Saimaa University of Applied Sciences
Technology, Lappeenranta
Double Degree Programme in Civil and Construction Engineering

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RISK ANALYSIS AND WORKING INSTRUCTIONS FOR CONCRETE INDUSTRY

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ABSTRACT

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Risk analysis and working instructions for concrete industry
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The aim of the thesis was to estimate work hazards and to analyze work safety risks in order to provide appropriate working instructions for concrete factories and quarries. This work was written in Helsinki, southern Finland, commissioned by the Rudus Oy Company.

The main reason for choosing this graduation thesis topic was the desire to learn more about the European experience in this field in order to help the Rudus Oy Company with revealing and minimizing its operational risks. Developing the risk analysis theory was based on the information provided by earlier reports on this topic and previous studies in this sphere.

The tables presented in the supplied thesis work determinate different types of risks and show ways of protection and preventive measures. As a final result, the tables identify the level of risks and give their description correspondingly. On this basis, executives and commissions can easily define hazards and specify what measures of work safety should be taken in each particular situation. Thus, this work will provide assistance for the safety department in the area of minimizing risks. The tables were made in accordance with the Rudus Oy Company's latest requirements.

In general, work safety has been already provided by the company, however, new dangerous risks have been revealed. Zero risk level is the key objective for the Rudus Company this year and they will do their best to achieve that.

Keywords: risk analysis, work safety, work instructions

CONTENTS

1 INTRODUCTION

Rudus Oy was established near Helsinki in 1931. The beginning of their operating activities was marked by crushed stone refining. Nowadays the company's field of activities encompasses producing ready-mixed concrete, concrete products, aggregates, and asphalt, extracting gravel and sand as well as raising stone buildings, carrying out crushing works, and recycling. Furthermore, Rudus operates also in Russia and in the Baltic region, with about 1200 people engaged. Since 1999 the Rudus Company has been part of the Irish CRH Group (Cement Roadstone Holdings) which conducts business in 34 countries, employing about 92000 people all over the globe. Offering a wide range of high quality products and reliable service to their customers, Rudus Oy looks to the future aiming its efforts at further business enhancements (Kuha 2010).

An urgent issue nowadays, which the company should concern with a due regard in their daily operation, is health and safety at work. It is essential that human life safety should be given the unquestioned priority during any building process. In this regard, people are searching for new solutions involving all their expertise, cutting edge technologies and advanced methods of minimizing risk factors which endanger workers' health.

As for the Rudus company, it complies with all the requirements existing in the legislation of Finland. It is a basic principle for the company as the CRH Group aims to become the safest enterprise in the market. In their research on work safety, the Rudus Company managers bound accidents and the principles which are relevant in this regard. All the accidents were given a thorough examination. The report on this topic will be shared to all Rudus centers in order to prevent the accidents. The aim is to learn the faults which had already been made in this sphere by the others and, thus, to take the advantage of avoiding them by the Rudus Company in their future operation activities.

The aim of the thesis is collecting information about the working operations which can be dangerous for the people who carry them out. Visual analysis was made on the ground of the work hazards when protective measures were taken

in accordance with existing requirements. In the thesis, the existing working instructions and available information on risk analysis were updated. In order to do that, all the company's subsidiaries in three different countries were visited. Thus, the main goal of the thesis is to provide Rudus with true data and explain how to put those working instructions into practice.

The general aim of this work is to identify hazards and to assess risks actual for Estonian, Russian and Latvian concrete factories and quarries. That can help the CRH Group to improve their methods of work safety which is essential for the company itself, for its subcontractors and employees.

To achieve the above-mentioned objective of the thesis the following tasks were performed:

- Finishing the work safety course
- Conducting interviews with workers on the hazards which they face at their workplaces
- Composing tables for each particular factory and quarry
- Providing hazard assessment
- Providing risk assessment
- Working out protective measures
- Formulating working instructions

2 CRH POLICY

2.1 Health and safety policy

When investigating risk analysis and operational safety, we should mention that CRH seeks to achieve the best standards of labor and safety conditions within the industry. The company's managers recognize that it is a critical issue for all their stakeholders, and for their employees and contractors, in particular.

The health and safety policy applied across all companies of the Group is aimed to:

- comply with all the applicable legislation in this field and improve the company's health and safety stewardship towards industry best practice
- ensure that their employees and contractors respect the Group's health and safety imperatives
- ensure that their companies provide a healthy and safe workplace for their employees and contractors, and take due care of all customers and visitors at their locations
- require all their company employees and contractors to work in a safe manner as mandated by law and industry best practice.

2.2 Health and safety management

Health and safety management is a daily priority of the company's line management. Safety results for the entire Group are closely monitored by senior management and are reported to the CRH Board on a monthly basis.

The line management is responsible for ensuring that company health and safety policies are fully adhered to, and that site managers and employees, supported by the company safety officers, are trained in health and safety risk analysis and prevention. At the end of each year, the safety officers also assist the Group Technical Advisor in carrying out a detailed safety performance review of all Group Companies, the results of which are reviewed by the CRH Board.

Where accidents occur, they are thoroughly investigated and corrective action is taken to avoid a recurrence. The lessons learned are actively shared via Safety Best Practice groups. Experiences on safety best practice are also shared on an industry-wide basis through the Cement Sustainability Initiative (CSI) Health and Safety Task Force.

2.3 Safety performance

Judging by their own experience, the CRH Group understands that some newly acquired companies need considerable inputs to bring them up to the safety standards. Also, variations in approach towards safety have been noticed in different countries, demanding additional management focus on that issue.

The most common causes of accidents are slips, trip and falls, injury by falling and moving objects and improper manual handling. With additional care and attention by all, many of these accidents are preventable.

The main goal is zero fatality and zero accident level. Due to the nature and the volume of the company's operation activities, these are extremely challenging goals. They will continue to require substantial management and time, and all the appropriate resources will be directed to this area to promote Group advance towards those targets. The Group general strategic plan is currently being implemented in order to eliminate fatalities.

2.4 Product safety

The products delivered by the CRH companies, when properly used, present negligible health risks, and are accompanied by Material Safety Data Sheets advising on optimal application procedures. The Group Technical Advisor and internal health and safety specialists liaise with the relevant industry associations and regulatory bodies to ensure that all Group companies are aware of and comply with their obligations in this area (Henry M., 2009).

3 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

3.1 The key importance of health and safety

Aggregates (such as crushed rock, gravel and sand) and cement are among the most widely used substances on the earth. Producing cement and concrete is an energy and resource intensive process with both local and global environmental, health and safety impacts.

Ensuring healthy and safe working conditions for employees and contractors is a fundamental key to corporate social responsibility, and is one of the most important issues for the concrete industry. CSI members recognize that more attention should be paid to this area across the whole industry.

One cannot overestimate the importance of work safety in the concrete industry. For instance, the frequency of accidents is about 50 – 60 per million working hours, and on building sites it amounts to almost 85 accidents per million working hours (Mr. Colm Bannon, 2009).

Differences in safety levels are quite high. Accidents at work result in significant direct and indirect costs. Different estimates show that the actual costs make up 2 to 4 times the amount of statutory accident insurance fee. The total cost of accidents may result in the company`s wage bill increase by 10 percent (Mr. Colm Bannon, 2009).

It is important to point out that increasing safety level at workplace always requires additional funds to be raised. However, the economic factors alone which are mentioned above are sufficient to justify the importance of safety activities. A safe working environment is usually a highly effective working environment (Mr. Colm Bannon, 2009, pp. 8-15).

3.2 Occupational Health and Safety Act

Occupational Safety and Health Act requires the assessment of risks and dangers. Occupational Safety and Health aims to improve the working

environment and working conditions and to fight against occupational accidents, diseases and other work-related physical or mental health problems.

All employers must constantly monitor working environment, workplace safety and working space. The employers must also keep under review how the appropriate measures for increasing work safety and wholesomeness are taken.

Employees must comply with the employer`s powers in accordance with orders and given instructions. The employees must comply with work and working conditions required for safety and wholesomeness, for maintaining order, usual care and caution.

The Occupational Safety Course and small group training is the first step for all workers in this regard. The employers receive instruction, guidance and professional equipment to ensure their safety work in accordance with the rules.

3.3 Risk analysis goals

The main purpose of the thesis is to determine the existing safety measures, to work out new ones, to examine and to fix them. This requires familiarization with their current practical application. Risk analysis is available in many different methods, from simple scratch paper to sophisticated risk modeling techniques. Suitable method will be selected according to the company size and functions. The analysis must also ensure that the assessment is implemented systematically, with different types of tasks and specific cases taken into account.

The employer at each workplace has a general duty to ensure the safety and health of workers in every aspect related to work. The purpose of carrying out a risk assessment is to enable the employer to take the measures necessary for the safety and health protection of workers in the most effective way (OHSAS 18001, OHSAS 18002, 2008).

These measures include:

1. Preventing occupational risks
2. Providing workers with the necessary information
3. Arranging systematic trainings for workers
4. Controlling that the necessary measures are implemented properly

Whilst the purpose of risk assessment includes the prevention of occupational risks, and this should always be the goal, it will not always be achievable in practice. Where elimination of risk cannot be realized, then the risks should be reduced and the residual risk controlled. At a later stage, as part of a review programme, such residual risks will be reassessed and the possibility of elimination of further risk reduction, perhaps in the light of new knowledge, can be reconsidered.

The risk assessment should be structured and applied so as to help employers when controlling the operational process to perform the following:

- to identify the hazards created at work and evaluate the risks associated with these hazards so as to determine what measures they should take to protect the health and safety of their employees and other workers in accordance with legislative requirements;
- to evaluate the risks in order to make the best informed selection of work equipment, chemical substances or preparations made, the workplace fitting out, and the organization of work;
- to demonstrate to themselves, the competent authorities, workers and their representatives that all factors pertinent to the work have been considered and that an informed valid judgment has been made about the risks and the measures necessary to safeguard health and safety;
- to ensure that the preventive measures and the working and production methods considered to be necessary and implemented following a risk assessment, provide an improvement in the level of protection afforded to workers with regard to safety and health (Guidance on risk assessment at work, pp. 11-14).

4 RISK ANALYSIS METHODOLOGY

4.1 Introduction

When we start talking about the analysis of professional risks, the question “What for?” is asked. The answer will be definitely different in each particular case. However, if we ask the owner of the business what is of interest for him, most probably, we will get one obvious answer - money! Other stakeholders start from afar and if we sometimes ask this question ”What for?”, we will receive some sequence of answers (Figure 4.1), but actually with one outcome (Kuha 2010).

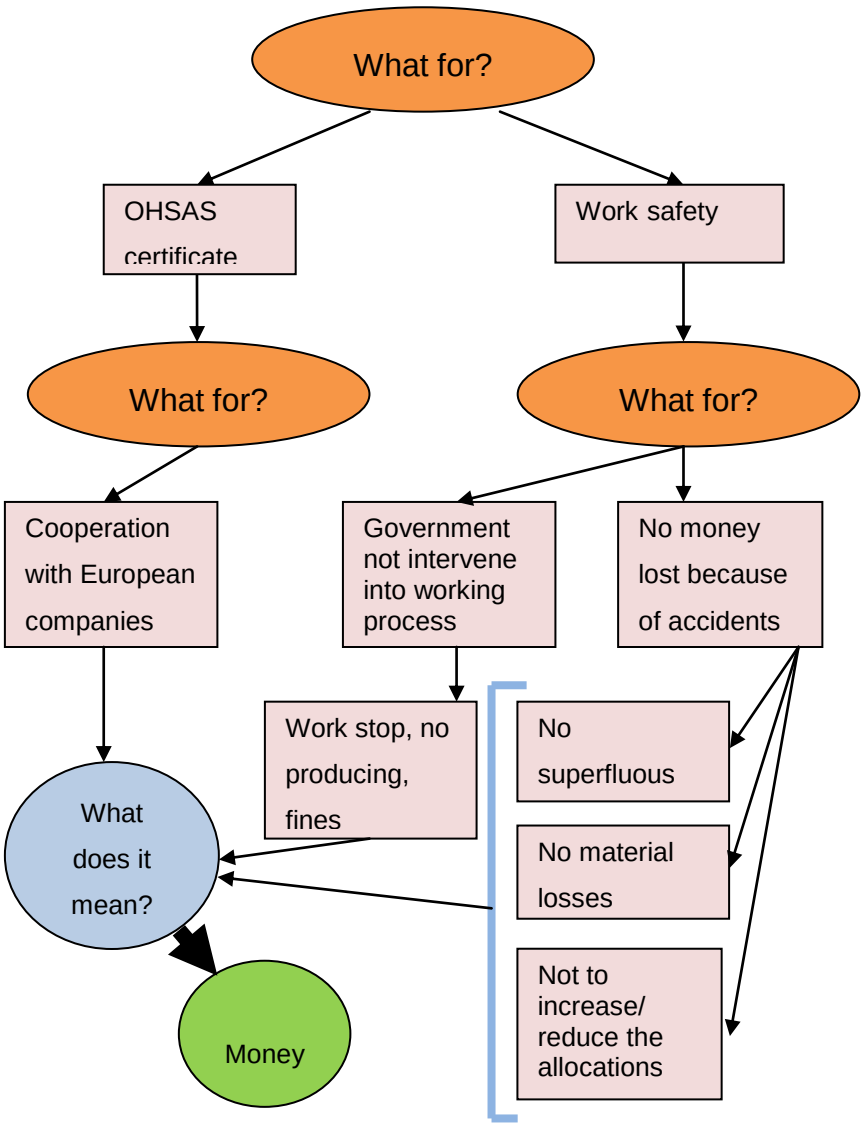

Figure 4.1 Answer sequence

Finally, the estimation and management of professional risks are carried out, and should be carried out, because of money. Anyhow, the estimation of risks sets the goal of minimizing company's legal, financial, and material losses, or otherwise, the goal of maintaining the competitive advantage in the market.

Risk assessment is a process of evaluating risks arising from hazards with taking into account the adequacy of any existing regulative measures, and deciding whether the risks should be undertaken or eliminated in each particular case.

4.2 Risk analysis methodology

There are no fixed rules (Figure 4.2) about how risk assessment should be undertaken. However, there are two principles which should always be borne in mind when approaching any risk assessment:

- to structure the assessment to ensure that all relevant hazards and risks are addressed (e.g. not to overlook tasks, such as cleaning, that might take place out of 'normal' working hours, or ancillary departments such as waste compacting).
- when a risk is identified, to begin assessment from the first principles by questioning if the risk can be eliminated: is the causal hazard necessary (for example, could an internal road traffic problem be avoided by insisting that traffic only used an existing roadway within the enterprise, but at the boundary).

After risk identification one should think about their causes, risk results and how to prepare for them, what is the probability and consequences of the same design of different control measures to eliminate or reduce hazards (Guidance on risk assessment at work, p. 15).

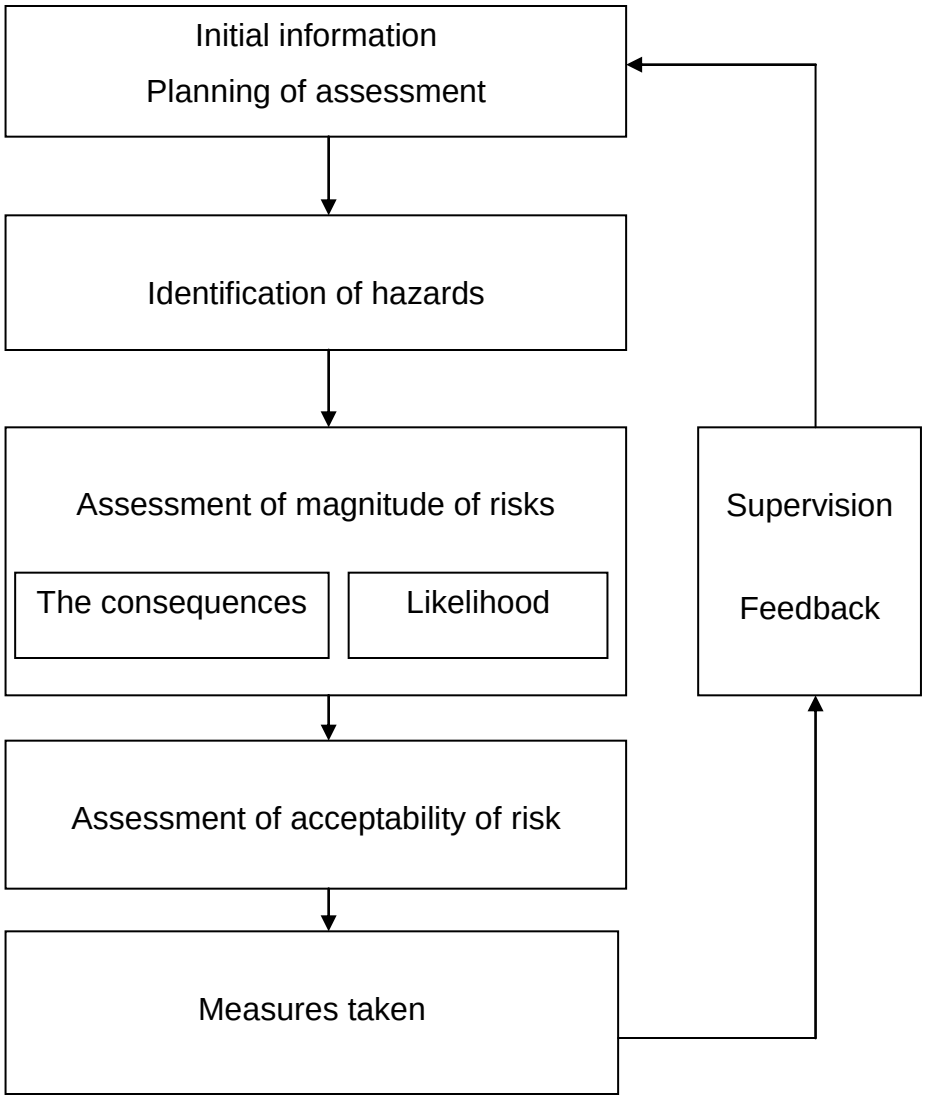

Figure 4.2 Risk analysis phases

All work and points of the risk analysis are presented in Appendix 1.

5 HAZARD IDENTIFICATION

This part is about the main types of health hazards associated with the cement industry and its allied activities (aggregates and concrete) which may have negative implications on health.

5.1 Fatality causes and prevention

The table below summarizes those at higher risk of fatalities, the main causes and corresponding preventive strategies. It is vital that management addresses these preventive strategies, and abides consistently by them in their daily plant management (CSI, 2004, p.18).

High Risk Categories:	Prevention:
• Contractors	• Contractor Safety Management
• Young/Temporary Employees	• Special Safety Induction
Direct Causes	
• Traffic & Mobile Plant (43%)	• Driver Training
• Falls from Heights, Objects falling from Heights (21%)	• Safety Procedures for Work at Heights, Overhead Protection
• Caught in Starting/Moving Equipment (15%)	• Plant Isolation Procedures

Table 1 Higher risk of fatalities (CSI, 2004, p.18)

5.2 Typical injury causes and types

The main causes are slips, trips and falls (29%), falling or moving objects (19%) and lifting, overload and exertion (18%). These three causes account for 66% of the total accidents. Most Injuries are to arms and hands (32%), legs and feet (25%) and back (13%). These injuries are 71% of the total (CSI, 2004, p.18).

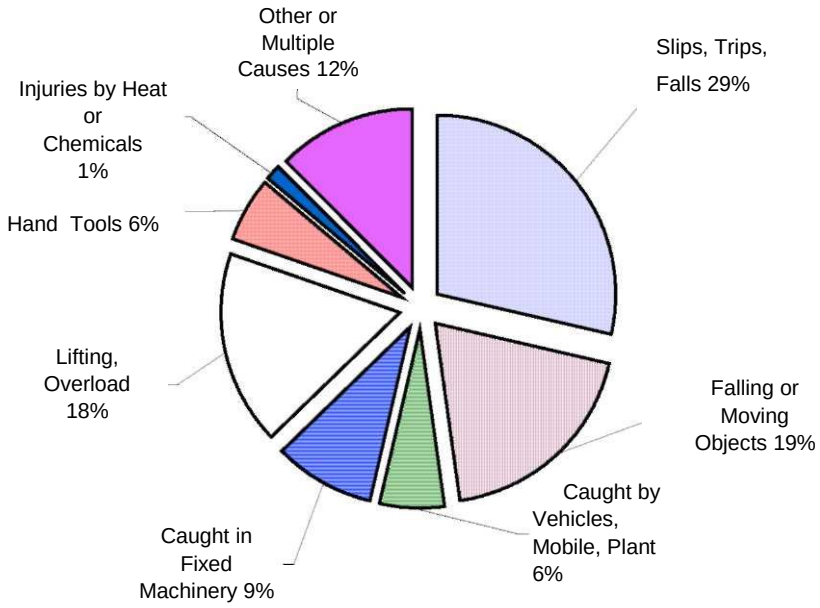

Figure 5.1 Injuries by cause

5.3 Typical injury categories and ages

- Plant Operators (39%) and General Operatives (33%) are the most injury prone.

- 30-39 is the most injury prone age range (33%), followed by 20-29 (25%), and 40-49 (24%)

5.4 Conclusion on injury causes and prevention

The table below summarises the main injury causes and the corresponding prevention strategies. These prevention strategies should be embedded in the ongoing daily plant management.

Injury Causes:	Prevention:
• Slip, Trips & Falls	• Housekeeping, clear designated walkways
• Falling/Moving Objects	• Guards on Machines and elevated areas
• Lifting & Overload	• Manual Handling Training
Injury Types	
• Arms and Hands	• Proper use of PPE
• Legs and Feet	• Proper use of PPE
• Back Injuries	• Lifting gear, forklifts
(PPE: Personal Protective Equipment)	

Table 2 Causes and prevention (CSI, 2004, p.19)

5.5 The injury triangle

In each industry there is a statistical relationship between various injury severity levels from "near misses" through to fatalities. This emphasizes the importance of monitoring and reduction of "near misses" in order to eliminate the possibility of more serious injuries.

Figure 5.2 The injury triangle (CSI, 2004, p.19)

5.6 Health Issues

The main health hazards which may have implications on health associated with the cement industry and its allied activities (aggregates and concrete) are usually the following:

- Airborne dust
- Noise and vibration
- Dangerous atmospheres
- Radiation hazards
- Handling of alternative fuels

Specific guidelines on these occupational health issues are given in the sections that follow.

Some other health issues that may be encountered but are not specifically related to the cement industry and its associated activities are:

- Smoking and other drug dependencies.
- High blood pressure
- Diabetes
- Nutrition and obesity
- Stress and mental health
- Heat stress, cold and wet conditions
- Heart disease
- Diseases such as HIV/AIDS, Typhoid, Malaria

Sufficient general health guidelines on these non-occupational issues already exist and for that reason are not treated any further in this document. However many CSI companies do include internal guidelines and support on these issues as part of their employee well-being programmes. Several also provide a similar support for employee's families and local communities which is very laudable.

5.5 Instructions for giving risks consequence probability

Risk points (Table 5.1) from 1 to 5 are defining each of the hazard or problem. The rough distribution is (Guidance on risk assessment at work, 2008):

- Insignificant risk (I): No effect
- Slight risk (II): Situation monitoring, take measures to facilitate
- Moderate risk (III): Planning measures
- Substantial risk (IV): Planning and start the fast steps
- Intolerable risk (V): Planning and start prevention work immediately

Probability of incident	Minor	Moderate	Major
Improbable	I. Insignificant risk	II. Slight risk	III. Moderate risk
Possible	II. Slight risk	III. Moderate risk	IV. Substantial risk
Probable	III. Moderate risk	IV. Substantial risk	V. Intolerable risk

Table 3 Probability and consequence of incident

6 MINIMAL REQUIREMENTS FOR WORK

6.1 Introduction to work

Training is organized by the principal. Each company has particular work targets as well as operation environment, and therefore specific safety rules and methods to cope with dangerous situations, accidents, and malfunctions. Workplace-specific introduction and guidance complements the know-how of the employee. Each new employee and subcontractor should be thoroughly acquainted with their work target. Rudus has compiled its own acquainting plan which includes information about traffic and moving about, intoxicants and smoking, personal protective equipment and work clothes, work requiring a permit, tidiness and order, waste management, special circumstances or operations in a shared workplace, operating in accidents, and contact persons. Each superior must plan acquainting and must report on a due implementation of the training.

6.2 Occupational guidance

All employees and office workers are getting occupational guidance during their work (Figure 6.1). Occupational guidance involves new tasks, methods of work, machines, devices or materials. Each task or method of work compile in occupational guidance plan. In particular, each employee of Rudus has the opportunity of going through the occupational guidance provided by the company.

Figure 6.1 Information desk (Kuha, 2010)

6.3 Training

Rudus arranges annually at least 8 hours of safety and security training for each of their employees. Each employee must have an occupational safety card (Figure 6.2). All employees and subcontractors are instructed and thoroughly acquainted with the conditions of their work places in advance. Subcontractor has also responsibility to take care of new employees and ensure the work safety in Rudus. From 2009 Rudus has been provided 12 hours of training for each employee. Training will be continued in order to improve and maintain general security awareness and its observation by the staff at a proper level.

Figure 6.2 Training course (Kuha 2010)

6.4 Personal protective equipment and work clothes

When selecting protective equipment (Figure 6.3), it is important to pay attention to the following properties: comfortability, maintainability and effectiveness. The employer is obliged to acquire protective equipment for each employee. The same is also required from the subcontractors who work with Rudus. Protective equipment is mandatory for all the Rudus workers. Equipment must be used in accordance with the instructions given. Mandatory

protective equipment is as follows: safety shoes, helmet, ear protection, light jacket. To accomplish some specified tasks, workers must use safety goggles, glasses, face masks and have the insurance against falls. During winter time special footwear must be used.

Figure 6.3 The equipment of workers (Kuha 2010)

7 WORKING INSTRUCTIONS

7.1 Introduction

A new safety strategy was launched in the European division in January 2008. The primary goal of the strategy is elimination of fatal accidents in operation work as well as significant reduction of accident frequency and severity ratios. Issues such as safety leadership, safety training and contractor management are also covered in detail in the new strategy.

The division faces many challenges from the point of view of health and safety in terms of differences in legislation and safety culture among the different countries where Rudus operates. For the company to achieve the primary goal of zero fatal accidents, it is important that it adheres to definitive mandatory safety standards across all its operations. These standards are applied in addition to the active legislation of the countries where CRH operates.

The 16 rules were initially devised by the Europe Materials Safety Best practice group and represent international best practice in terms of risk management techniques. The implementation of these 16 mandatory rules is an absolute requirement and CRH management at all levels is responsible for their proper implementation.

Considering the fact that CRH Group does not want people to be injured in any way while working at their company, these mandatory rules are designed to assist people as management in achieving that goal.

7.2 Machinery guarding / isolation

There has been a significant number of fatal and serious accidents (Figure 7.1) involving people becoming trapped in machinery due to inadequate guarding and fault isolation procedure.

The aim of this recommendation is to ensure that we have a uniform approach across the division providing the guarantee that all machinery guarding corresponds to the highest standard.

The following technical standard must be used when carrying out machinery safety inspections and when formulating management training courses: “Code of Practice for the Safeguarding of machinery used in the aggregates Industry” published by the U.K. Quarry Products Association and containing pictorial guidance on guarding and isolation requirements.

Also, concerning machine isolation (electrical, pneumatic, hydraulic or mechanical), the use of personal locks and hasp locks should be adopted across the division – the use of such safety devices should be introduced in conjunction with specific training programs.

Requirements:

- The above guidance document should be circulated to all group safety personnel and used as machinery guarding and isolation best practice guidance
- All plants should be audited with such guidelines as the baseline
- Hasp locks should be introduced, with relevant training, as part of all isolation safe systems of work

Figure 7.1 Employee was killed when he was entrapped in a tension roller (Michael K. 2007)

7.3 Employment of contractors

Contractors and their employees continue to represent a significant proportion of serious accidents within the Group. Most of these accidents have involved young contractor employees who lacked knowledge of the hazards involved in the work they were undertaking.

A pre-qualification system for contractors must be introduced in each company that could take the form of one of the following:

1. Formal accreditation that obliges a contractor to have an accredited safety management system
2. A formal system of ensuring that contractors provide safety information relevant for the work they are going to carry out and that the CRH Company provides information according to its requirements.

An example of such a system is Contractor Safety Checklist used in Cementbouw, Rudus, Finnsementti, and also some other companies in Ireland and Poland.

This 4-page document covers CRH`s main legal responsibilities, in particular, to ensure that:

- all contractors and their employees are suitably qualified and experienced (this is of particular importance in relation to specialist contractors such as electrical contractors, lifting specialists etc.),
- they operate safe equipment / Personal Protective Equipment (PPE) (requirements are outlined),
- they are aware of details of past safety performance in terms of prosecutions and serious accidents,
- a safety Training I.D. system or Contractor Passport is introduced – to help plant managers easily identify contractors who have received the necessary screening and training.

The pre-qualification procedure should be used in each company as a component of the general procedure to ensure the safety of contractors.

Requirement:

- All companies are required to have a formal system for ensuring that contractors provide all the relevant information (Figure 7.2) and that the company involved provides information on its safety requirement while the contractor is on site.

Figure 7.2 Information desk for contractors (Michael K. 2007)

7.4 Trip wires on conveyors

A conveyor trip switch (Figure 7.3), when activated, should open a pair of contacts and operate at the same time a latching mechanism which keeps the contacts open. The latching mechanism keeps the circuit open until the reset button on the switch is manually operated. A faulty trip wire switch can result in the contacts opening without operating the latching mechanism.

While emergency pull cords are not alternatives to guarding, it is important to ensure that they are of correct technical specification and that they are tested on a monthly basis.

For all conveyor trip wires, the following applies:

1) Technical Specification

Either a switch is provided to each end, or a single switch is used at one end and tension spring anchors the other end so that a pull on the wire in any direction will stop the conveyor.

2) Testing

It is important to make sure that all trip wires are tested regularly, i.e. physically checked to ensure latching performance, and that the switches have not seized up – this should be completed on a regular basis (at least four times per year). It is the responsibility of the Location Manager to ensure such test/checks are carried out.

Requirements:

1) All trip devices should be checked for conformity with the above technical specification.
2) All such devices should be tested for tripping and latching performance, and it should be ensured that the associated motors will only restart after a manual reset.

Figure 7.3 Conveyor trip wire (Michael K. 2007)

7.5 Site transport safety

Accidents involving mobile plant account for over 60% of fatal accidents within the aggregates industry. Two of the main causes of such fatalities are persons

being run over by a vehicle, or a site vehicle going over an unprotected edge (Michael K. 2007).

The following measures should be taken:

1) To deal specifically with these issues, and as minimum, all dump tracks (rigid and articulated) and loading shovels, both company owned and contractor vehicles working on site, must be fitted with a close circuit television system (Figure 7.4) in addition to a reverse warning alarm. Moreover, all vehicles (including paving equipment such as rollers) should be fitted with seat belts.
2) In addition, in dealing with the risk, the use of high visibility clothing (preferably high visibility overalls) is now required at all operations.
3) Then, edge protection for haul or access roads must be adequate to prevent a vehicle going over an unprotected edge. Work on Stockpiles must be conducted in accordance with the guidance document provided by the Europe Material Safety Best Practice group.
4) There must be a system to ensure the regular testing of brake systems on loading shovels and dump trucks. This test must be carried out at least twice per year.

Requirements:

If these measures have not being completed yet, the companies should now arrange them.

1) To have CCTV and reverse warning systems fitted to dump trucks and loading shovels. In addition all vehicles (including paving equipment such as rollers) should be fitted with seat belts
2) To ensure edge protection on haul and access roads within the operation are adequate to prevent a vehicle going over an unprotected edge. Work on stockpiles must be carried out in accordance with the guidance document by the Europe Material Safety Best Practice group
3) To ensure a policy is in place, and implemented, requiring all employees and contractors to wear high visibility clothing

4) To provide a system for testing (at least twice per year) brake systems on dump trucks and loading shovels

Figure 7.4 Camera (Michael K. 2007)

7.6 Drilling and blasting safety

There has been a number of flyrock incidents in group companies, any of which could have resulted in fatal injuries to employees, contractors and, indeed, members of the public.

In order to eliminate such dangerous occurrences, the following systems are required for each drilling and blasting operation.

Drilling:

- Each driller must have completed a training course, which focuses on basic shotfiring procedures, i.e., burden and spacing considerations, causes of flyrock, dangers of clay in quarry faces, dangers of falling from the face, dangers from angled holes,
- Each drill rig associated compressor must undergo a detailed inspection at least once per year,
- Each compressor system must be fitted with a device to restrain the compressed air line in the event of it coming loose from the compressor.

Blasting:

- All those involved in blasting operations must receive specialized training in the use of explosives,
- Key parameters such as burden, spacing, amount of explosive, hole depth and angle must be recorded for each blast,
- A “Danger Zone” must be determined and recorded in writing for each blast.

Recommendation:

Companies should currently arrange to have in place the system of formal training for all those involved in drilling and blasting. The systems to record key data for both drilling and blasting should be introduced.

7.7 Use of mobile phones in the workplace

Accidents involving mobile plant account for a significant section of serious accidents in our industry. An issue that has arisen over recent years has been the use of mobile phones by both mobile plant operators and pedestrians / workers walking in the areas of traffic movement (Michael K. 2009).

Each company must implement a policy in relation to mobile phones (a sample was developed by the Europe Materials Best Practice Group in 2006).

Each company`s policy must include:

- A commitment that all company vehicles or company phones will be accompanied with either a hands free, earphone or Bluetooth system,
- A requirement that the use of mobile phones in the workplace must be restricted to a minimum,
- A clear requirement not to use mobile phones near moving machinery or near areas where moving mobile plant is operating.

Requirements:

1) Mobile Phone policy is to be formulated, drafted and implemented, as a minimum, in reference to the issues highlighted in the sample produced by the Best Practice Group;
2) This policy is to be circulated to all employees and contractors. The policy must be incorporated into the safety induction process for employees and contractors.

7.8 Inspection of interlocks

There has been a number of serious accidents within the group, where interlocks (Figure 7.5) had been bypassed by maintenance staff. It was agreed that each company must introduce a system of formal checks on all interlocks to ensure integrity so that they could not be bypassed.

When inspections reveal that machine interlocks are bypassed, an assessment must be carried out to identify the cause having led to such a bypass. In most cases, maintenance staff bypasses an interlock, as they need to view the process, e.g., to look at a batch. Such requirements must be addressed in risk assessments, and where the problem persists, one should consider the use of the following:

1) A captive key system and/or
2) Position guarding

Requirements:

1) All interlock systems to be inspected on a regular basis (at least monthly). The location manager must arrange that.
2) Where interlock systems are bypassed – the reasons for such modifications should be identified and addressed through the machine risk assessment.
3) Captive Key/Position guards/inching systems must be considered where persistent problems exist.

Figure 7.5 Interlock system (Michael K. 2007)

7.9 Work at height: protecting against falls

Falls from height have accounted for a number of fatal accidents across the group in recent years. This recommendation focuses on four risk control strategies for this particular hazard:

1) The full time presence of a leased/hired/purchased MEWP (Mobile elevating work platform) or “Cherry Picker” on site, where the scale of operation warrants the presence of such a vehicle (Company safety personnel can determine the need based on a risk assessment);
2) The installation of man grids on all hopper/bin openings, where there is a risk that a person may fall into that structure;
3) The use of safety nets during the construction / demolition / modification of plant or buildings (in addition to having a MEWP available) is required. The installation of the nets should only be carried out by a competent contractor;
4) The risk of those working on the quarry top (drilling and blasting operations) of falling over the edge is eliminated through the use of a barrier system. It is important that a safety harness/lanyard is also provided to deal with a situation where a person may have to go in front of the barrier. A safe system of work, with all parts of this system incorporated by the Group Safety Officers.

Risk assessments relating to the work at height must now address the 3 key risk control measures outlined above.

Requirements:

1) The risk assessments for each location within each company should include an assessment for the presence of a MEWP on a full time basis. Please note that formal certified training is required for all those using this vehicle;
2) Man grids should be fitted to all hoppers and bin openings where there is a risk of a person falling into such an opening;
3) Safety Nets to be used for work at height on projects relating to work at height;
4) Barrier systems to be introduced in accordance with the safe system of work.

7.10 Purchase of equipment – safety issues

One factor that emerges in a significant number of machinery accidents is that of a poor design. That would include:

- Lack of safe access for maintenance leading to the increased risk of a fall from height,
- Inadequate guarding,
- For mobile plant, inadequate consideration of the driver`s all round vehicle visibility, e.g., lack of CCTV`s, etc.

When the specification for purchasing new plant and equipment is being drawn up, it is essential that a detailed consideration of the safety issues takes place.

To aid safety personnel specific guidelines were issued in the form of an internal guidance document relating to safety specifications for new plants and equipment.

The guidelines were issued to the Safety BP Group in May 2007, and have now being translated into Polish, Russian, Portuguese, German, Spanish, Turkish, French, Hebrew, Dutch and Finnish.

Requirements:

1) The detailed guidance on safety specifications for the purchase of a new plant and equipment to be circulated to the relevant personnel involved in the purchasing process within each company.

7.11 Haulier safety

A significant section of the workers within the company`s operations are employees and contract drivers of public road HGVs (Heavy Goods Vehicles).

In this regard, it is essential that:

1) A formal system is in place to ensure that all such drivers have received formal safety training for the type of work they will be carrying out. This training must include a detailed section on the hazards of overhead power lines and the precautions required while tipping a load;
2) A pre-qualification procedure is in place to ensure that all drivers and in particular contract drivers are suitably qualified and insured to drive/operate the particular class of vehicles.

This formal training could take the form of:

- SAFEPASS (Ireland)
- CSR (Construction Skills Register) (U.K. and Northern Ireland)
- EPIC Haulier Training (U.K. and Northern Ireland)
- Työturvallisuuskortti (Finland)
- A formal internal safety induction

Requirements:

1) All public road HGV drivers (contractors or employees) operating on behalf of a company must receive formal safety awareness training;
2) This training must include the issue of overhead electric cables and the precautions required while tipping loads (ground conditions, consideration of gradients etc.);

3) Each company must have in place a pre-qualification procedure for contract drivers which covers the issues of drivers' qualification and insurance.

7.12 Review of risk assessments in relation to confined space work

Following EU directive 89/391 on work place safety, countries within the EU were required to introduce legislation relating to work in confined spaces. The UK and Ireland introduced this directive in 1997 and 2001 respectively.

In terms of Europe Materials operations, it was agreed that 2 key approaches should be taken in relation to this issue.

1. The definition of confined space should be worked out in the context of elimination of hazards.
2. All risk assessments must be reviewed to ensure the following issues have been included.
    - 2.1. The need to eliminate work in confined spaces through design and procedure
    - 2.2. Risk assessment and safe systems of work for such tasks to cover
        - 2.2.1. Risk of engulfment
        - 2.2.2. Risk of fire / explosion
        - 2.2.3. Risk of oxygen depletion
        - 2.2.4. Risk of exposure to toxic gases
    - 2.3. Formal planning and resourcing of such work
    - 2.4. No lone working

Requirements:

All safety personnel should review their own internal risk assessments relating to work in confined spaces in regard of these issues.

7.13 Remote / Lone work

Lone working is not permitted in operations unless a detailed risk assessment has been carried out by the company safety personnel or other qualified person. Lone working is not permitted for high risk work such as crushing, drilling, maintenance work (including welding, work with tyres or work at height), electrical work, work at height, confined space work (or other work deemed to be high risk on the basis of the risk assessment).

However consideration must be given to those working remotely i.e. not alone at the location but remote from other personnel, in particular drilling contractors.

Three criteria must be used when conducting such assessments:

1. The health of the person involved
2. Communication – that this person has a means of communication e.g. a mobile phone available to him
3. That the person has detailed work instructions

Requirements:

1. All remote working to be identified and assessed

7.14 Forklift risk assessment

There has been a number of fatal and serious accidents involving forklift trucks within the group in the recent years.

This recommendation requires each company to ensure that the risk assessment for forklift operations at each site takes into account a number of key factors.

The current risk assessments must be reviewed in terms of the following criteria.

1. Any modifications to buckets or forklifts which may restrict the driver`s visibility, e.g., where the height of a bucket has been increased, must be assessed. This must be carried out on each individual forklift truck (in addition to ensuring a seat belt, reverse warning alarm, flashing beacon etc.)
2. Requirements for the use of high visibility clothing in the block areas (including drivers/hauliers) must be in place where forklifts operate.
3. All persons operating forklifts (including maintenance personnel who may only operate the units periodically) must receive the formal training.

Requirements:

1. All current risk assessments to be reviewed in light of the above criteria.

7.15 Lifting operations

There has been a number of fatal accidents within the division which have occurred during lifting operations. Such operations have often involved the use of mobile cranes.

Each company must now review their own risk assessment template to ensure all relevant aspects relating the safety of these operations are being addressed.

Requirements:

1. Companies must now review their current lifting operations/use of mobile crane risk assessments to ensure they include, as a minimum, the following key criteria:

- Control of operation – in terms of appointed persons, banksmen and risk assessment. This risk assessment must also cover methods of communication.
- Pre-assessment of contractors (see recommendation 2) including review of lifting equipment certification.

- Control of the work area in terms of demarcation, control of access, clearances and ground conditions.
- Adequacy of lifting equipment for load involved.

7.16 Overhead lines

There has been a number of fatal accidents and a significant number of near misses within the division relating to mobile plant coming into contact with overhead lines.

This recommendation requires each company to review its risk assessments relating to the hazard of mobile plant contacting overhead lines.

<u>On site</u>

Where overhead power lines are on a company's site, every effort should be made by the utility operator to have these lines placed underground. Where this proves not to be possible, a robust system of protective barriers/goalposts must be put in place.

<u>Surfacing/Contracts</u>

Each company engaged in surfacing work must have a system which assesses each site for the presence of overhead lines prior to work commencing. There must also be a safe working procedure where lines have been identified.

<u>Deliveries</u>

As outlined in recommendation 10, all public road vehicle drivers operating on behalf of a company must have received formal safety training which incorporates the issue of the hazards of overhead lines and actions to be taken in terms of visual inspections etc.

Requirements:

- All companies must now review their system relating to overhead power lines;
- This review must include operational sites, surfacing divisions and driver training.

7.17 Over-pressurization in silos

There has been a number of incidents where over-pressurization in silos has resulted in parts such as filters having been blown some distance from the plant. Blocked filters and damaged or underrated relief valves have been some of the causes of such accidents.

To allow a detailed assessment of this risk – all Group Safety Officers were issued with guidance notes from the BCA (British Cement Association) in relation to the prevention of over-pressurization. The document is called “Guidance to prevent over-pressurization of storage silos during the delivery of powder in the cement, concrete and quarrying industries”.

In terms of onsite silos, a number of basis measures must also be incorporated:

1. The filter should be chained to the silo railing. Maintenance on filters to include, on six monthly basis as a minimum (this is included in the Annual H&S Plan format), an inspection of the condition of both the filter media and the safety valve.

2. The “weight loaded” type pressure release valves should be replaced by a “spring loaded” pressure release valve. Pinch valves should be fitted on fill pipes to prevent pressure going upwards when the silo.

Requirements:

1. All silo over-pressurization protection systems and related maintenance procedures/schedules to be reviewed;
2. Delivery procedures to be reviewed and updated where necessary.

8 CONCLUSION

Building volumes and market competition steadily growing, the company has begun to pay more and more attention to the analysis of risks at concrete factories and in open-cast mines.

The organization of production, which complies with existing requirements and helps the enterprise to regulate risks connected with building, concerns measures of labour safety, and safety at concrete factories, in particular. However, one should emphasize that it would be insufficient without ensuring a proper technical supervision of the special equipment for preparing the concrete mix used at building.

Besides, according to the established rules, for safety observance on erected objects it is necessary to provide regular instructing of operating personnel and other individuals, who can be exposed to risks, on the work safety and health protection connected with manufacture at the enterprise. It can almost be called the main target of the company as workers carry out one of the most important tasks.

For this reason, information on safe work should be included into the obligatory training proramme.

Aiming at work safety and health protection, the organization should consider the results of risk estimation in its daily operation and put them into practice for risk managing. The given information should be documented and ready for actualization**.**

The management of the Rudus Oy Company should pay more attention to this issue as current working instructions have become a little outdated and, for this reason, they should be improved.

Making a conclusion on the made research, one could notice with confidence that the purposes set by the company have been executed and risks have been decreased thanks to the performed analysis.

This work on risk analysis will help Rudus Oy to decrease work hazards on their concrete factories and quarries. The employers will treat their employees in a more careful and responsible way providing them with proper working conditions. Working on that issue was an interesting and valuable experience for me and I can say that I have accomplished the task set.

Hopefully, the positive tendencies consequent on decrease in risk level at the concrete factory Rudus as well as getting control over manufacturing process will bring success to this company.

Rudus Oy has already prepared a thorough risk analysis and working instructions to be used in practice. Compiled work instructions remain in service and information on them is available for each employee. Rudus Oy has been raising their manufacturing appreciably as well as their economic capacity and market share, and aims at further improvements of their safety conditions.

FIGURES

TABLES

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	Object:		**Estonia, Tartu**		Remarks of the previous estimation were used			
	Estimation has spent:		**Lenar Sadykov, Eduard Kuha**					
	Date:		**2/14/2011**					
1. №	**2. Factors of dangers**	**Photo**	**3. Consequences**	**4. Prevention measures / Protection ways**	**5. An estimation of the risks**		**6. Risk**	**7. Necessary measures for risk reduction**
					Weight 1-3	Probability 1-3		
	Physiological (F)							
	The camera:							
1	Conditioner arrangement		The physiological factor which can cause cold diseases	Installation of the conditioners according the rules: there should not be hindrances of normal air circulation, it is impossible to establish opposite to a workplace	1	2	2	Install the conditioners to a correct place
2	Light		Physiological factors which can cause disease of organs of vision	Illumination should be 500 Lm	1	2	2	Install additional illumination

	Probable mechanical (T)							
	Factory territory:							
3	Slipping: Industrial territory, ladders, the courtyard, the wash place		Traumas from falling	Cautious movement, use hooks, strew a sand on the slippery territory	1	2	**2**	Precautionary signs on the wash place
4	Stumble: Industrial territory, ladders, the courtyard, the wash place		Traumas from falling	Care, passes (pure, free)	1	2	**2**	Monthly passes check
5	Work at height, elevating works		Falling, crane falling	Protections, barriers, points of fastening of a safety cable. Use of safety adaptations at work from above 2 meters. Height work training	2	2	3	Instructing to work at height, maintenance of the insuring person at performance of works
6	Work in the closed space		Risk of a lack of air, poisoning and explosion hazard	Instructing, the assistant to the worker, there should not be obstacles in an exit, branch from motive power, maintenance of giving of air	2	2	3	Work alone is forbidden

7	Cable of an emergency stop of the conveyor, buttons of emergency de-energizing		Can not work in an emergency	Should be checked monthly. Check chain short circuit it agree the plan. Rule 7.4 and 7.8	2	2	**3**	The cable of an emergency stop and the button of emergency deenergizing cannot be used for branch from motive power. Use the main switch blocked by the lock.
8	Site transport safety, mobile phone use on a workplace		It is a lot of road accident in factory territory. Speaking by a mobile phone, does not notice moving vehicles	Movement of vehicles on territory of factory with observance of a rule 7.5 and mobile phone use by a rule 7.7	2	2	**3**	Information board with the scheme movement in the territory of the factory and the instruction for a visitors
9	Superfluous pressure in silos		From superfluous pressure filters of cement silos can take off and can receive damages of a design of silos	Filters of silos and the valve of superfluous pressure are checked monthly, according to rule 7.17 CRH	2	2	**3**	Heads should carry out supervision of performance of the rule 7.17

10	Protection of the equipment and branch against motive power		Possibility to be hooked for the moving mechanism.	Protection of the equipment and the instruction on branch against motive power are checked monthly. Rule 7.2 CRH	2	2	**3**	At carrying out of preventive works it is necessary to observe инструкции on branch from motive power and on end of work protection should be established back on the places
11	Work alone, the remote work, work near overhead lines		There is no possibility to assist, to that who works alone. Possibility of defeat by an electric current at work close overhead lines	At work alone spend an estimation of risks. At high risk work alone is not admissible. At work close overhead lines are observe rule 7.16.	2	2	**3**	Works spent alone and work close overhead lines, should be supervised by the head of works.
12	Work with contractors, safety of drivers		Insufficient instructing and bad technical condition of vehicles, lead to dangerous situations and accidents	At work with contractors and safety of drivers observe rule 7.3 and rule 7.10. The general and instructing on a workplace. The contractors vehicles audits.	2	2	**3**	Introduction of the control of instructing of drivers in system Betaks

	Premise of additives:							
13	Absence of baths for capacities with liquids.	**1**	The liquid leaking in a premise is possible	Capacities with liquids should stand in special tight baths	1	2	**2**	To put capacities with liquids in tight baths
14	Electric cable on pumps	**2**	Possibility of blow by a current, short circuit	Dismounting of an electric cable after use.	1	2	**2**	To clean electric a cable and to provide with a separate place
	The weight:							
15	On an internal wall of a premise water flows down on the electric socket	**3**	Short circuit	Near to an electric current it should be dry and electric subjects should be isolated from moisture hit	2	2	**3**	To spend measures on drying and wall hermetic sealing, and also the electric socket
16	The pump is suspended on an electric cable to a metal hand-rail	**4**	Blow by a current	Dismounting of an electric cable after pump use.	1	2	**2**	Special places for fastening
	Courtyard:							
17	Absence of safe loads on external warehouse regiments	**5**	Safe load excess can lead to destruction of warehouse shelves	All warehouse regiments should have a safe load and it should be designated in a prominent place	1	2	**2**	To put a safe load for given regiments, on a face sheet

	Ergonomy (E)							
	Factory territory:							
18	Shortage of air in the lift		Possibility to choke from for air lack	It is necessary to provide достатучную ventilation for all term of work. Rule 7.12 CRH	1	2	**2**	To carry out actions for maintenance of sufficient ventilation
19	Cleaning of the cone	**6**	Cone cleaning is made without the insurance and special elevating mechanisms	According to rule 7.9 of work carried out at height above 2 meters, workers should be provided with the safety equipment and special elevating mechanisms	2	2	**3**	To provide with safety stock and elevating mechanisms
	Chemical (K)							
	Concrete factory:							
20	Danger of inhalation of a quartz dust		Hit in lungs	Use of respirators of class P2 is recommended	2	2	**3**	At the big maintenance of a dust to use распираторы, to beat a dust water, territory clearing. To make gaugings of the maintenance of a quartz dust.

21	Dust in working premises		Silicoz	At factory hygienic measurements for check of the maintenance of an industrial dust are spent	2	2	**3**	On the basis of the received results of measurements to bring necessary actions
22	Carbonic oxide		Air pollution, exhaust gases	To measure pollution level	2	2	**3**	On the basis of the received results of measurements to bring necessary actions
	Psychophysiological (H)							
27	Overtime works		Exhaustion of the personnel	Regulation of changes	2	2	**3**	Regulation of changes
28	Monotony of work		Exhaustion of the personnel		1	1	**1**	
29	Dialogue with contractors		Disagreements, quarrels	To find the general компромисы, respect	1	2	**2**	To instruct for the personnel

Photo 1

Photo 2

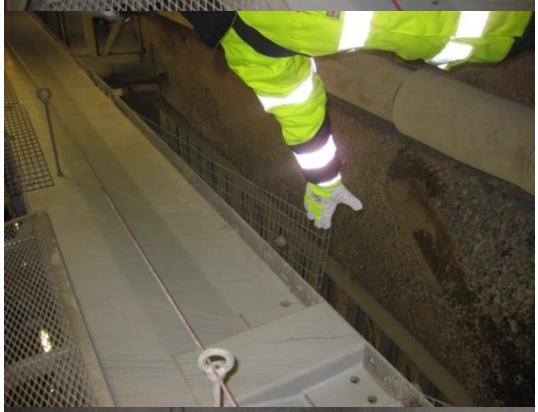
Photo 3

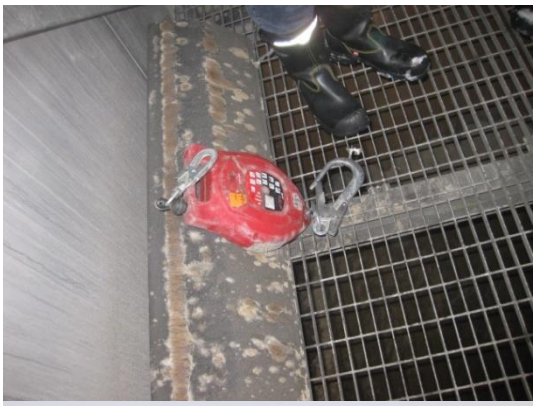
Photo 4

Photo 5

Photo 6


2.16/32






Käytettävä
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Melutaso
ylittää 85 dB(A).
Käytä
kuulonsuojaimia


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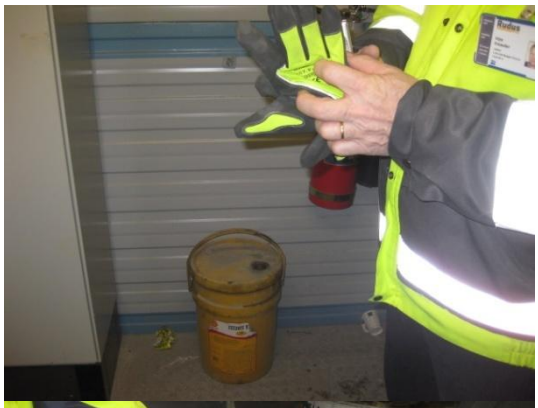


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