvement of all the players on the project is essential to make suitable allowance for the recommended preventive measures.

### **Further information**

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# 4.16. INTEGRATED SAFETY PROJECT FOR THE INSTALLATION OF SPECIAL SYSTEMS IN THE ST FRANCIS COMPLEX (MUNICIPAL LIBRARY) (ITALY)

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## Key points

The role of the safety coordinator is as follows:

- to ensure application of the provisions contained in the safety and coordination plan, and more generally implement the appropriate safety measures;
- to organise the construction site and work among the various people present on the site;
- to suspend the works, dismiss an enterprise or a self-employed worker or suspend the contract in the event of a serious breach of the law;
- to suspend the works in case of imminent serious danger.

## Introduction

Works were carried out in certain parts of the old San Francesco monastery, seat of the Imola municipal library, Scarabelli Museum and Risorgimento Gallery (province of Bologna in Italy), in order to install safety and lighting equipment.

The planned equipment was as follows:

- fire protection systems (smoke detectors, smoke shut-off and anti-heat devices), anti-flooding and anti-intrusion systems in the work sections that were not equipped during the previous work (including in the attics);
- electrical systems (lighting and power) in the attics.

Part of this work is the result of a legislative obligation, in particular the installation of smoke detectors and electrical systems.

Since the work was being performed in a municipal library open to the public, a number of preventive measures were taken to limit the risks for the workers, but also for the library's administrative personnel and the public.

This project was carried out by the firm CMR and employed six people full time between September and December 1999.

The customer is the municipality of Imola, acting as contracting authority. Works management was entrusted to an expert from outside the municipality.

The company Quasco, for its part, worked out the safety and coordination plan for this project, and acted as health and safety coordinator during the work performance stage. Three people were involved in this project.

On this project, Quasco was able to experience directly the role of occupational health and safety coordinators, from the invitation to tender stage through to work performance, within the framework of a public works contract.

Quasco's main activities in the construction sector are as follows:

- information and documentation;
- training;
- research;
- quality and safety management.

## **Background of the action**

The risks identified by Quasco in the safety and coordination plan were as follows:

- interference with other activities (presence of the public and administrative personnel);
- presence of water pipes and electrical cables in the floors and walls;
- high areas (risks of falls from a height).

The role of the safety coordinator (Quasco company) during execution of the project was therefore as follows:

- to ensure application of the provisions contained in the safety and coordination plan, and more generally implement the appropriate safety measures;
- to organise the construction site and work among the various people present on the site;
- to suspend the works, dismiss an enterprise or a self-employed worker or suspend the contract in the event of a serious breach of the law;
- to suspend the works in case of imminent serious danger.

## **Ambitions of the action**

In view of the presence of the public and the municipal staff in the library, specific measures had to be taken to perform the planned work. The objective of this project was to place the library rooms in conformance, especially with regard to the electrical systems and smoke detectors.

## **Scope of the action**

During the work planning stage, a survey was carried out on the site by Quasco. This involved taking photos of all the workplaces covered by the invitation to tender, consulting with the municipality, as contracting authority, and the works manager so as to learn of the problems relating to feasibility of the works which had to be allowed for in the contract, but also to meet the people supervising the municipal staff present during work performance.

During the work performance stage, follow-up was conducted by the occupational health and safety coordinator through weekly field surveys, in cooperation with the works manager. The workers were trained in the risks and the measures adopted to prevent them. Those who were required to work with collective equipment for protection against falls from a height received specific training with this equipment.

The safety and coordination plan worked out by Quasco before the start of the work identified all the risks involved in the work and recommended solutions. These solutions were then applied during the work performance stage.

#### *Interference with other activities*

The site was occupied by the public (library reading rooms) and by the municipal staff (offices, caretaker's lodge, etc.).

The rooms to be closed to the public were chosen by agreement with the management of the library and the work was able to be carried out without the presence of the public and only after approval by the Works Department in the case of operations to be carried out in the presence of the municipal staff.

Transport of bulky equipment in the attics was performed only on days on which the reading rooms were closed to the public, to avoid any interference between the movement of workers and movement of the public in the large stairway.

#### *Presence of water pipes and electrical cables in the floors and walls*

The planned work had to avoid touching the existing installations but, to avoid any risk of rupturing the existing pipes and cables, CMR checked that the owner had correctly disconnected all the installations. Where that was impossible, it had to proceed with the utmost caution and always following authorisation by the Works Department and the work performance coordinator. Signs ('Work in progress') were placed on cable troughs and control panels in order to prevent third parties from reconnecting the installations inadvertently.

#### *High areas (risks of falls from a height)*

For work at heights, it is important to choose the temporary structure most appropriate for differences of level. These problems were faced above all in a few specific cases:



- installation of smoke detectors on the centreline of the ceiling in the main entrance, a hall over 9 m high and 2 m wide, with two levels of shelving placed along the walls. The furniture placed in the centre of the room was moved, then scaffolding was assembled to obtain access to the ceiling;
- installation of a smoke detector in the centre of the arch over the main stairway giving access to the first floor. The work had to be performed at a height of about 12 m above the ground floor, where the temporary structures were installed (aerial basket or other perfectly stable device);
- installation of anti-smoke and anti-heat systems above the stairway providing access to the second-floor offices: the temporary structure was adapted to the stairway steps, on which it was supported, to ensure perfect stability;

- installation of optical smoke detectors at a height of 10 m in the library's main hall: the scaffolding already provided for other works was used in this case.

In addition, some high areas (about 6-m high) were located above furniture or shelving placed along the walls of certain rooms (offices of the municipal staff, fossil museum, etc.). Now it was prohibited to use this furniture as a supporting surface. It was therefore shifted and an aerial basket was then used to obtain access easily and safely to the areas to be reached.

### *Long, narrow passageway*

Smoke detectors and the associated electrical cables were installed in a long, narrow passageway (18 m long, 1.4 m wide and 1.4 m high). This passageway had to be suitably illuminated and ventilated and it was also planned to ensure the constant presence of at least two people in the passageway, to be able to provide help to a worker who might faint or lose his sense of direction (this was also the case for the work performed in the attics).

### *Work in the attics*

It was prohibited to walk on the wooden floor, which provided no adequate assurance of safety (risk of giving way under the weight of the workers). A footbridge provided with a guard rail 1 m high was therefore installed, on which the workers could move without danger.

### *Radiation*

One observed the presence of 52 detectors with two ionisation chambers, which could emit ionising radiation. These chambers had to be deinstalled in accordance with a specific procedure: dismantling, packing, transport by an approved carrier to an appropriate retrieval centre and handover of documents of release. The town of Imola nevertheless performed measurements of the emissions from these detectors, which proved very low and of no danger to the workers' health.

## **Proposals to improve safety conditions for future maintenance operations**

- Construction of a footbridge in the attic and installation of extinguishers
- Purchase of an aerial basket
- Installation of a lifting system to enable the smoke detectors to be lowered to the ground for maintenance

## **Problems encountered during implementation**

No particular problem was encountered in carrying out the works. The safety and coordination plan worked out by Quasco identified all the risks present on the site and the recommended measures were taken to prevent them.

## **Results and evaluation of the action**

The result of this experience was positive for Quasco, which has described it at seminars and during training courses for technicians involved directly or indirectly in the field of occupational health and safety.

Coordination of this construction site made it possible to reduce the risks incurred by the employees and to carry out the work in the best possible conditions.

### **Identified success criteria**

During the planning phase, the success criteria consisted in carrying out investigations on the location of the construction site before drawing up the safety plan, and consulting with the project manager to know specifically the work that would be performed and to analyse in depth all problems concerning the management of internal staff (municipal employees) and the outside public interfering with the construction site. A working group is important to have the planning and execution aspects of safety explained by qualified people.

Finally, it was important to define safety measures which could be useful for future maintenance work.

During the execution phase, it was also important to carry out regular investigations on the construction site and define operating instructions for the workers stage by stage.

### **Is the action transferable?**

The method used can be transferred to other construction sites and other countries. The construction site coordination phase is, moreover, required by Directive 92/57/EEC on the implementation of minimum safety and health requirements at temporary or mobile construction sites.

### **Statement**

'Being a safety coordinator requires above all care and competence. In order to move forward, everything should always be clear and any problem arising should be solved, even when it requires hard work and more time than expected.' (Andrea Vicenzi, Quasco)

### **Further information**

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## Conclusion

The case studies demonstrate that by effective implementation of good practice in the construction industry the standards of occupational safety and health can be significantly improved. However, what they also demonstrate is that these improvements are urgently required. Cultural change in the industry, with the involvement of all the key players, throughout the duration of a construction project, will take time to achieve. It is possible to derive from the case studies some useful information for those who would like to adopt similar approaches.

### **Consequences of the measures described on the frequency level of occupational injuries**

Several of the actions described have as their stated main objective a reduction in the number of occupational injuries. However, for the individual case studies, the sample is never sufficient to assess if there has been any reduction. On any single project the number of accidents will normally be very small or zero. Comparisons made with national figures based on the whole industry, over a period of time, are not valid. To adequately assess success based on reactive measuring, such as accident numbers, the data used must be of adequate size and over a suitable period of time.

Some case studies report very positive results, for example the Dutch company Mourik, which has observed a 90 % reduction in the number of occupational injuries following implementation of an occupational health and safety management system on its construction sites, which also involved quality and the environment. This demonstrates that safety and health are inseparable from the other business needs. Holistic management of a construction project can achieve significant business benefits in all areas, including safety and health.

Some of the case studies report less success. The campaign of information and inspection on site carried out by the Swedish and Danish labour inspectorates during construction of the Øresund Bridge between these two countries seems to have had only modest effects on the frequency of occupational injuries on the site. However, the Danish experience is that this project reported about half the number of accidents when compared with the national figures. This emphasises the problems of only using reactive monitoring (i.e. accident and ill-health data) when measuring performance.

Nevertheless, it should not be forgotten that there are several reasons for the more or less successful results of the various measures described. These reasons may include, for example:

- recognising the importance of the design phase;
- having inclusive management, involving all relevant persons;
- the method of risk assessment and prevention put in place;
- ensuring effective implementation of all prevention systems;
- motivation of all the workers, managers and others involved in the project;
- information, training and communication;
- monitoring performance.

## **Importance of the design phase**

The main objective of the design phase is to anticipate the appearance of risks as far upstream as possible and hence be able to implement measures to eliminate or minimise these risks.

Risk assessment is the basic factor in all accident prevention actions. It is, moreover, compulsory in all the European Union Member States. This makes it possible to identify and analyse risks, and to identify and implement the appropriate preventive measures. Follow-up and control are then required.

For risk assessment to be effective the system used must be appropriate for use in construction. An important factor is its ease of use in the complex environment of a construction project. The best systems take into account the changing situations found in construction: the need to design and plan; the different stages of a project; the multiple employer situation; and the importance of involving the workforce.

For several actions described in this report, simple, easily understood systems are used to identify risks on the construction project.

A checklist principle has been adopted in the risk inventory and evaluation method developed by the CNAC in Belgium (Belgian Committee for Safety and Health in the Construction Industry) to help employers perform risk assessment and analysis on site. This method is very comprehensive and can be applied without preliminary training, a manual explaining the various stages being sufficient for the purpose.

The preparation phase has been very important in the works carried out in the old San Francesco monastery, home of the Imola municipal library in Italy, in order to install safety and lighting equipment. The planning phase involved carrying out investigations of the location of the construction work before preparing the safety plan. The project manager was involved in order to inform the team what, specifically, work was to be carried out and to analyse in detail all problems concerning the management of internal staff (municipal employees). This process also considered the outside public affected by the construction work, who could consequently be at risk. This phase also allowed safety measures which could be useful for future maintenance work to be implemented.

## **Need for coordinating the various tasks performed on the site and for involving all the players**

Many players are involved in work on a construction site: the client who procures the project, designers and architects, engineers and surveyors, the project manager, employers, workers, subcontractors, self-employed workers, coordinators, etc. This co-activity can result in risks if it is not — or is insufficiently — coordinated.

### *Cooperation between the various players*

Motivation and cooperation between the players are essential to prevent risks. Construction of the French Stade de France stadium owes much of its success to this factor. Despite major health hazards due to the discovery of various sources of pollution in the soil on which the stadium was to be built, no health problem was reported throughout the project. Risk assessment and coordination of the various players on the site made it possible to determine the

risks and implement appropriate prevention measures. The involvement of the contractors working on this site should also be emphasised, especially the information and training measures that they developed for their employees. The role of the coordinator was also an important factor in achieving success: shared risks were taken into account as soon as they were identified, and they were managed under his vigilant supervision.

The Construction Safety Partnership in Ireland is a good example of cooperation between the major organisations concerned with health and safety in the construction sector. The main objective of this initiative is to raise health and safety standards in the Irish construction sector and involve all those concerned, which means clients, designers, contractors, workers and regulators.

#### *Involvement of subcontractors*

Training for the contractors and subcontractors on the construction site for the Egnatia motorway in Greece was an important initiative that had numerous follow-on effects. Subcontractor firms are often harder to control, because of the indirect management control the overall project manager has for them. Another problem is that they may also be unfamiliar with their occupational health and safety obligations. The training provided improved this situation from the start of the project.

Construction of the tunnel under Warnow River in Germany provides a good illustration of the difficulties and the methods to be applied for managing subcontractor firms. Between 20 and 25 subcontractors worked on this project. The size of the project, lack of experience and the need to supervise all the subcontractors made this construction site a real challenge for the project manager. The main objective was to reduce risks and the number of accidents insofar as possible. The success of this is partly due to the very strict rules imposed by the project manager on the subcontractors, such as the establishment of a health and safety plan, risk assessment, implementation of preventive measures and, finally, a weekly technical report on working conditions on the site. Despite some reluctance at filling in all these documents, the subcontractors applied these rules, and there was only one serious accident. Cooperation with the labour inspectorate was also one of the factors in this project's success.

#### *Empowerment of employers*

In 2003, the Ilawa Building Company in Poland implemented an integrated quality management system based on ISO9001:2000 as well as an occupational safety and health management system. The implemented system made it possible to take a number of actions in the company aimed at improving working conditions, and eliminating or reducing, on an ongoing basis, exposure to harmful agents. A noticeable increase of awareness by the workers of occupational risks has been recognised.

#### *Employee involvement*

Employee involvement in the survey carried out by Elinyae in Greece on the Acropolis restoration project seems to have been the key to its success. One of the main steps in this survey was to ask the workers to fill in a questionnaire on health and safety on the site. Not only were the workers involved in this survey, but this also made it possible to obtain an initial overview of the risks present on the site. In spite of technical problems in performing the survey (the very nature of the renovation work on the Acropolis making the site inaccessible to

cars, with all the measuring equipment having to be carried by hand to the site), a large proportion of the employees took part in this study.

### *The role of worker representatives*

Direct contact between the workers and their representatives for occupational risk prevention is very important. This is one of the success criteria of the agreement signed between the trade unions and the General Directorate for Labour of the Valencia regional government for the construction of the 'Terra Mítica' theme park in Spain. The presence on the site of supervisors appointed by the trade unions permitted improved communications with the workers and a certain independence relative to the project manager working on this project. This had the consequence of raising the safety awareness and standards for all.

### **Monitoring performance**

The safety observation method was developed by Finland to measure the safety performance on construction sites, during the construction phase. This is an easy-to-use method making it possible to monitor all aspects of health and safety on the site. It consists of a standardised monitoring system used during weekly inspections, covering work habits, scaffolding and ladders, machinery and equipment, protection against falling, electricity and lighting, and order and tidiness. The keys to its success are, in particular, the ease with which it can be learned and used, speed, and real-time monitoring of changes in working conditions on the site. The involvement of joint inspections by management and workers is also key to its success.

### **Information, training and communication**

Safety culture is still very weakly developed in the construction sector, because the risks incurred by the employees are accepted as just part of the job by many of them: risks form an integral part of their work and they must accept them.

Thus, on the construction site of the Egnatia motorway in Greece, one of the biggest problems was to have the various enterprises employed accept the safety measures imposed. While the young engineers were more receptive to the principles of occupational health and safety, the older ones found it harder to accept these measures and apply them as required.

In order to develop this safety culture, both employers and employees must be trained and informed of occupational risks in the construction sector, and of their obligations.

Likewise, the clients are not always aware of the risks run by the workers when working on their projects. This was the case in particular during the demolition of buildings constructed in the former German Democratic Republic. The buildings to be demolished contained asbestos creating major health risks for the workers. The client doubted that the buildings contained asbestos and claimed he did not know that asbestos fibres were carcinogenic. The labour inspectorate had a very strong presence on this site, in particular performing laboratory analyses and highlighting the real risks involved. They then ensured a very strict control of working conditions (asbestos removal being a costly operation, some firms could have been tempted to 'skip over' this phase of the operations).

A good example of a large-scale information campaign was the prevention of falls from a height project carried out by the Latvian labour inspectorate, with the aid of the National Working Environment Authority of Denmark. The aim of this campaign was to inform and monitor employers in the Latvian construction sector, carrying out work at a height, so as to improve the application of Directive 92/57/EEC on the implementation of minimum health and safety measures at temporary or mobile construction sites. The employers greatly appreciated this campaign, and in particular the guides published as part of the campaign.

Communication between the various players is also a factor guaranteeing the success of such actions. This is the role that was played by Mr Dowling as worker safety representative on one of the projects of the Bovis Lend Lease company in London. In particular, he made it possible for information to circulate between employers and employees on the project, and vice versa. This was possible because the workers saw him as a credible person with detailed knowledge, and the employers as a good communicator enabling them to effectively manage the safety and health risks. He was therefore able to carry out numerous actions based on communication and information.

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