

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

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WORK SAFETY DEVELOPMENT FOR RUSSIAN CONSTRUCTION PROJECTS

Bachelor's Thesis 2010

ABSTRACT

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Work Safety Development for Russian Construction Projects, 57 pages,
4 appendices

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The purpose of the thesis was to develop efficient arrangements for work safety in compliance with Russian norms. In addition, the task was to develop extra arrangements for work safety in compliance with Finnish norms. During the comparison of Russian and Finnish norms should be developed new arrangements for work safety for Russian construction companies, which can be useful for many different construction projects in Russia. The customer for this work was the construction company ZAO "SU-11".

The basic material for this study was the project of the organization of construction (POS – general documentation about construction works). Based on it arrangements for work safety in compliance with Russian norms were developed. Also based on Finnish norms further decisions for work safety and arrangements for monitoring of compliance of work safety during construction were developed.

The results can be applied during the design of works. They will be useful also during the execution of construction works in Russia.

Keywords: work safety, ergonomic organization of work, TR-Metering

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1 INTRODUCTION

This thesis was commissioned by the construction company ZAO “SU-11”. Most of the thesis was written in the company's office in St. Petersburg.

The main idea of this thesis is to create new solutions for work safety during construction works, which would help to reduce risks of injury to workers and make work safer. These solutions will be identified during the comparison of Russian and Finnish building norms.

The goal of this thesis is to create solutions for work safety during construction works in accordance with Russian standards. It is also necessary to provide additional solutions in accordance with Finnish norms. On the basis of these materials it is necessary to create new solutions for the company ZAO “SU-11” that will be applied in construction projects.

In the first part arrangements for work safety during different construction works in accordance with Russian building norms will be developed. After that arrangements for work safety in compliance with Finnish norms, which are not typical for Russian standards, will be described. In the end, the decision about the introduction of new arrangements for work safety for the company ZAO “SU-11” will be made.

1.1 Definitions of abbreviations

POS is the project of the organization of construction

PPR is the project of the execution of work

SNiP is building norms and rules

PPB is fire regulations

SanPiN is sanitary rules and norms

2 ABOUT THE COMPANY

Construction department number 11 was formed in 1963 and until 1993 it was part of the trust number 47 "Kirovstroy". The main focus of work at that time was industrial construction. "SU-11" as a general contractor has been involved in the construction and reconstruction of such objects as: "Industrial workshops of the Kirovskij factory", "Hydrolysis factory", "Krasnogvardeets factory", "Vtorchermet factory", mill industrial complex at Predportovaya Station. In 1993 "SU-11" became independent.

The main directions of work of the company ZAO "SU-11" are as follows:

- preparatory works
- earthworks
- stonework
- installation of concrete and reinforced concrete structures
- mounting of concrete and reinforced concrete structures
- mounting of light filler structures
- insulation works
- roofing works
- finishing works
- land improvement
- floor works
- pipelines and networks
- implementation of a general contractor.

In the period from 1993 to 2008 ZAO "SU-11" as a general contractor was involved in the construction and reconstruction of the following objects: the Military Transport University of Railway Troops, bread-baking plants "Zarya" and "Chleb", OAO industrial complex "Himpischearomatika", OAO "ATP-15", Kirov mill industrial complex, OOO "Alternativa Sinici", ZAO "North-West Technology Park", ZAO "DSK-3", residential complex in the district of the village Kaltino and others.

The qualification of senior and middle management contributes to the fact that the company acts as a general contractor. At the present time the size of the personnel is 16 engineers and technicians and about 50 workers. The general director of ZAO "SU-11" Mr. Vyacheslav Bychkov has been awarded the order "Honorary constructor of Russia". (official web-site of the company ZAO "SU-11").

3 MAIN DOCUMENTS FOR WORK SAFETY

The main documents for work safety, which are used in the execution of construction and installation works in Russia are:

- SNiP 12.03-2001 Work safety in construction. Part 1. General requirements
- SNiP 12.04-2002 Work safety in construction. Part 2. Construction execution
- PPB.01.2003 Fire safety regulations by the execution of construction and installation works
- PB 10-382-00 Rules of design and safe exploitation of cranes
- SanPiN 2.2.3.1384-03 Hygienic requirements for the organization of building works.

These documents are fundamental in the development of arrangements for work safety. On this basis specific arrangements for work safety consisting of the POS and subsequently of the PPR are developed.

The project of the organization of construction (POS) is a document, in which the issues are resolved to enlarge the rational organization of the construction of the whole complex of objects on the building site. The creator of POS is the general design organization.

The project of the execution of work (PPR) is a document, in which the issues of rational technology and the organization of the construction of a specific object on the building site are elaborated. The PPR on the basis of POS is developed

by the general contractor. The PPR is developed on the stage immediately preceding the execution of work.

An important element of the POS and PPR is an explanatory note. It describes conditions and complexities of construction, arrangements for work safety, environmental protection, the size of storages, number and size of auxiliary temporary buildings, calculation of engineering networks, the choice of machinery and equipment (Telichenko et al. 2006, pp. 8-9).

Construction is one of the most traumatic industries. The very specificity of construction work is characterized by its increased risk to others, e. g. in the erection of tall buildings, the use of sophisticated technology and technological methods of work and digging of underground utilities. The result is the detailed regulation of construction works (building norms and rules, as well as other documents in this area), and also the administrative and criminal liability for violation of these rules is established.

First the liability of workers is discussed. For disciplinary delinquency, i. e. non-fulfilment of their own obligations) the workers may suffer such punishment as reprimand, penalty or discharge from work.

Also officials can go to trial for a violation of work safety norms. The main documents, which contain information on the violation of these norms, in Russia are codes of administrative violations and crime. For small breakings of law in a construction area administrative responsibility (penalty) exists. But if the accident entails serious consequences (permanent injuries or death) the responsible person (foreman, site manager, general director, etc.) will suffer criminal punishment (a prison term).

4 ARRANGEMENTS FOR WORK SAFETY IN COMPLIANCE WITH RUSSIAN NORMS

This chapter describes main arrangements for work safety during different types of works in compliance with Russian norms. The main idea is to tell shortly about all arrangements during each type of work (storage of building materials, personal protection equipment, safety by moving goods, etc.). These arrangements are very important during the construction execution. Their violation may lead to human death.

4.1 Storage of building materials

Materials and equipment should be placed on the level-headed and rammed areas, and in winter on an area cleaned of snow and ice. The diversion of surface water through drainage ditches should be organized from storage areas. On the storage between stacks should be left a gangway of a width not less than 1,0 m. And if there is movement of vehicles through the zone of storage the width of passages should be not less than 3,5 m. Materials should be stored in stacks of the same brand. Stacks should have nameboards facing the gangway with the number and type of products. Linings and paddings in stacks should be placed in a vertical plane near the hairpins, and their thickness by storage panels, blocks etc. must be more than obtrusive hairpins on 20 mm. The use of the paddings of circular section for the storage of building materials in stacks is prohibited.

When you work on a stack with the height of more than 1,5 m you should use an inventory portable ladder. It is not allowed to lean (prop up) materials and products on the fences and elements of temporary and permanent structure. The distance from the stacks of materials and equipment to edges of grooves (foundation pits, trenches) must be assigned to the stability analysis of slopes (fastenings), as a rule, outside the prism of the collapse, but not less than 1,0 m from the edge of the natural slope or the fastening of a groove. Rolled steel, steel pipes, reinforcing mesh, sheets of dry plaster, mineral wool and finish must be stored under the roof. Silty materials should be stored in silos and

bunkers, and friable materials in stacks with slopes: sand – 1:2, gravel - 1:1,5. Materials and products should be stored not less than 1 m from the edge of the foundation pit. (Grabovoy P.G. 2006, pp. 148-152) Appendix 1 shows the scheme of the storage of building materials.

Russian companies often do not give big consideration to the correct storage of building materials. Only few of Russian building sites have well equipped areas for the storage of building materials. Most problems are with the storage of steel (it is often outdoor without a protection apron) and bulk solids (with not correct slope). The most reason for it is that construction companies do not give big consideration for storage areas during the preparatory period. So, this problem can be solved if supervisors force building companies to make correct areas for storage.

4.2 Personal protection of employees

By the execution of construction works all workers and engineers at the building site must wear protective helmets. Employees who are working on an open area in the cold season should be provided with a set of personal protective equipment from the cold. In order to avoid local cooling workers should be provided with gloves, footwear and headgear for a specific climatic region. When the air temperature is below minus 40⁰C then should be provided with the protection of the face and upper respiratory tract system. In terms of heating the working temperature should be maintained at a level no lower than 21⁰C. Breaks for heating (first - 10 min., other - 15 min.) give the obligatory stay indoors for heating in order to normalize the thermal condition of workers.

It is necessary to reduce dust by the dismantling of structures. Employees in dusty conditions should be provided with respiratory protection from dust in the air. In the execution of finishing works (filling and the painting of surfaces) respirators and goggles are used.

In Russia the majority of building companies think only about general personal protection equipment (helmets, working clothes). The situation with specific

personal protection equipment (headphones, goggles, signal vests, etc.) is not so good. This problem can be solved only by strengthening the role of labor unions or with big penalties to companies.

4.3 Safety work at height

It is not allowed to admit anyone to work at height if workers have not received detailed training at the workplace about safe methods, practices and the conditions of work at height. It is necessary to take care of the cleanness and adequate illumination of workplaces and gangways to them on the building and scaffolding. Foremen must immediately protect people by checking the construction process areas and zones, which are dangerous, e. g. openings on floors, exits to not-fenced balconies, landings, flights of stairs, or to close the gangway to these places.

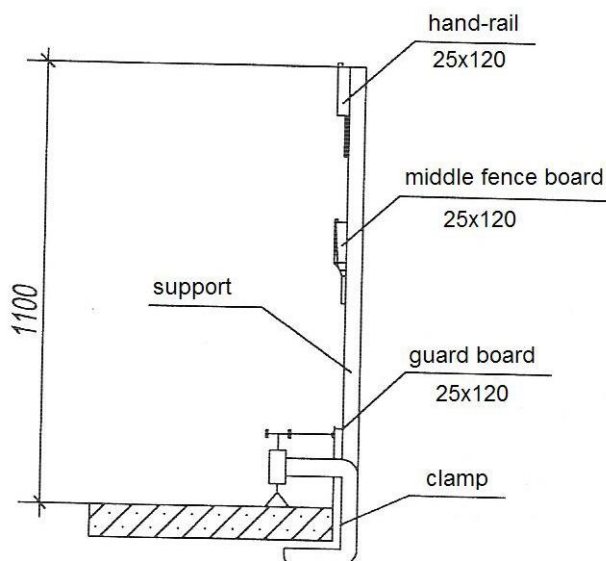


Figure 4.1 Scheme of ceiling barrier (Telichenko V., Teren'tjev O. & Lapidus A. 2006)

If it is not possible to use protective fencing the work must be executed with the use of a safety belt. Safety belts must be certified and tested in the prescribed manner.

There are two main options for fixing the worker to structure:

- Option 1: the safety belt is fixed to a safety hinge, which should be laid by the fulfillment of a reinforcement of walls (ceiling). The safety hinge is made of reinforcement AI with the diameter of 10 mm.
- Option 2: the safety belt is fixed to the anchoring device, which is installed in the remaining after the dismantling of form panel tension bar hole. Before the use it should be tested with the static load of 4 kN (time of application 5 min.).

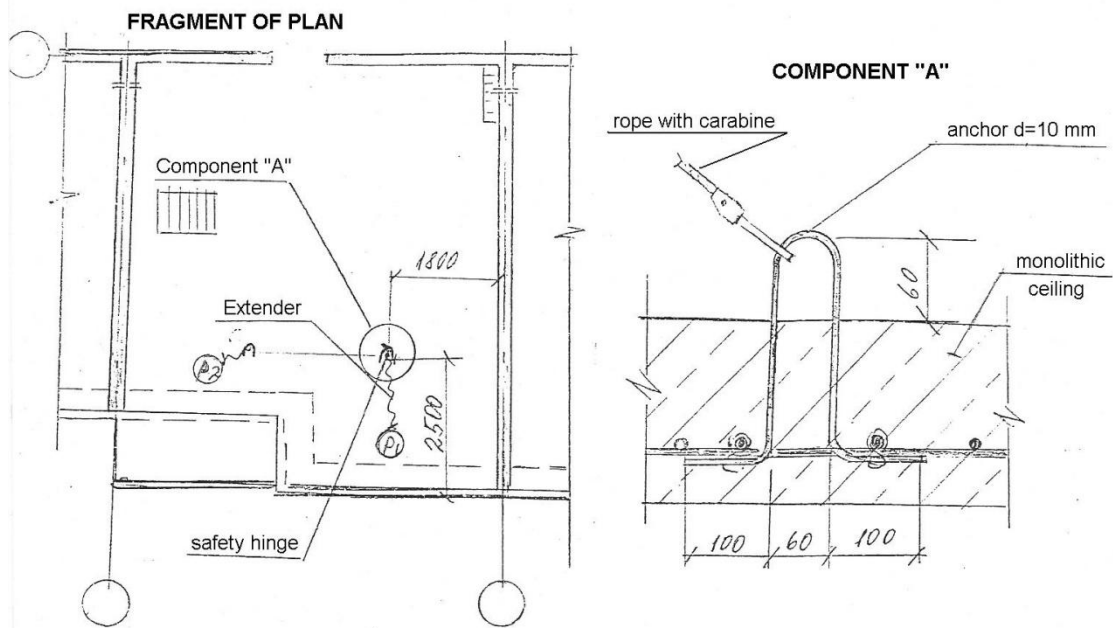


Figure 4.2 Fastening of the worker to a safety hinge (Telichenko V., Teren'tjev O. & Lapidus A. 2006)

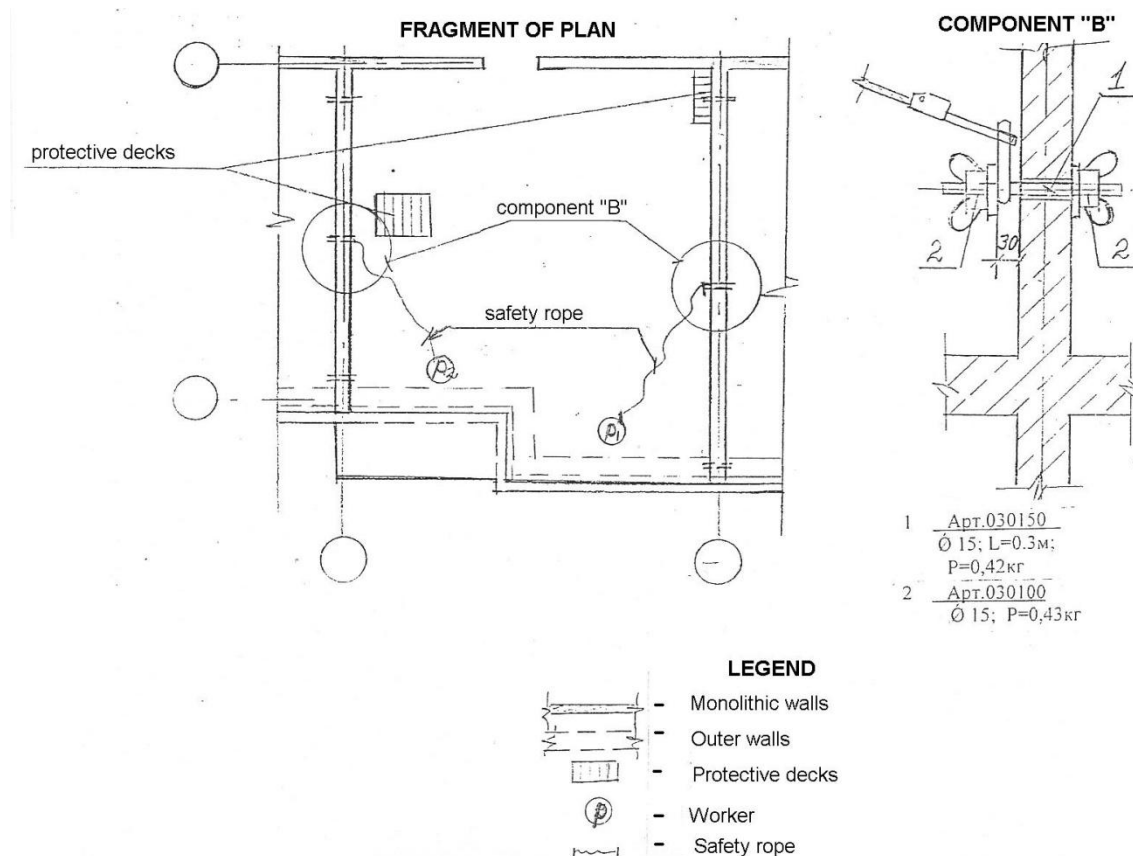


Figure 4.3 Fastening of the worker to an anchoring device in walls (Telichenko V., Teren'tjev O. & Lapidus A. 2006)

The situation with personal protection equipment for height works in Russia is quite good, because these are dangerous works and everybody from the company management understands this. So, usually companies have good equipment. Some workers, especially industrial alpinists, have their own good equipment.

But the situation with areas and zones, in which there is the danger to fall from a height is not very good. These arrangements need a lot of money from the company's budget. And often companies do not want to spend money to this. This problem can be solved with the increase of responsibility for the violation of these norms by the company management.

4.4 Safety when moving goods

Before a crane operator's assistant on the ground starts his job he must obtain instructions from the person who is responsible for the safe work of cranes on building site. He must check hauling devices and packing before moving goods. Condemned hauling devices and packing should not be on the building site.

During the work the assistant must avoid the suspension of the cargo on the hook by other people. It is necessary to select hauling devices (packing) in compliance with the mass and character of the lifted load, according to the schemes of strapping. The strapping of removable elements should be produced in places, which are specified in the working drawings (the schemes of strapping). We must ensure the lifting and supply of components to the installation place, which is close to the project. The lifting of load, which does not have a scheme of strapping, should be executed in the presence and under the direction of the person who is responsible for safe operations with cranes.

Before the lifting of each element it is necessary to check:

- its compliance with the design mark
- status of embedded items
- availability of marking hairlines
- lack of mud, snow, frazil, damage of the surfaces of facets and edges
- equipment (in accordance with PPR): scaffold, ladders, barriers
- accuracy and reliability of the fastening of hauling devices.

Before the assistant gives a signal for the moving of goods he must:

- make sure that the load has no free objects and that the load can not catch on something
- make sure that there are no people on the way of moving goods
- stretch slings, give a signal to the crane operator to lift the load by 20-30 cm and verify the accuracy of strapping

- move away from the load at a safe distance in the direction which is opposite to the way of moving goods and give a signal to the crane operator to move the load.

When goods are moving the assistant must:

- watch that the load does not move above people
- watch that the cargo moves over mounted structures or their obtrusive parts at a distance of not less than 1,0 m horizontally and 0,5 m vertically
- in the event of immediate danger to signal to the crane operator to stop the movement of the cargo.

By lifting, lowering and moving of cargo the assistant must go to a safe distance in the direction opposite to the displacement of the load. The assistant can stay near the cargo if the cargo is at a height of not more than 1 m above the ground. It is not allowed to load or unload a car when people are in the body or in the cab of the car. Figure 4.4 shows the safe operating procedures for unloading cargo from the car.

The lifting and moving of small-pieces and friable goods must be done in specially designed containers for this. The lifting of bricks or small blocks on pallets without fences is permitted only during loading and unloading on the ground or on the car. Before the strapping of friable goods the surface of the load must be leveled so that the distance from the upper edge of the container to the surface laid down in the packaging material is not less than 10 cm, and the edges of the container must be cleaned from adhering material. Before the lifting of the cargo which is longer than 6 m it is required to fix on it stays that prevent it from rocking and rotation. Appendix 2 shows the schemes of strapping goods.

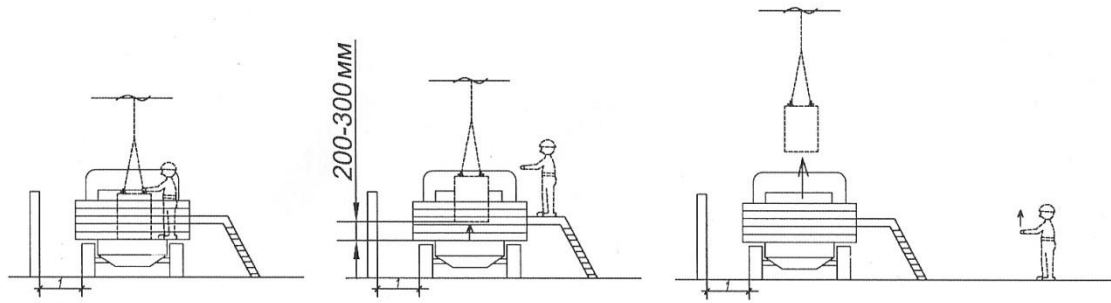


Figure 4.4 The order of the safe unloading of cargo from the car (Grabovoy P.G. 2006)

Due to the lack of visibility of crane operators when the load is fed to the working place, work must be done through a signalman. The signalman must be on the upper part in the visibility of the crane operator, outside the danger zone of the moved load. In this time the signalman and the crane operator should have an intercom system. During the work of the signalman the prevention of falling from height must be ensured on the ceiling (Paragraph 4.3).

The main problem with safety when goods are moved in Russia is that this work is done by employees, who do not have education and permission for this job. Only few companies have their good trained crane operator assistants. It leads to the incorrect strapping of goods and injuries. This problem can be solved by two ways:

1. extension of the number of qualified assistants in companies;
2. holding regular lessons to workers, where employees can get information about the safe methods of moving goods.

4.5 Safety when executing reinforcement works

Before the beginning of work fitters should:

- put on working clothes, shoes and a protective helmet
- check the workplace and its approaches for compliance with safety requirements
- prepare production tools, instruments, accessories.

Warehousing and the billet of reinforcement should be made in specially designated for this purpose and accordingly equipped places. When billets are reinforced is it necessary to:

- put on goggles
- protect places for the straightening of reinforcement
- use devices that prevent from flying rocks by cutting reinforcement bars into segments of less than 0,3 m
- cut only reinforcement the diameter of which and steel grade correspond to the published data of the used machine
- protect the workplace by the processing of reinforcement bars, which are longer than the dimensions of workbenches
- close with shields the butt parts of reinforcement bars in places of common passageways with a width of less than 1 m.

The elements of reinforcement frames should be packaged with the conditions of their lifting, storage and transportation to the place of mounting. It is necessary to lay wooden linings between reinforcement frames by transportation. When installing the reinforcement such procedure of work is adopted, in which the previously set elements do not interfere with subsequent mounting. A protective layer and the distance between the rows of reinforcement must be provided. In places, which are close to electricity cables is it important to ensure the measures against the exposure of workers to electric current.

The assemblage of reinforcement frames of vertical structures is made on the decks with a minimum width of 0,8 m and with railings. It is prohibited to walk on ready reinforcement of floor. To move from one workplace to another fitters must use ladders, traps, step-ladders. For passages through deposited reinforcements traps with a minimum width of 60 cm on supports mounted on formwork are placed. Parts of reinforcement that are abandoned after concreting should be bent at 180° or marked with red flags. In places of mass gangways reinforcement parts must be protected.

An open reinforcement, which is near to the part under electric curing of concrete is subject to ground connection (grounding). The acceptance of mounted reinforcement is made with a statement of covered-up works.

In general, the situation with safety when executing reinforcement works in Russia is quite good, because all ready-mounted structures are controlled by engineering supervision. If something is wrong, the building company must correct it. There are only small problems with old equipment for welding. But lately companies have bought new modern equipment for this purpose.

4.6 Safety when concreting structures

Before the beginning of work concretors should:

- show a certificate of the examination of safe methods of work
- put on working clothes, shoes and a protective helmet
- check the workplace and its approaches for compliance with safety requirements
- prepare production tools, instruments, accessories which are necessary for carrying out the work and verify their compliance with safety requirements
- check the integrity of formwork and scaffolding.

Concretors should not start work by violating the requirements of work safety; by the absence of fencing of the work place, the height of which 1,3 m or more; by the faultiness of industrial equipment and instruments; by the poor illumination of working place.

It is not allowed to place on formwork equipment and materials, which are not provided by the PPR, and also people who are not directly involved in the production of works. For the passage of concretors from one workplace to another special systems of access (ladders, traps, foot-bridges) should be used. For the passage through deposited reinforcement traps with a minimum width of 60 cm on supports mounted on formwork are placed. Concretors are not allowed on the elements of building structures and on bunkers with

concrete. The formwork of ceiling must be fenced around the whole perimeter. All openings in the floor formwork should be closed. If you want to keep the holes open, they should be delayed with a wire mesh. To prevent the collapse of formwork from the action of dynamic loads (concrete, wind etc.) is it necessary to arrange the additional fastening of formwork. Attachment points as well as additional requirements during concreting with the use of formwork of the used type are specified in the project, which is developed by the owner of formwork.

By the delivery of concrete with dump trucks when the machine is moving concretors must be on roadsides in the field of visibility. The unloading of dump truck should be made only after a full stop and by a raised body. The raised body should be cleaned from concrete with a shovel or scraper with a long handle. When unloading high-discharge mixers it is prohibited to speed up unloading with shovels and other hand tools. The cleaning of drums and troughs of mixing machines is permitted only after stopping the engine and the dismissal of voltage with hanging on knife-switch a poster "Do not include - working people!". Delivering concrete to bunkers and buckets transportation should be executed only by closed shutter. When you receive concrete from a bunker the distance between the bottom edge of the bunker and earlier as cast concrete shall be not more than 1 m. The giving of concrete in the formwork should be smooth, with small portions, to avoid shock loads on formwork by the fall of concrete.

It is allowed to disassemble and remove the formwork only with the permission of the foreman. When disassembling measures against the accidental fall of formwork's components should be taken. The elements of collapsible formwork should be lowered to the ground after sorting out and removing the obtrusive nails, staples. Elements of formwork on scaffolding or working decks cannot be stored, or thrown down from the height.

Concretors with a group II of electrical safety are allowed to work with electrovibrators. The following requirements must be fulfilled when compacting concrete with electrovibrators:

- disable the electrovibrator during outages and when passing from one place to another
- do not move the vibrator behind live parts
- do not work with vibrators from ladders
- every 30-35 minutes switch off the vibrator for 5-7 minutes for cooling
- hang up the wiring of the vibrator, and not to lay on the freshly placed concrete
- close electrovibrators during rain or snowfall.

When breaking concrete surfaces with pneumatic chippers is it not allowed to execute works when there are people below the place of work on the same vertical line. If you find fault in fixing formwork, power tools, the appearance of voltage on not concrete-enveloped reinforcement you must stop working and inform the foreman. It is not allowed to work when the wind speeds up to 15 m/s or more, or during storms, snow or fog.

The main problem with work safety in concreting the structures is that often for this job workers with insufficient knowledge are used. They often do mistakes, which can cause serious injuries. This problem can be solved by regular lessons to workers, in which they can study safe methods of work.

4.7 Arranging lighting on the building site

In accordance with SanPiN 2.2.3.1384-03 "Hygienic requirements to the organization of construction and construction works" working, emergency, evacuation and security lighting are organized at the site.

Working lighting is provided for all building sites where work is performed during night and twilight time of day, and is made by plants of general and combined lighting. For areas of work where normal levels of illumination should be more than 2 lux, in addition to even illumination, the localized illumination should be include. In areas, where people work only temporarily, the levels of illumination can be reduced to 0,5 lux.

Emergency lighting is provided in places of work when concreting main structures in those cases, when by the technology a break during concreting is impossible. In areas of concreting of reinforced concrete structures lighting should provide the illumination of 3 lux, and on the parts of concreting of body 1 lux at the level of concrete is enough.

Evacuation lighting is provided in places of the main way of evacuation, and also in gangways, where there is a risk of traumatism. Evacuation lighting inside the building under construction provides the illumination of 0,5 lux, outside the building - 0,2 lux.

For security lighting is it necessary to mark out part of the lamps of the working lighting. Security lighting is provided at the boundary of a building site with horizontal illumination of 0,5 lux at the ground level or vertically - on a plane of a fence.

The situation with lighting on Russian building sites is very different. It depends on the company. Only way to solve the problem with lighting is the increase of responsibility for the violations of these norms.

4.8 Fire safety

A responsible person for fire safety in construction works should be appointed from the technical and engineering employees of the organization. All workers, who are employed in production, should be allowed to work only after passing fire instruction and additional training about fire protection. Signs with the phone number of fire prevention and scheme with evacuation system in case of fire should be displayed at the workplace. At the workplace fire positions, which are equipped with fire extinguishers, sand boxes and shields with the tools must be set. All equipment must be in good condition.

On the territory of the building site and doghouses it is forbidden to make fire, use open fire or smoke. Smoking is allowed only in areas specifically designated and equipped for this purpose. There have to be a barrel with water.

Electricity should always be kept in good condition. After work you should switch off knife-switches of all plants and working lighting. You should leave only emergency lighting. Illumination should be equal, without the dazzle for workers. Work in dark places is not allowed.

Workplaces and approaches to them must be kept clean all the time. Outside fire-escapes and the fence on the roof must be kept in good condition. Driveways, walkways, entrances to the water sources, location of fire equipment and fire alarm should not be obstructed.



Figure 4.5 Fire shield on a building site (http://www.movdpo.ru/stend22_06.html)

The networks of fire line must be in good condition and ensure the required standards for water consumption in case of fire. The check of their efficiency should be made at least twice a year (in spring and autumn). Fire hydrants must be in good condition.

For the heating of doghouses factorial steam and water heaters and electric heaters should be used. Drying clothes and shoes should be done in a specially adapted rooms with a central water heating or the use of water heaters. Cleaning cloths and other materials should not be dried on the heating devices.

Oiled working clothes and rags and containers of flammable substances should be stored in closed metal boxes and removed after work. A car with leaking fuel or oil, and with an open fuel filler must not left on site. Spilled fuel and oil must be filled up with sand, which should be removed afterwards.

A welding set should be grounded during work. Above portable and mobile electric welding sets, which are used outdoors, the awnings of incombustible materials for protection from rain must be constructed. Workers and engineers, who are engaged in the production, must:

- comply with the requirements of fire safety, as well as to observe and maintain the fire regime during work
- carry precautions when using hazardous substances, materials and equipment
- in case of fire report about it to the fire department and take actions to save lives and eliminate the fire.

The situation with fire safety in construction works in Russia is quite good. The main reason for it is that firemen have very big influence on builders. They often carry out the inspections of building sites in accordance with fire norms. If something is wrong, they can stop the work or impose a big fine to the company. But the problem is wide corruption in this organization. This problem must be solved by the government.

5 ARRANGEMENTS FOR WORK SAFETY IN COMPLIANCE WITH FINNISH NORMS

Main arrangements for work safety in any kind of construction works in general are similar in Russian and Finnish standards. But in Finland the value of labour is higher than in Russia. So, requirements to work safety are also stricter. Finnish labour unions play also big role in the execution of work safety norms. In table 5.1 you can see the comparison between Russian and Finnish norms.

Table 5.1 Comparison between Russian and Finnish norms

No	Item	Russian norm	Finnish norm
1	Lighting	At the site working, emergency, evacuation and security lighting is organized. (SanPiN 2.2.3.1384-03)	The construction site and especially traffic routes shall be provided with enough general and special lighting. (Government Decision on the Safety of Construction Work 629/1994)
2	Personal protective equipment	By the execution of construction works all workers and engineers at the building site must be in protective helmets. Employees who are working on an open area in the cold season should be provided with a set of personal protective equipment from the cold. (SNiP 12.03-2001)	Persons shall use safety helmets on construction sites when work is carried out in circumstances where knocks or blows to the head can happen. When necessary, a hood shall be worn under the helmet. (Government Decision on the Safety of Construction Work 629/1994)
3	Protection against falls	Foremen must immediately protect workers in the construction process areas and zones which are dangerous for fall from a height (openings in floor, exits to not-fenced balconies, landings, flights of stairs etc.) or close the gangway to these places.	When carrying out work at height, the work platforms and equipment for lifting persons shall be fitted with protection against falls, or safety nets or other protective structures attached to the main structures shall be used. If the nature of the work does not allow such equipment or structures to

		<p>If it is not possible to use protective fencing the work must be executed with the use of a safety belt. (SNIIP 12.03-2001)</p>	<p>be used, such safety belts with ropes shall be used that are appropriate for the purpose. The ropes shall be attached safely.</p> <p>If the safety equipment is not in place, access to danger zone shall be prohibited through a reliable way, e.g. posting a guard.</p> <p>(Government Decision on the Safety of Construction Work 629/1994)</p>
4	Lifting	<p>Before the crane operator's assistant starts his job he must obtain instructions from the person who is responsible for the safe work of cranes on building site. Due to the lack of visibility of crane operators when feeding of the load to the working place, work must be made through the signalman. (SNIIP 12.04-2002)</p>	<p>If the user of the crane or other lifting equipment cannot continuously control how the load moves, a signaller shall assist the user. The impact of weather conditions on the safety of lifting work shall be examined before the work is begun.</p> <p>(Government Decision on the Safety of Construction Work 629/1994)</p>
5	Fire and explosion hazard	<p>Responsible person for fire safety shall be appointed from the technical and engineering employees of organization, which executes the work. All workers, who are employed in the production, should be allowed to work only after passing fire instruction and additional training about fire protection. At the workplace signs with the phone number of fire prevention and scheme with evacuation system in case of fire should be</p>	<p>The construction site must be provided with appropriate fire fighting and fire alarm equipment and safety signs. When necessary, the construction site shall be provided with equipment for detecting fire. The first-hand extinguishing equipment shall be easy to take into use. The responsible person shall ensure that there are enough persons familiar with first-hand extinguishing on the construction site.</p> <p>(Government Decision on</p>

	displayed. At the workplace fire positions, which are equipped with fire extinguishers, sand boxes and shields with the tools must be set. All equipment must be in good condition. (PPB.01.2003)	the Safety of Construction Work 629/1994)
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The differences, which I will describe in more detail in the thesis, are as follows:

- a clearer description of the rules and a wider range of personal protection equipment for workers
- high priority given to the ergonomic organization of work
- written notice of the situation close to the accident
- the use of TR-Metering as a tool for the objective estimation of the compliance of work safety rules on the building site.

First, about personal protection equipment. As was told earlier, the situation with personal protection equipment in Russia is, that workers in general have only a basic set of equipment (a helmet, working clothes). And with other specific equipment the situation is worse. Only few companies give their workers special personal protection equipment. But in Finland almost every worker has a big set of personal protection equipment. The main reason for this is the important role of labour unions and high penalties to companies if an accident happens. So, in chapter 5.1 there is the detailed description of personal protection equipment, which is used on Finnish building sites.

Also Finnish labour unions promote in Finland the use of auxiliary tools for the improvement of ergonomics on building sites. Because of this the workload of employees is lower. In Russia it is quite new. However, in Russia most companies are interested in long-term work with good qualified employees and this information will be for them quite useful.

As for the written notice of the situations close to the accident, in Russia the situation on building sites is often that foremen do not want to give information

about small accidents to their boss. It can affect their salary, so they prefer to hide this information from their boss. But the introduction of the written notice of the situation close to the accident can change this practice. In Finland such a system has existed quite a long and brings a lot of advantages.

TR-Metering is quite a new method of the objective estimation of the compliance of work safety rules on the building site for Russian companies. The introduction of this method in Finland has brought Finnish companies a lot of advantages, such as: possibility to estimate the compliance of work safety rules on each building site; compare the situation with work safety on different building sites; estimate the efficiency of money given to work safety; etc.

The introduction of these arrangements in Russian companies will significantly reduce risks associated with work safety.

5.1 Personal protection equipment

For the personal protection of workers in construction the following items are needed:

- protection of the head
- hearing protection
- eyes and face protection
- protection of the hands
- protection of the feet
- protection of the skin
- protection of the whole body (including the fall).

In the following paragraphs 5.1.1 – 5.1.12 there is information from the book of H. Koski and T. Mäkelä called "Raturva 2" about personal protection equipment.

5.1.1 Protection of the head

Protective helmets are used in construction in all works, where falling objects can cause injuries of the head or you can get a blow on the head. When moving

on the building site everybody has to wear a protective helmet. On the helmet, if necessary, you can attach ear protection, goggles and respirator. Under the helmet there can be a liner. When selecting a protective helmet workers should pay attention to its weight, the way it sits, the possibility of regulating the size and that it does not fall from the head.

The use of protective helmets on the building site is the first criterion, which shows how in this construction company things are going with work safety. If all workers on the building site have helmets, it shows, that the company gives consideration to the health of their workers. Work without protective helmet is very dangerous and shows that the worker and construction company do not think about work safety.

The use of modern protective helmets with fixed headphones in Russia will have a good impact on the image of the construction company. It will show that the company cares for their workers.



Figure 5.1 Protective helmet with fixed headphones (http://www.trakt.ru/catalog/198/?SHOWALL_1=1)

5.1.2 Hearing protection

The employer must provide workers with individual ear protection equipment if noise levels exceed 80 dB. Headphones must be used if the noise at the workplace is 85 dB or more. The employer is obliged to plan and implement a

program to eliminate the noise. The noise level, which is measured inside the headphones, should not exceed 87 dB. If the noise level goes beyond fixed borders, the employer must ensure that workers use hearing protection.

One of the so called harmful daily doses of noise is received at work, for example, in the following ways:

- 8 hours at a noise level of 85 dB
- 15 minutes at a noise level of 100 dB (for example, circular saw)
- 1 minute with the noise level 115 dB (for example, angle grinder).

The noise from strokes (such as a pneumatic nail gun) can cause more deleterious effect than the equal noise.

The main hearing protection is earplugs and headphones. Earplugs are placed in the ear canal. Headphones close the whole ear completely, they can be connected as a shackle, and attached to a protective helmet.

Earplugs and headphones can be very useful for workers on Russian building sites, because there are no special protection from noise and zones with big noise are not marked. So, this hearing protection can help workers to reduce harmful effect from noise.

5.1.3 Eyes and face protection

Goggles in a spectacle frame, which also has side protection, are used for the protection of eyes usually. If necessary, you should use a face shield. For the protection of the face various shields and masks, as well as liners, which can also be used as respiratory protection are fit.

Eyes and face protection is very useful for Russian workers, especially during reinforcement works. Work without goggles or face shield can cause injuries. If the worker has on eye injury, he cannot work for a long time. So, the employer is interested in eyes protection, because he does not want the worker to be absent for a long time.

5.1.4 Protection of respiratory ducts

Respirators are used to remove harmful pollution such as dust, steam and gas from the inhaled air. They should be used when the content of the air pollution exceeds acceptable standards or if the oxygen content in the air is too low. Respirators should be used in the processing of wood, especially harmful dust is hardwood.

Respirators can be divided into two groups:

1. Filters (the user receives air through the filter)
2. Isolation (the user receives air from an external source)

By the design respirators are divided into light or disposable, half masks, full masks and mechanical masks. Respirators consist of a front part (in half masks or full masks) and attached filter or breathing apparatus. Disposable lightweight respirators, that cover the nose and mouth, are suitable only for filtering dust.

The protection of the respiratory ducts can be very useful in Russia, especially during rig-down operations. Dust can lead to serious diseases. If the employer is interested in long-term work with his worker, he needs to give him good protection of the respiratory ducts.

5.1.5 Protection from the fall

Different types of safety belts and leashes are used as personal protection equipment against falls from the height. Depending on the purpose, protection from the fall is divided into three groups:

1. Systems that stop the fall

With their help injuries from the possible free fall of the worker are prevented.

2. Protection, which prevents the fall

With its help workers are supported in dangerous positions so that the fall cannot happen.

3. Protection that prevents the hit to the danger zone

A safety belt with a rope fixed to it prevents the hit of a worker.

Safety harnesses with a belt with enhanced durability are also recommended for use at work on scaffolds.

The modern systems of protection from the fall can be useful in many Russian construction companies, because they can save human lives. The use of modern systems of protection from the fall can have a significant effect, because the use of other arrangements for protection from the fall is more expensive and not so popular on Russian building sites.



Figure 5.2 Safety belt (<http://www.asiaexportgroup.kz/?q=node/300>)

5.1.6 Special clothing

The help of special clothing and signal vests, i.e. vests with light-reflectors, provide the visibility of workers in all lighting conditions. Warning clothes are sewn from two kinds of tissues, from the fluorescent base, which is clearly visible in the fog and darkness. Ribbons on these clothes are made of retro-reflective material. Fluorescent-based material should cover the entire body, and it should be used on pants and sleeves. Depending on the visibility warning clothing is divided into the classes of protection 1-3, where class 3 means the best visibility and is, for example, for road patrol.

It is recommended to choose clothing with reflectors, which provides the visibility of workers on the building site without additional funds. Visibility must be maintained also in cases, when a worker uses, for example, a worker vest.

The use of signal vests will have a good impact on the image of the construction company. Also this arrangement will have a good effect on the reduction of injuries at the building site, because all employees see each other better, especially in the night time.



Figure 5.3 Signal vest (<http://www.keil.ru/index.php?categoryID=2287&offset=30&sort=Price&direction=ASC>)

5.1.7 Working clothes

In construction protective clothing consists of two parts, which protect from dirt, dust, humidity and cold. Working clothes usually have pockets and loops for the transfer of personal protective equipment, tools, etc. For different weather conditions different clothing, for example, for rain a raincoat and for cold a warm coverall should be provided. The characteristics and needs of workers must be taken into account when choosing working clothes.

Modern comfortable working clothes are one of the most important personal protection equipment for every worker. Every construction company must

provide their workers with working clothes for different weather conditions. For Russian companies it is especially important, because the temperature difference during a year is very high (40⁰ - 90⁰ C).

5.1.8 Special gloves

Protective gloves are used for the protection of hands from injuries and various influences. Gloves can protect against the following influences:

- mechanical (cuts, stab-wounds, rub);
- chemical;
- thermal (heat, cold and spray of molten metal)
- biological.

Additional gloves, protective tape, protection for fingertips and palms can be worn under protective gloves. Protective gloves are made of different materials, the choice of which depends on the requirements of protection, quality of work and risk. The most commonly used materials are rubber, plastic, textiles and leather, as well as their combinations. Special gloves are made of coal, glass and metal-fibre.

All employers should provide their workers with protective gloves, because hands are the main tools for every worker. Russian employers must provide their workers with different types of protective gloves (not only with cotton gloves!), because different work needs different protective gloves.

5.1.9 Special footwear

Safety characteristics, structure and model of special footwear should be chosen in accordance with a probable risk during work and the features of workers. Symbols on shoes indicate from which danger they protect. During construction works leg injuries can be caused by:

- mechanical factors (falling, sliding and sharp objects, chain-saw and slippage)
- touching objects which are under voltage

- chemical factors (acids, alkalis, solvents, flammable materials, mineral oil, grease and moisture)
- thermal factors (heat radiation, heat and cold).

Workers should compare different models of footwear before they find suitable footwear for themselves. Material, size, weight, heel, the risk of slipping during operations, flexibility of shoes, and the purpose of use should be taken into account when choosing special footwear. Workers should have different footwear for different conditions, for the winter and summertime.

The use of modern protective special footwear on Russian building sites can help to avoid injuries from sharp objects, e.g. nails and glass, which are under foot. This equipment will be very useful, because mostly building sites in Russia are strongly littered with construction waste.

5.1.10 Protection of knees

Knee-caps are designed for the protection of knees from stress, moisture, and harmful substances that may enter the skin through clothing when workers work on their knees. Knee-caps should be made of flexible materials, usually a polymeric material, rubber or leather. Knee protection can be packed and inserted in the pockets of coveralls on someone's knees, or for tighter protection it can be attached around the knees with a ribbon. Equipment for the protection of knees should be used during all works where workers knees, for example, during concreting, tile paving and other installation works, painting, welding and installation of pipelines.

The equipment for the protection of knees is interesting to such Russian employers, who are interested in long-term work with their employees. This equipment will reduce harmful effects on knees.

5.1.11 Vibration protection

The impact of vibration on people should be prevented in the workplace. The parameters of vibration should not exceed $5,0 \text{ m/s}^2$ (by local vibration) and $1,15 \text{ m/s}^2$ (by the impact of vibration on the whole body). If these parameters are exceeded, you must take immediate steps to reduce them to normal. The indices of the exposure of vibration are $2,5 \text{ m/s}^2$ (by local vibration) and $0,5 \text{ m/s}^2$ (by the impact of vibration on the whole body). If the indices of the exposure of vibration are exceeded, then on the basis of risk assessment you should plan and conduct activities to eliminate vibration.

The results of the risk assessment of the exposure of vibration should be presented to workers and the necessary information about dangers of vibration, healthy methods of work, etc. should be given. The manufacturer gives information about the level of the vibration of machinery and equipment, safe methods and duration of use.

The harmful effects of vibration are eliminated in the following way:

- by the correct choice of equipment (vibration level is specified in the instructions);
- using shock absorbers (on the handles, seats, gloves);
- reducing the exposure time and increasing intervals;
- keeping the muscles warm and reducing the use of force.

Russian employers must think more about vibration protection. At present they do not show serious consideration to this theme. They must give more information to workers about the safe methods of work during vibration. This can help to reduce harmful effects from long-term work under vibration.

5.2 Ergonomic organization of work

Construction work is hard physical work, and working positions can be uncomfortable. Due to the inefficient and burdensome methods of work, but also because of accidents at work, building organizations carry huge costs. Part

of the influence of bad ergonomics are felt at the firm level only when the workers are in middle age, when various professional illnesses lead to frequent absences from work and low efficiency. In terms of profitability the building company should encourage the use of good methods of work and auxiliary equipment, which improves ergonomics.

It is difficult to estimate costs related to accidents and bad ergonomics. By nature they are the same as costs associated with deficiencies in quality, where direct and obvious costs are only a low part of total costs. Only one need of breaks because of the tiresomeness of work is significant in terms of costs.

The improvement of ergonomics in construction through the development of working methods and the increase of the use of auxiliary tools have a positive effect also on the work. The result of good ergonomics is the increase of productivity.

The good ergonomic organization of work can bring the company a lot of benefits in a long-term period. A lot of Russian construction companies are interested in long-term work with their good qualified employees. This is especially important for small companies. In this case the introduction of auxiliary tools for the improvement of ergonomics can help to reduce harmful effects from work in an uncomfortable position. Companies do not need to spend money on the training of new employees. A Russian proverb says: "Old horse is better than two new!"

Instructions for ergonomic work

In construction especially the liftings and transfers of goods, which are performed manually, can cause. Lifting and auxiliary equipment should be used during liftings. In addition to liftings, uncomfortable working postures are working with hands up, maintaining a posture, and working in a bent or curved posture.

Effect of posture

Work in a bent and curved body position has a load on muscles, tendons and joint ligaments. A prolonged load causes constructive damages in the back, which are shown by pain, ache, perceptibility of movements or numbness. The quick turns of back can cause pain, e.g. sciatica.

The inclination of the head forward or sideways and a bent position exert a load on neck muscles, tendons and joint ligaments. By the inclination of the head back causes the broken circulation of the blood and nervous activity due to the compression of the cervical vertebraes. The weakening activity is shown with numbness, pain, ache and the decrease of the amplitude of movements.

Work on heels and on knees can cause prolonged numbness, pain and aches in the muscles. This is due to the reduction and slowing of blood circulation. Over time, the symptoms of excessive loads are shown with pain, ache, and the limitation of motion.

It is preferable to use

- auxiliary equipment for transport and lifting
- supports for equipment and machinery, which are attached to the side button start
- nozzles which extend the handle of tools
- good scaffolding (with a correct height workers do not have to stretch, bend, or turn back, hands should be below the shoulder level)
- work with the erected head and straight neck
- seat-support when working on heels and on knees
- lifting of loads with the straight back.

Avoid

- work with forward inclination

- work with the position of hands above shoulder level
- work on heels and on knees
- work with the inclination of the head back or forward and bending the neck
- strong turns and the bends of wrists
- lifting of loads in the bent position of the body.

Remember unloading

Unloading means stretching muscles immediately after the movements or stages of work with the load. The duration of stretching should be 0,5 minutes. The purpose is to improve the metabolism in muscles and the restorative function of muscles.

Auxiliary tools for improvement of ergonomics

5.2.1 Handles for transfer

Handles for transfer are simple auxiliary tools, which can help during the transfer, for example, of windows and doors in a vertical position over short distances. There are also handles for the transfer of sheet items, such as gypsum plasterboards. The transfer is usually carried by two workers. Handles are attached on both sides of the load.

Influence to productivity

The device allows you to move windows, doors and sheets quickly and accurately. It reduces the risk of injuries during transfers.

Characteristics that improve the ergonomics

The device reduces the need for inclinations during lifting and allows to transfer heavy and awkward objects with less energy.



Figure 5.4 Handles for transfer (Raturva 2, p. 26)

5.2.2 Stair handcart

The device consists of a handcart, motor, power supply and battery. It can be provided with auxiliary tools and additional equipment for the transfer of various goods. The device is designed for the transfer of heavy and awkward items along stairs.

Influence to productivity

With this device the worker can alone move, for example, equipment to the next floor. A motor facilitates and accelerates the transfer.

Characteristics that improve the ergonomics

The device reduces the load to the worker and allows him to move heavy and awkward objects with less energy.



Figure 5.5 Stair handcart (Raturva 2, p. 27)

5.2.3 Tip-over handcart

A tip-over handcart is an auxiliary tool for the transfer, which is designed for use on the building site and equipped with large wheels, lifting loops and the possibility of turnover. Its capacity is about 400 liters. The handcart is designed for the collection and transfer of various materials, such as construction waste, soil, etc. It is well suited as a garbage container under the circular machine.

Characteristics that improve the ergonomics

The big wheels of the handcart facilitate the movement of the device on the building site. Because of lifting loops the handcart can be moved over longer distances with the help of a crane. The possibility of turnover helps unloading.



Figure 5.6 Tip-over handcart (Raturva 2, p. 27)

5.2.4 Roller and forks clamp device for the local movements of goods

The device is a lever on small wheels and with a curved claw. The device allows workers to move heavy objects within short distances or take them from the pallet.

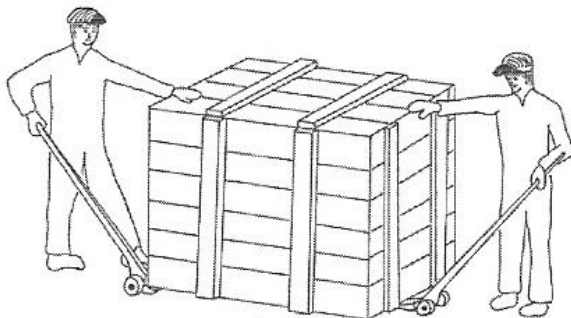


Figure 5.7 Roller and forks clamp device for local movements of goods (Raturva 2, p. 27)

5.2.5 Handcart for the transfer of floor covering

Handcart for the transfer of floor covering consists of a metal frame, wheels and handles. One device is needed at each end of the roll.

Influence to productivity

The device is simple and convenient for use. It greatly facilitates the movement of the rolls of floor covering. Based on the results of a research, productivity amounted by 5-10%.

Characteristics that improve the ergonomics

The position during the transfer is more stable and the weight is distributed evenly on both sides. The device significantly reduces the amount of force. Based on the results of investigations physical load is reduced by about 15%.

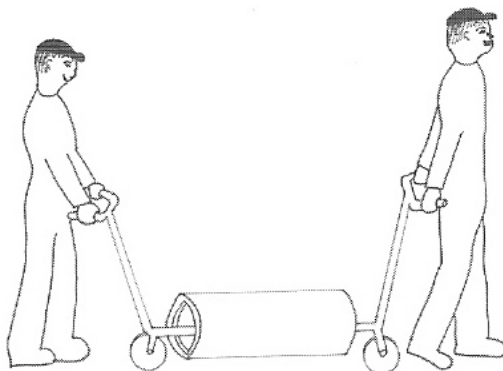


Figure 5.8 Handcart for the transfer of floor covering (Raturva 2, p. 27)

5.2.6 Table for reinforcement cutting

Using a table when cutting reinforcement causes the employee to work in the right position. The handling of the reinforcement becomes easier due to the table and rollers, which allow to move the table. Also the working position and the height are comfortable. Measuring become easier. Based on the results of research the productivity increase was 3 - 7%.

Characteristics that improve the ergonomics

The working position is more stable, the job does not require extra turns of the back or body. The feeding of the reinforcement from places of storage and transfer after handling become easier. Based on the results of research the physical work decrease is approximately 10%.

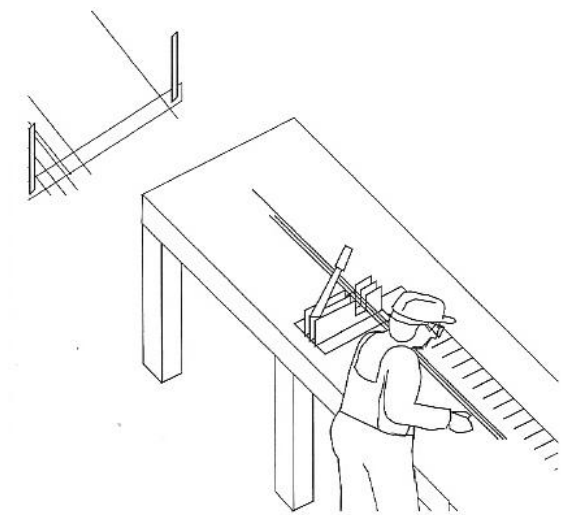


Figure 5.9 Table for reinforcement cutting (Raturva 2, p. 27)

5.2.7 Table for plinth cutting

When a table is used plinth cutting is done in the right position. Based on the results of research the productivity increase was 1,5 – 3 % .

Characteristics that improve the ergonomics

The working position is more stable than when working without a table. The job does not require extra turns of the back or body. The feeding of the plinth from places of storage and transfer after handling become easier. Based on the results of research the physical work decrease is approximately 4%.

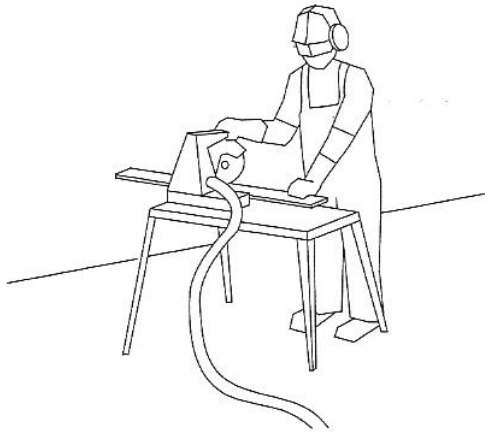


Figure 5.10 Table for plinth cutting (Raturva 2, p. 28)

5.2.8 Device for plinth screwing

The device is designed for the fastening of plinths to the wall using a drill and / or screwdriver. The device is attached to a drill or screwdriver. The device allows to fix the plinth to the bottom of the wall without bending down.

Characteristics that improve the ergonomics

The device reduces the number of inclinations during the fastening of plinths. It reduces the load on the back, and the rotational movement of the back is missing.

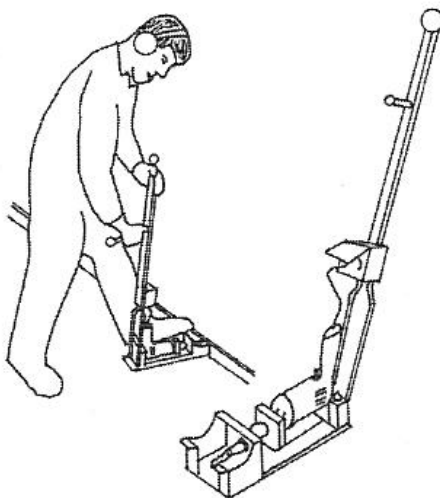


Figure 5.11 Device for plinth screwing (Raturva 2, p. 28)

5.2.9 Polishing machine

The device consists of a polishing disc, handle, where the motor is situated, and vacuum cleaner. The motor, which is situated in the handle, twists the disc through the rope. The device is suitable for the polishing of the joints of gypsum plasterboards on the walls and ceilings. The polisher can be at a distance of 3 meters from the machine. The device has a turning polishing head and the stepless regulation of the speed.

Influence to productivity

The device allows to polish even high walls without the use of scaffolding or other supplements. The system of local dust removal decreases the need for cleaning.

Characteristics that improve the ergonomics

The device is easy to use and it is well balanced. The joining of a vacuum cleaner allows to polish without dust.

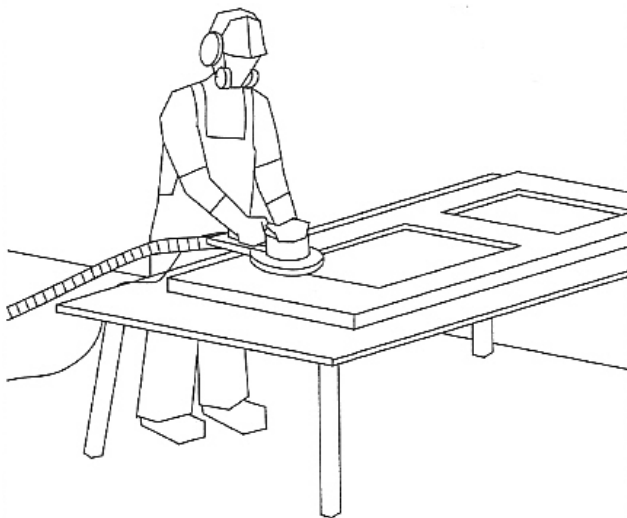


Figure 5.12 Polishing machine (Raturva 2, p. 28)

5.2.10 Support for a drill or screwdriver and a device for lightening the load

A support for a drill or screwdriver and a device for lightening the load are additional devices for the support of working tools. It is attached to the drill or to the pneumatic device. Supports are usually made of metal and they have handles and switches for use at a distance. The weight load falls on the spring mechanism in the device for easy use.

Influence to productivity

The devices allow to work on the ceiling without the use of additional instrument. This speeds up the movement from one object to another one. Reducing the load from the weight of the tool saves force that can be spent at work.

Characteristics that improve the ergonomics

With this device you can work with a straight back. There is no need to maintain working tools. The devices reduce the load.



Figure 5.13 Support for a drill or screwdriver and a device for lightening the load (Raturva 2, p. 28)

5.2.11 Device for window mounting

A device for window mounting is a support equipment with claws on wheels. The device for door mounting is an auxiliary metal construction for the easy installation of doors.

Influence to productivity

The devices allow to install windows or doors with only one worker. The damages of doors or windows during installation are reduced.

Characteristics that improve the ergonomics

The device allows to work in an upright position. The load does not need to be maintained, there is no danger to fingers and physical work decreases.

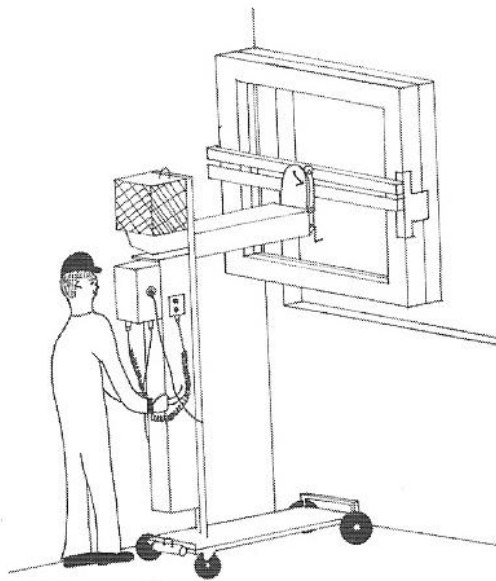


Figure 5.14 Device for window mounting (Raturva 2, p. 29)

5.2.12 Lift and handcart for plates

A lift for plates is an auxiliary device for lifting and mounting the sheets and plates, which are made of tubular metal frames and equipped with wheels and a winch. It is designed for the fastening of gypsum plasterboards to the ceiling, and it is also suitable for the finishing of ceiling with a slope.

The handcart for plates is designed for the processing and moving of plates and sheets. It is made of metal frame, fitted with wheels and a rotating plane. The handcart is suitable for the moving, short-term storage and processing of sheets.

Influence to productivity

A lift with a flat platform reduces the need to support and the expenditure of energy when mounting the plates to the ceiling is reduced. It speeds up the installation of sheets in the right place and reduces the need to support the sheets before their fastening. The handcart for sheets allows to transfer, storage and process sheets on one device.

Characteristics that improve the ergonomics

The lift with a flat platform reduces the need for stretching the body during installation.

The handcart can be a smooth and firm foundation for the processing of sheets. The moving of sheets is easier on the handcart with big wheels.

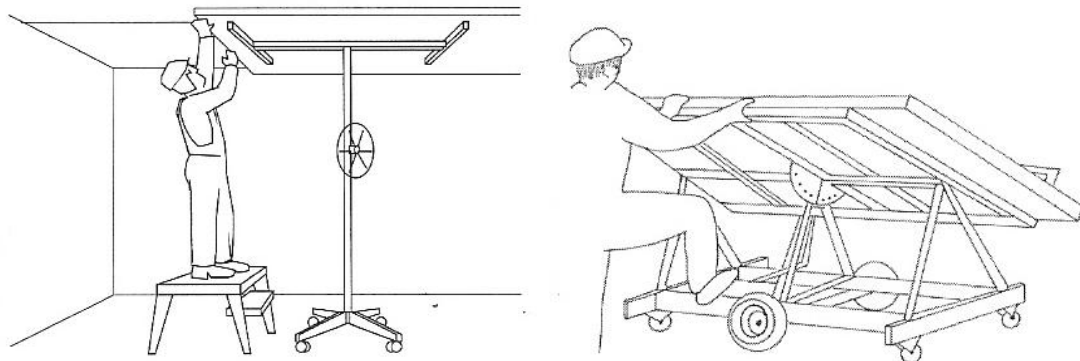


Figure 5.15 Lift and handcart for plates (Raturva 2, p. 29)

5.3 Reports about near miss

Situations, in which there have been close calls of danger, are a warning about the state of affairs at the workplace. Such cases require clarifying the chain of events and activities to correct the situation.

Correctly motivated employees notify the authorities about the occurrence of dangerous situations and about situations that could lead to accidents. The whole team needs to know about the benefits of messages, which inform about the possible risks and dangers. The important issue is not to find the perpetrators, but to identify the causes and factors that set in motion the chain of action. The motivation of employees should be constant. It is important that the staff regularly receive feedback and are aware of what actions were taken on the basis of their submitted their reports.

The practice of filing reports depends on the work site and in different organizations it is built differently. The report can be submitted in different ways, but it is essential to ensure that it is easy to make, and that it contains enough information. For messages you can use the paper form (A4, form of a pocket size), electronic form, e-mail, text messages, digital photo with explanations, etc. (H. Koski & T. Mäkelä, p. 17). Appendix 3 shows a near miss reporting form.

5.4 TR-Metering as a tool for objective assessment of safety norms on the building site

The big disadvantage of the existing Russian building standards is that there is no mechanism that would allow the objective assessment of work in compliance with safety norms on the building site. Now the compliance with safety requirements is judged by orders, which are made after the inspections of the building site. They specify violations that have been identified during the audit. However, when several building sites are compared it is difficult to say which of them is better and how well safety regulations are observed.

The tool that would allow us to correct this deficiency is TR-Metering. The principle of this method is simple: during the construction the periodic testings of the objects to maintain safety requirements are realized. In this case the inspector completes a special form, which has columns for the various sections of safety (personal protection equipment of workers, protection against fall from height, electricity and lighting, dust, etc.). In these graphs it is indicated how many safety items are completed, and how many not.

The following TR-observation items are in this form:

1. personal protection equipment of workers
2. scaffolding, stairs
3. machinery and equipment (welding equipment; hand tools (drills, angle grinders, hammer drills, etc.); concrete mixers; lifting equipment (cranes, hoists))
4. protection against falling
5. electricity and lighting
6. cleanness on the site and the utilization of waste products

The inspector indicates violations in the form. For example, there might be the following violations of personal protection equipment (one for each employee):

- no helmet, goggles, respirator, earphones, gloves
- no personal protection equipment from cold (in winter)
- lack of fall protection (safety belt)

The full list of violations and criteria for counting these violations is shown in Appendix 4.

At the end the overall level of compliance with safety on the building site (TR-level) is calculated as follows:

$$TR - Level = \frac{correct}{correct + false} \times 100\% = \dots\% \quad (5.4)$$

This value of the level, which is expressed as a percentage, can quite objectively assess the compliance with safety requirements on the building site. At the end of the form the inspector specifies the places, where irregularities have been detected. Appendix 4 shows the developed form of TR-Metering.

Not only the objective assessment of compliance with safety norms on the building site is the reasons why companies do this TR-Metering. TR-Metering can give construction companies the following benefits:

- it shows to the company management how successfully the money, which have been given to the increase of work safety, is spent
- it shows to the company on which building site the things are going not very well with work safety, and what the company needs to change to improve the situation
- it shows how well the things are going in the compliance with work safety norms in different construction companies.

6 NEW IDEAS FOR INTRODUCING WORK SAFETY IN THE COMPANY

Russian and Finnish arrangements for work safety during construction works has been considered in the previous chapters. As a result of comparing them, new ideas that could improve work safety in construction projects in ZAO “SU-11” and other Russian building companies were developed. Here is a list of these suggestions:

1. Use of new, modern personal protection equipment for workers, i.e.:

- safety helmets with fixed headphones
- vests with reflective strips
- special protective footwear.

This decision is necessary because the risks associated with falls, electric shock, heat, etc. cannot be prevented in all situations. And the use of modern personal protection equipment for workers will help to minimize injuries in case of emergency.

2. There should be an inclusion in the list of the responsibilities of an engineer for the protection of labour, that the periodic inspections of building sites in compliance with safety requirements must be conducted. A progress report should be given on the TR-Metering form (Appendix 4). This solution will enable managers objectively to evaluate the safety situation by the realization of construction works on various building sites. Based on these data the company’s management will be able to eliminate violations during construction works in proper time.

3. Holding regular meetings about safety on building sites. During these meetings all members of the construction process will be able to speak about the problems of security in accordance with their immediate tasks. Through such meetings it will be possible to solve problems, which appear during the construction process more quickly.

4. Purchase and introduction of new devices that improve the ergonomic organization of work (Section 5.2). This solution will reduce costs associated with the periodic absence of older workers due to occupational diseases. If the company is interested in the long-term cooperation with its workers, this decision will eventually bring great dividends. Also, the result of good ergonomics is the increase of productivity.

5. The introduction of written reports about near miss situation (Appendix 3). This solution will quickly bring the necessary information to all participants of the construction process. Since, for one reason or another, managers cannot always be in a place of work, some dangerous situations remain hidden from their eyes. This solution will always help to be aware of the dangerous situations arising on the construction site, and make in proper time conclusions based on these data.

Most of these innovations will be suitable for Russian companies. Items 2 and 5 will be very interesting for the management of the company, because managers can have real information about the situation with work safety on the building site not from foremen, but from workers and other independent experts. It is important in Russia, because not always foremen want that their boss gets to know about accidents on the building site.

Some problems can happen with the introduction of new devices that improve the ergonomic organization of work, because in Russia labour costs are smaller than in Finland. And most companies are not interested in employing their workers for a long time. Companies do not want to pay high salaries to workers. For them is more profitable to discharge workers and hire new staff. This item will be suitable only for small and middle sized companies, who are interested in qualified workers. They invest a lot of money in the training of workers. So they need workers for a long time. And devices that improve the ergonomic organization of work will be interesting for these companies.

7 SUMMARY

New arrangements for work safety for Russian companies during construction works were developed in the course of the study. Their implementation will reduce risks associated with safety during work. Certainly, the introduction of these innovations will require large financial costs, but in the end benefit for the company will be quite substantial. The image of the company, which uses latest innovations in the field of work safety, is significantly better than that of its competitors, which have lagged in this area.

Solutions for work safety in accordance with Russian construction norms were developed as a result of this work. In addition, solutions for work safety in accordance with Finnish norms have been developed. Based on these data, decisions, which can be used to improve the situation with safety during construction works, were suggested. It is possible that over time, these new solutions will be quite typical for ZAO "SU-11", and for many other Russian construction companies.

The use of new, modern arrangements for work safety shows that the company thinks about the health of their workers. Smart employers think about money, which they spend to train their workers, because they do not want to have absent workers in consequence of accidents on the building site. So, they will spend money to development of new arrangements for work safety.

Main arrangements for work safety during different types of works (storage of building materials, personal protection equipment, safety by moving goods, reinforcement and concrete works, lighting, fire safety) in compliance with Russian building norms were described in this work. These arrangements are obligatory during the execution of construction works in Russia. In the second part of the thesis the additional arrangements for work safety in compliance with Finnish norms were described. They are not obligatory during the execution of construction works in Russia. But their implementation in Russian construction companies will make construction processes safer. Most of these arrangements

are very interesting for such construction companies, which are interested in long-term work with their employees.

All in all the introduction of the innovations in the field of work safety during construction works will influence the image of the company ZAO "SU-11" very positively. The lack of accidents during construction will reduce the incidental costs of the company.

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REFERENCES

Official web-site of the company ZAO "SU-11"
<http://zaosu-11.spb.ru> (Accessed on 1 March 2010)

ООО "Solov'eva O.I. architect's bureau". 2008. POS "Reconstruction of warehouse and administrative building at Barrikadnaya Str. 17A"

2001. SNiP 12.03-2001 Work safety in construction. Part 1. General requirements. Moscow: Gosstroy Rossii

2002. SNiP 12.04-2002 Work safety in construction. Part 2. Construction execution. Moscow: Gosstroy Rossii

2003. PPB.01.2003 Fire safety regulations by the execution of construction and installation works. Moscow: Gosstroy Rossii

2000. PB 10-382-00 Rules of design and safe exploitation of cranes. Moscow: Gosstroy Rossii

2003. SanPiN 2.2.3.1384-03 Hygienic requirements for the organization of building works. Moscow: Gosstroy Rossii

Telichenko V., Teren'tjev O. & Lapidus A. 2006. The technology of constructing buildings and structures. Moscow: Higher School

Grabovoy P.G. 2006. Organization, planning and management of building production. Lipeck: ООО "Inform"

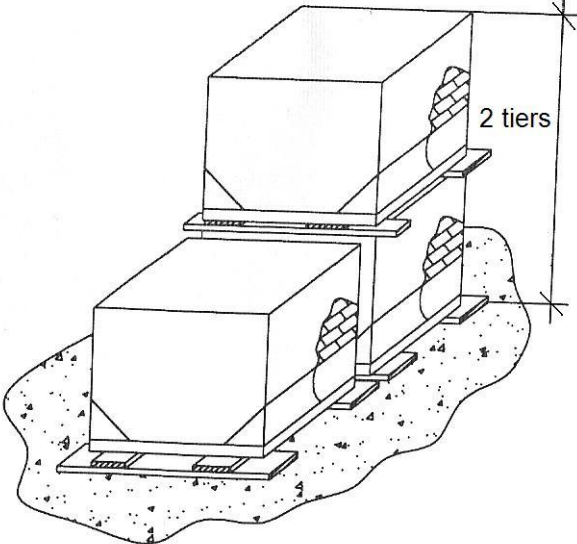
H. Koski & T. Mäkelä. 2008. Raturva 2. Tampere: Tammer-paino

Finnish Institute of Occupational Health
<http://www.ttl.fi/internet/english> (Accessed on 16 April 2010)

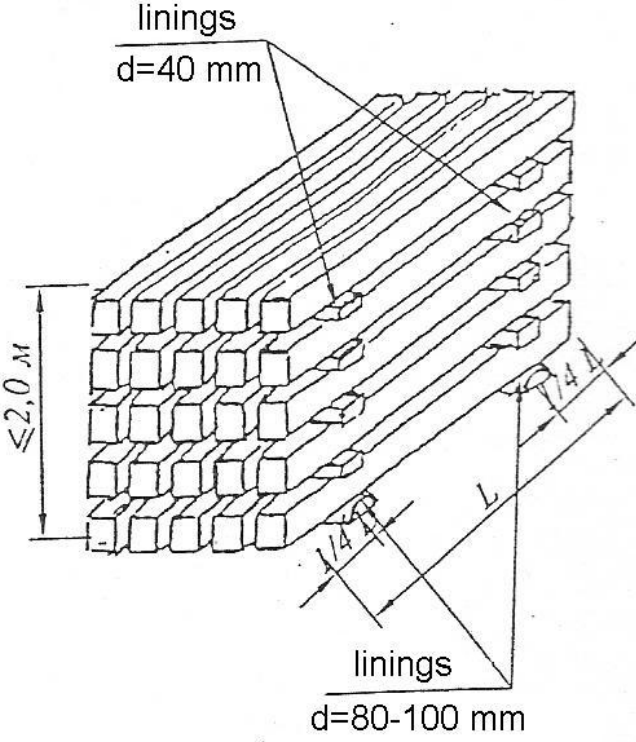
2007. Government Decision on the Safety of Construction Work (629/1994, amendments up to 702/2006 included). Finland: Ministry of Social Affairs and Health

ARRANGEMENTS FOR THE STORAGE OF BUILDING MATERIALS ON BUILDING SITE

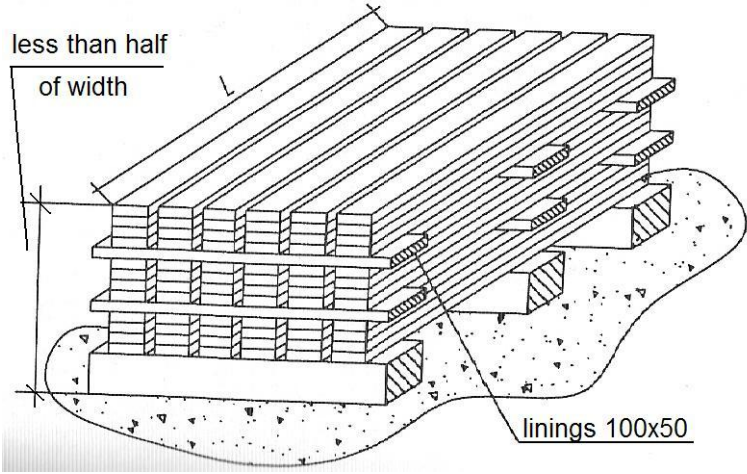
1. Brick



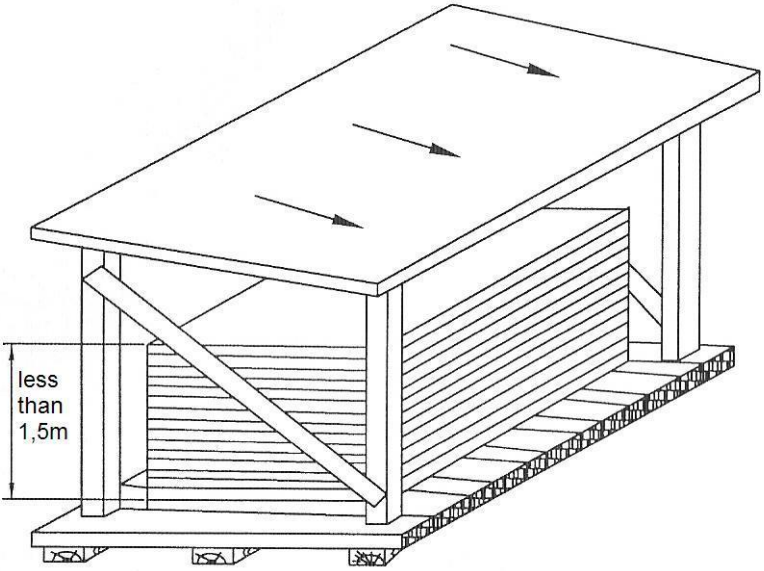
2. Crosspieces



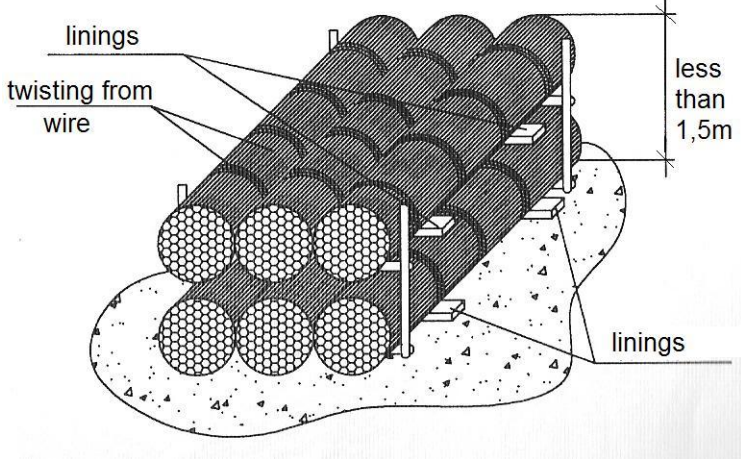
3. Saw-timber



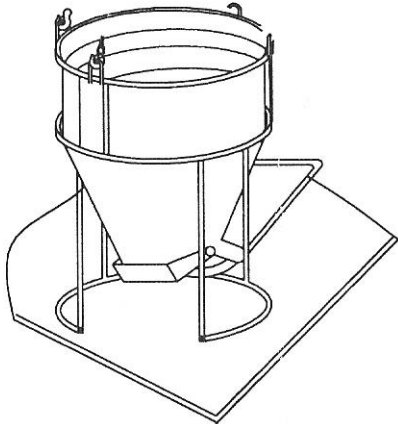
4. Plywood



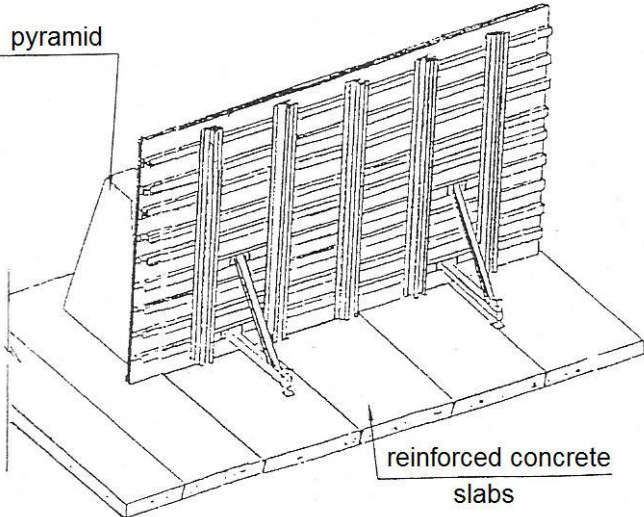
5. Re-bars



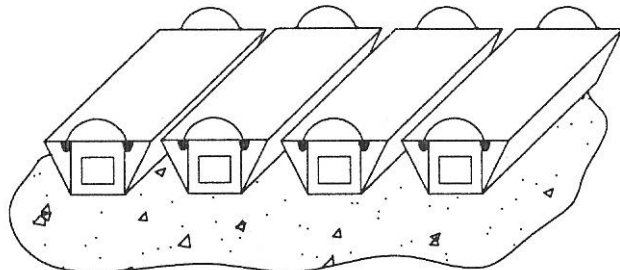
6. Bunker with concrete



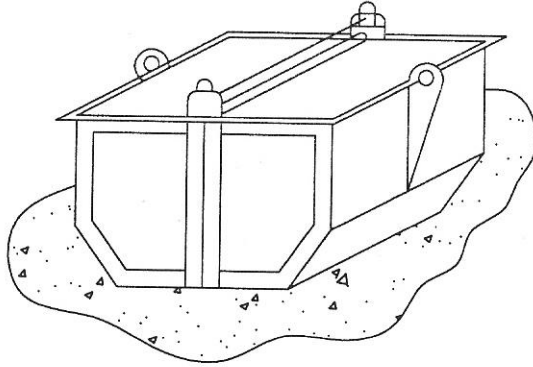
7. Form panels



8. Box of mortar



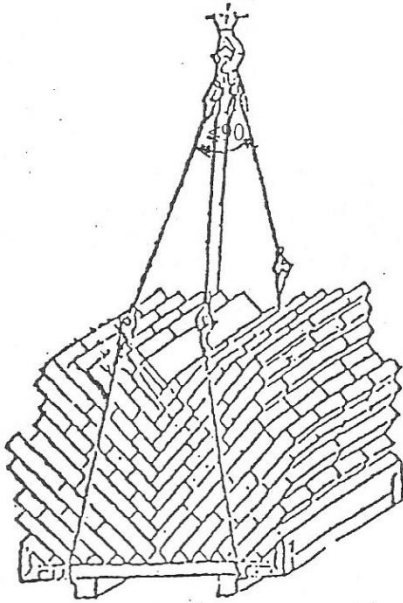
9. Bunker for garbage



THE SCHEMES OF STRAPPING GOODS

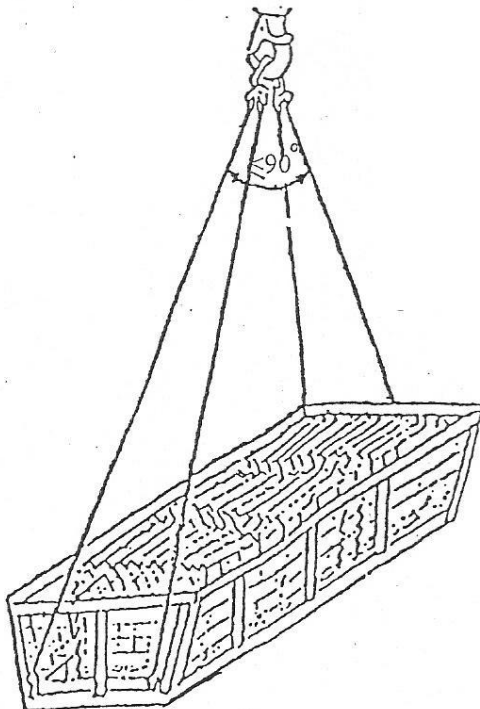
1. Pallet with brick

Only by loading / unloading of truck.
P less than 1 t



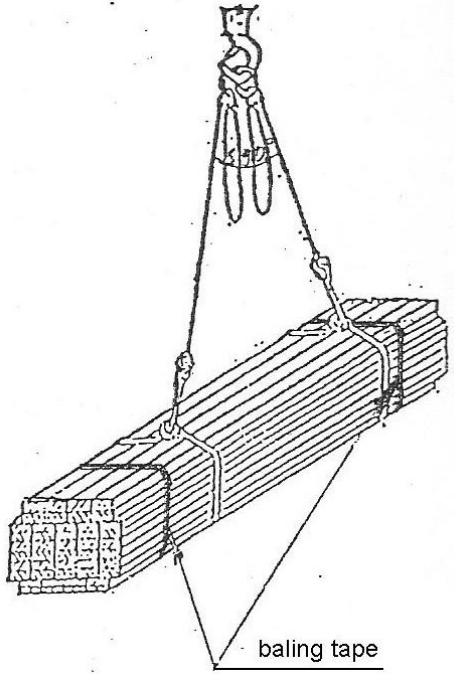
2. Container with brick

P less than 2,5 t



3. Saw-timber

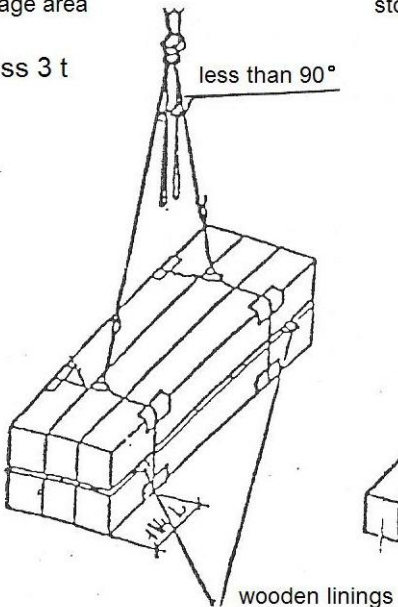
P less than 1 t



4. Crosspieces

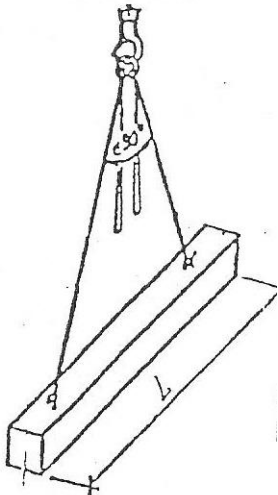
by unloading to storage area

P less 3 t



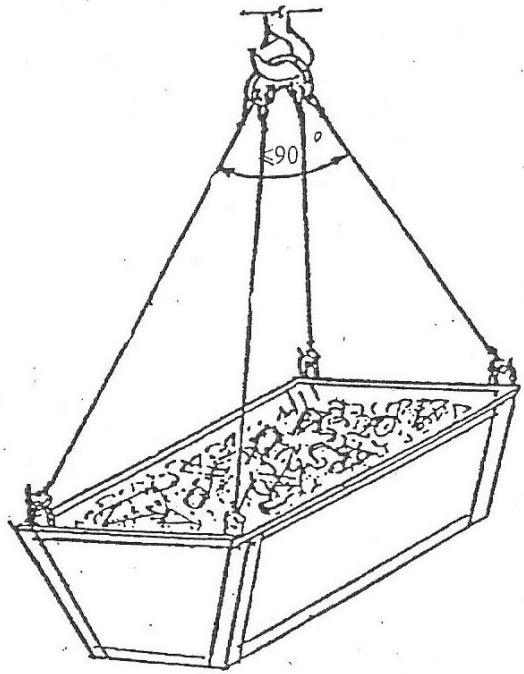
by giving to stowage place

P less 1 t



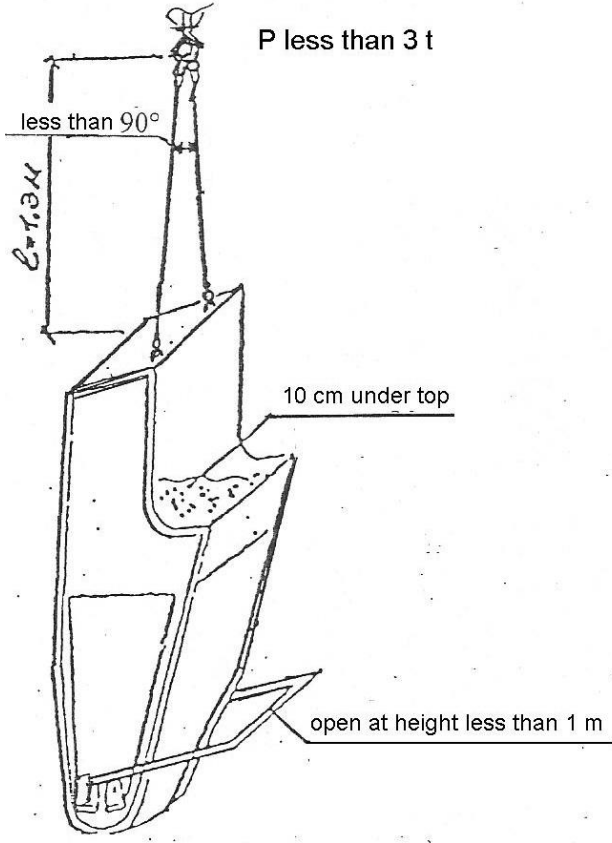
5. Box with mortar

P=1 t



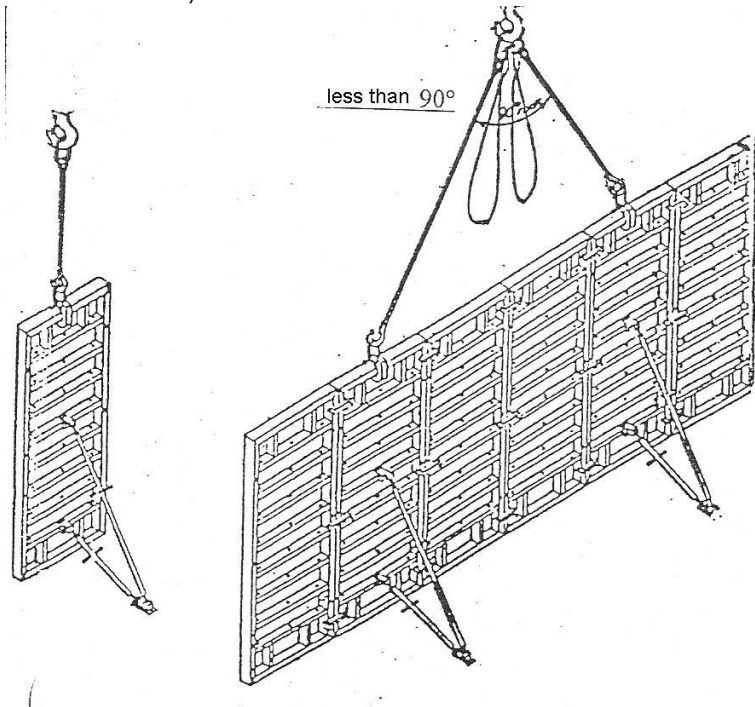
6. Bunker with concrete

P less than 3 t



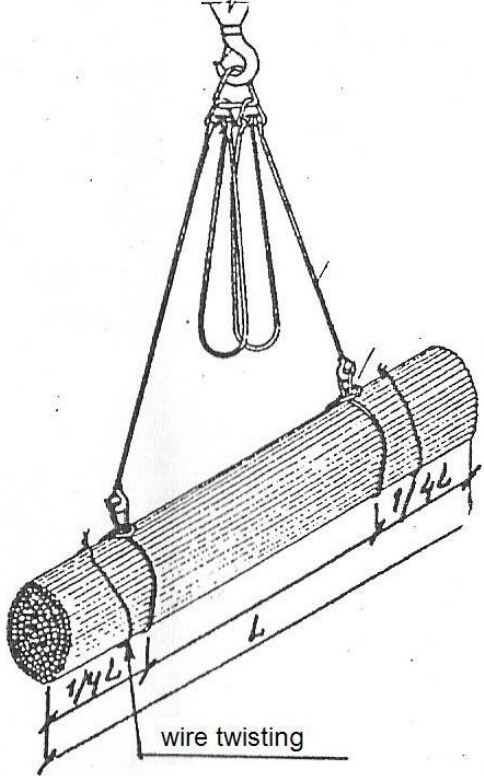
7. Formwork

P less than 1,5 t



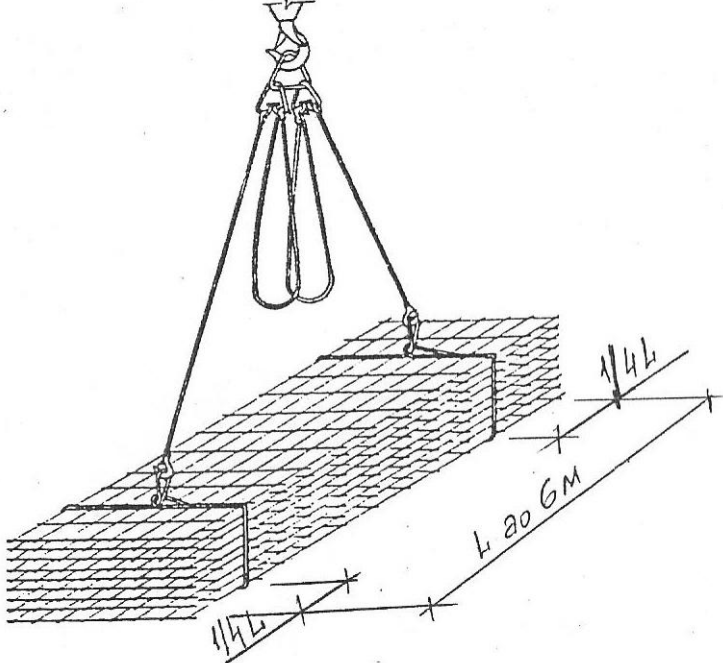
8. Reinforcement bars

P less than 1 t

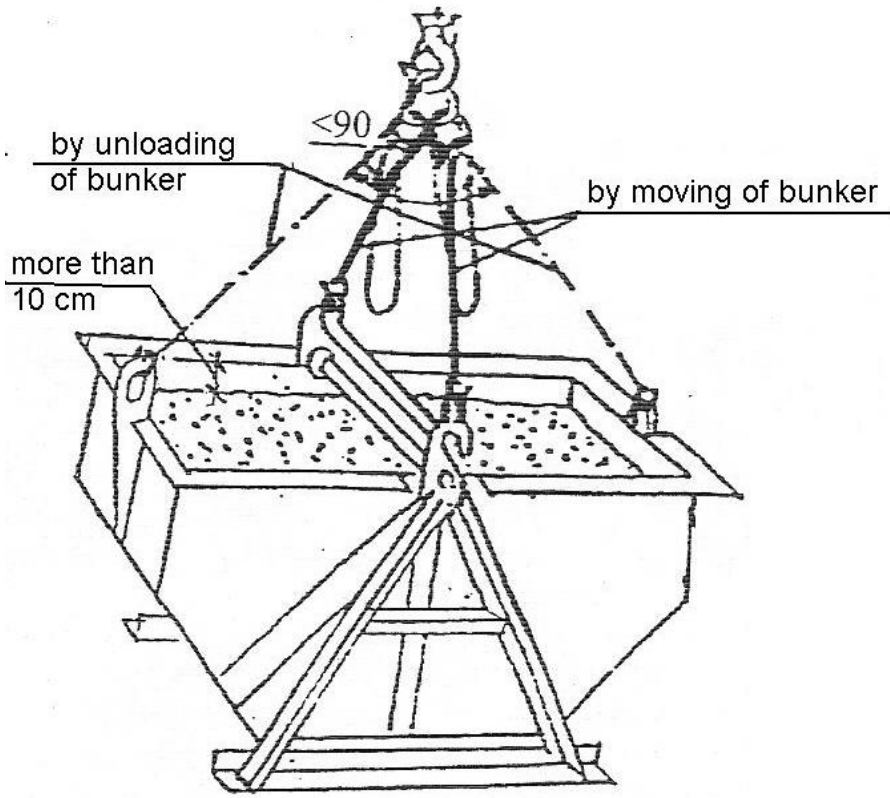


9. Reinforcing fabric

P less than 1 t



10. Bunker with garbage



A NEAR MISS REPORTING FORM

Date of incident	____/____/____ time_____
Building site	
Place of incident	
Work phase	
Description of the dangerous situation in own words (what, how, whom)	
Consequences of a dangerous situation (damage to materials, delay of work, etc.)	
Steps to save, correct, what could happen, what saved	
Options for improving	
Was informed foreman, commissioner for labour protection, others?	
About the incident reported	Name_____
	Employer_____
	Telephone_____

TR-METERING FORM

Name of the construction firm _____

Building site (name, address) _____

Inspector _____

Date ____/____/____

Item	Correct, pcs.	Total, pcs.	Not correct, pcs.	Total, pcs.
1. Personal protection equipment of workers				
2. Scaffolding, stairs				
3. Machinery and equipment				
4. Protection against falling				
5. Electricity and lighting				
6. Cleanness on the site and utilization of waste products				
	Total correct:		Total not correct:	

$$TR - level = \frac{total\ correct}{total\ correct + total\ not\ correct} \times 100 = ___ \times 100 = ___ \%$$

Remarks	Responsible person	Time of corrections

____/____/20__

_____/_____/_____

APPENDIX 4
2 (2)

TR-observation item	Criteria for accounting of violations	Violations
1. Personal protection equipment of workers	<ul style="list-style-type: none"> • one for each employee 	<ul style="list-style-type: none"> • no helmet, goggles, respirator, earphones, gloves • no personal protection equipment from cold (in winter) • lack of fall protection (safety belt)
2. Scaffolding, stairs	<ul style="list-style-type: none"> • one for each device 	<ul style="list-style-type: none"> • there are openings in the floor, or not provided the required bearing capacity (large deflections of flooring, etc.) • scaffolding is not attached to the structure • device is installed on uneven ground, or carrying capacity is insufficient
3. Machinery and equipment <ul style="list-style-type: none"> • welding equipment • hand tools (drills, angle grinders, hammer drills, etc.) • concrete mixers • lifting equipment (cranes, hoists) 	<ul style="list-style-type: none"> • one for each device 	<ul style="list-style-type: none"> • Lack of earthing for welding equipment • use of uncertified equipment • use of faulty equipment • presence of uninsulated electrical parts
4. Protection against falling <ul style="list-style-type: none"> • holes in the ceiling • fenceless doorways and stairways • danger zone of the crane 	<ul style="list-style-type: none"> • one for each fenceless opening • one for each hole • one for each flight of stairs 	<ul style="list-style-type: none"> • presence of fenceless or unclosed openings in the ceiling • lack of fences in places where the difference in height is 1,3 m and more • lack of fencing of the danger zone of the crane
5. Electricity and lighting	<ul style="list-style-type: none"> • one for each uninsulated element • one for each unilluminated area 	<ul style="list-style-type: none"> • presence of uninsulated wires • lack of warning signs about high voltage • presence of unlit places in the working area
6. Cleanness on the site and utilization of waste products	<ul style="list-style-type: none"> • one for each littery room • one for each unauthorized sanitary fill • one for each sewer of sewage 	<ul style="list-style-type: none"> • presence of littery places • no special area for landfill • availability of illegal sewer of sewage