

RISK ASSESSMENT OF HANDLING LOADS IN PRODUCTION PROCESS

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Abstract

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This paper deals with the evaluation of risks in the production process. The possible hazards were determined in the production of plastic windows and security measures were proposed. The level of risk were evaluated by using the extended point method, where were defined the probability and consequence of events as well as the opinion of the evaluator. The level of the risk is calculated as the multiplication of these three parameters and is classified into categories: Negligible, moderate, precarious, Adverse and unacceptable. The levels of hazard and safety measures are defined for employees for the manual handling of loads. The highest level of the risk (precarious) was achieved in danger of spine injury, where the risk cannot be accepted without protective measures. Other monitored threats (overload, wrick, fall of the load etc.) are classified in negligible risk or moderate risk that is acceptable or acceptable in increased attention. By compliance of suggested precautions it is possible to achieve the minimization of health threats of employees at work.

Keywords: security, risk, burden/load, risk, point method, danger

INTRODUCTION

Regulations of the Slovak Republic establish minimal requirements for safety and employees health protection in the manual handling of loads where there is a risk to health, particularly the spine of employees, and to prevent this risk.

The employer is obliged to ensure that workplaces, machinery and devices, tools, widgets, materials, working equipment and practices, the layout of workplace and organization of work do not endanger the safety and health of workers. Rules of safe work in the organization must include an evaluation of the list of unavoidable risks and threats that arise from work in production. They must also define the possible risks and suggestion of protective measures against hazards (Ingaldi *et al.*, 2013; Konstanciak, 2012; Kredatusová *et al.*, 2010).

Machine equipment has to meet all safety rules. Seeing that during the working process machines are subjected to degradation forces (abrasion, corrosion), their planned servicing must be

processed regularly. The current trend is to replace worn parts by materials of higher quality (Votava, 2013a; Votava, 2014).

In the production process, it is necessary not only to pay attention to load handling but also to individual technologies. If an inappropriate surface treatment is used, workers' health can be harmed. For this reason, it is necessary to switch to environmentally and worker-friendly technologies such as zinc coating, duplex systems or waterborne paint systems with a minimal content of organic solvents (Matisková, 2013a; Votava, 2013b).

The manual handling in this paper is defined as any transferring or carrying of a load, including people and animals, by one or several employees, its lifting, supporting, putting down, pushing, pulling or other moving that due to the load characteristics or unfavourable ergonomic factors present a risk to health (Šolc *et al.*, 2013; Píla *et al.*, 2014). In this paper, the risks are evaluated in handling of loads in the production process, which is focused on production of windows.

MATERIAL AND METHODS

According to relevant laws and directives, the employer is responsible for the safety and health protection at work of all employees (Girmanová *et al.*, 2009; Majlingová *et al.*, 2013). His duty is to organize corresponding measures and supervise their implementation. The basic principles of prevention at work with loads should be included in the corporate policy of safety and health protection at work.

Dangers and threats will be assessed in the company specializing in the production of plastic windows. This production company employs nearly 50 workers who come into contact with loads.

To evaluate the risk assessment will be used the extended point method that determines the level of risk (R) by multiplication of three parameters, namely the probability of occurrence of an event (P), the result of occurrence of an event (D), and the opinion of evaluators (V). The level of risk will be evaluated according to the scoring indicated in Tab. I.

RESULTS AND DISCUSSION

The handling of loads is an essential part of the job of workers in the production of plastic windows.

Measures to ensure the safety during the work with loads are defined by the government regulations of the Slovak Republic that were considered in the hazard assessment. The paper was focused on the threats associated with spine injuries and other occupational accidents that may occur during movement or other handling with loads.

Tab. II–V: describe dangers of manual handling of loads and the proposal for measures to reduce threats as well as the value of the level of risk.

Nowadays, the risk management is considered to be a coordinated and complex approach to the management of all processes of risk assessment. It is based on declaring and documenting the policy as the obligation of management that has to respond to strategic areas, goals, intentions and to the entrepreneurial activity of organization. The programme of risk management consists of designing a general list of a potential number of risk sources, i.e. the identification of sources and list of areas of their impacts (Matisková, 2013b; Matisková, 2013c; Ingaldi, 2014).

The verification of safety and health at work in the manufacturing organization means the safety audit. Results of examination are recorded in various forms. This type of audit includes experience obtained by executives and experts in the field

I: Characteristics of numerical risk assessment

VALUE	CHARACTERISTICS
P – probability of occurrence of an event	
1	Unlikely – adverse event is almost excluded
2	Random – adverse event is unlikely, but possible
3	Likely – adverse event could occur
4	Very likely – adverse event is likely to occur
5	Permanent – adverse event occurs very often
D – result of occurrence of an event	
1	Negligible – minor injury, less than light injury, negligible financial and material losses
2	Insignificant – minor injury, illness, beginning occupational disease, small financial and material losses
3	Significant – serious injury requiring hospitalization, higher financial and material losses
4	Critical – severe occupational injury with permanent consequences, occupational disease, high financial and material losses
5	Catastrophic – fatal, mass injury, irreparable loss, losses leading to liquidation
V – opinion of evaluators	
1	Negligible effect on probability and consequences
2	Insignificant effect on probability and consequences
3	Considerable effect on probability and consequences
4	Significant effect on probability and consequences
5	More significant effect on probability and consequences
R – level of risk	
1–4	Negligible – acceptable safety
5–10	Moderate – acceptable risk for increased attention
11–50	Precarious – the risk cannot be accepted without protective measures
51–100	Adverse – poor security, a strong possibility of accidents, adverse events
101–125	Unacceptable – permanent threat of injury, irretrievable losses

Source: own

II: *Threat – spine injury*

Description of threat	P	D	V	R
● Spine injury during long-term lifting and handling of loads at an inappropriate position; ● Spine injuries can occur especially in cases where the load is: ○ too heavy or too large; ○ unwieldy or difficult to grasp; ○ unstable or its contents tend to move; ○ placed in such a position where it is necessary to hold it or to manipulate with it far away from the body with incline or rotating of torso; ○ it is likely that due to the consistency or the contour it could cause injury of workers, particularly in the event of a collision; ● Risk of spine injury may occur if the physical exertion is: ○ excessive; ○ achieved only by rotating the torso; ○ likely to result in a sudden movement of the load; ○ done by the body in an unstable position; ● Joint injury by sudden uncoordinated movement; ● Progressive damage of the skeletal system, muscles, ligaments and blood vessels; ● Acute or chronic injury of the skeleton, manifesting lumboischiatric pain in the croup part of spine (often as a result of lifting loads with a bent back).	2	3	2	12

Security measures

- To provide exercise and staff training about the correct methods and procedures of handling;
- To respect the principles of safe and wholesome method of operation, preferably in a position without bent back;
- To practise the right moves in handling (e.g. to hold the load near the body, not to perform lifting by jerky movements, to carry out manipulations as far as possible without bent back, etc.);
- To provide adequate space, especially in the vertical direction;
- To ensure that the ground or support is stable;
- To keep straight and non-slippery floor;
- To use appropriate work shoes;
- To ensure the manipulation in a safe working height and proper level and allow the worker to take the correct position at a safe height;
- To ensure adequate, eventually more frequent and adequate physical rest and breaks for recovery in case the physical exertion is too frequent or too long, especially with regard to load on the spine;
- If it is possible to exclude activities in which the worker cannot change the tempo of work.

Source: own

III: *Threat – overload and wrick*

Description of threat	P	D	V	R
● Overload and wrick; ● Rupture or overstretch of muscles and tendons of shoulders/arms as a result of congestion and inadequate physical exertion; ● Rupture of muscles and tendons in sudden, acute movements of cold, not enough bestirring muscles, especially associated with high load; ● Limit values of physical activity depend on a variety of factors, mainly on age, physical condition, sex, static or dynamic loading, weight and shape of load handled, manner of manipulation, lifting height and time, trajectory of handling loads, frequency of handling operations and on health, especially in weaker individuals, women and adolescents; ● Formation of groin or femora hernia during acute lifting of loads by manipulators who have a soft abdominal muscles and lack of strength in groin ligaments accompanied by increase of intraabdominal and intrathoracic pressure due to breath holding and excessive burden of ligament during acute lifting.	2	2	1	4

Security measures

- To inform workers of all measures that should be performed in the area of safe handling of loads, especially about the weight of load and about the centre of gravity of the heaviest part when the weight of the load is unevenly distributed;
- To provide exercise and staff training about the correct methods and procedures of handling;
- To follow the correct methods of manual handling;
- Do not overload workers, to comply with the guidelines of weight values according to applicable laws and regulations;
- During designing the manual unit designed for manual manipulation, it is important to simultaneously solve also the number of workers with regard to shape, weight, size (especially length), and in case when there are more workers handling with load, to determine the supervisor who will manage and coordinate the work of the whole group;
- To equip the workplace with suitable working equipment, for example crowbars, heaver, self-locking and other pliers, stands, adjustable straps, barrows, containers, baskets, cages, positioners, rollers, slip, etc.

Source: own

IV: Threat – fall of the load on a person

Description of threat	P	D	V	R
● The fall of load on the worker, bumping the worker by the fall of load or by moving load; ● The fall of load after destabilization of stacks; ● Pushing by the load when the worker lets his limb under the load or between parts of the load, between the load and the fixed obstacle, or because of moving or rolling load (pushing by the load occurs most frequently during vertical storage of the load); ● The loss of cohesion and disintegration of fragile incoherent load; ● The fall of load on the lower extremities, pushing by the load; ● The bruise and crash of hands and legs because of skid and slip off the load from the hand.	2	2	2	8
Security measures				
● To abide the prohibition of staying in the zone of possible unwanted movement of the load or under the load, especially not staying in the immediate vicinity of elevated loads; ● Do not interrupt the stability of stacks, for example by taking the objects and elements from below or beside the stack; ● Do not ascend and do not climb on borders, on piled materials; ● During the moving of loads by forklift, possibly by other lifting handling equipment, it is important to exclude the presence of workers on the load and in the potential fall zone of possible fall, do not pass under elevated loads; ● Do not catch the load during manipulative work with the fork-lift; ● To respect international manipulative marks that indicate the correct and safe manner of handling, for example 'centre of gravity', 'do not use hooks', 'suspension point', 'weight of stacking limit', 'limited number of layers in the stack', 'do not stack'; ● To establish the co-ordination management of manipulative work by responsible person when there are more workers who manipulate with the load at the same time; ● To use an appropriate manipulative equipment (straps, harness, iron slips, manipulative clamps, clips, sucking disk, inferring rollers, roller lifters and other); ● To assure a firm grip of loads, to use the gripping holes, handles; ● To check the condition of the load, eventually to ensure a damaged load before manual handling; ● Do not use inappropriate, damaged and worn aids; ● To put heavier objects without handling aids on the base (lintel) high at least 30mm so that there will remain the safety gap between the load and the stowage space for insertion of fingers or for removing of the hand (fingers) in order to avoid pinching or pushing of the hands to stowage space and to base; ● To prepare backings in advance (use pads, lintel); ● To check conditions of transport packaging before beginning with handling (strength, consistency, fixation); ● To follow the correct methods of manual handling; ● To check the conditions of gripping elements before handling.				

Source: own

V: Threat – overthrow, slip of particulate material

Description of threat	P	D	V	R
● The fall, overthrow, slip of piece material on a person; ● Unwanted change of the position of material (fall, slip, dislocation, tilt, roll down, etc. of the piece of material).	2	2	1	4
Security measures				
● To ensure a stable position of material, its arrangement to a wider area; ● To secure the material by suitable aids that will eliminate the slip or fall and overthrow; ● For manual depositing of piece material with regular shapes, to store it only in shoulder height, eventually head (max. height of 2 m), for ensuring its stability by tying; ● To ensure piece material with pads, stoppers, support, stands, wedges, tying, especially of material stored upright, on narrower edges, pipes, tubes, bunches and rolls; ● Tools must be well grasped, modified, arranged, and adjusted to the weight of the load or according to the shape and size.				

Source: own

of safety and health protection during the work by visits in company, inspections and controls of workplace and technical equipment as well as during seminars and training (Burda *et al.*, 2010; Paulíček *et al.*, 2010).

The highest value of the level of risk was reached by possible damage to the spine. According to numerical evaluation, the risk is defined as 'precarious', which cannot be accepted

without protective measures. It is caused by a possible incapacity of employee associated with hospitalization. In Tab. II, are proposed the security measures that minimize a rise of potential damages to worker health.

When the loads fall on a person, the level of risk is 'moderate', i.e. the risk is acceptable, but with increased attention. Other threats define the level of risk with acceptable safety.

CONCLUSION

The employer is obliged to provide elimination of the manual handling of workers with loads by organizational measures or by use of appropriate instrument, mainly for mechanical equipment. If the manual handling of loads cannot be excluded, the employer shall take appropriate organizational measures, use appropriate resources and equip employees with the resources to prevent or to reduce the risk of harm arising from the manual handling of loads.

In the manufacturing enterprise was realised internal audit, which evaluated the safety and health of workers in the manufacturing process. There were monitored the implementation of the using the personal protective equipment and work habits and acts in the production process. The biggest gaps were found in adherence the principles of the correct procedures and handling. According to this reason, it is necessary to retrain employees about the minimum safety and health requirements for the handling loads.

This paper was focused on risks assessment risks at work with loads. The specific security solutions were suggested and designed to reduce the threat to the health of employees. Their implementation can ensure a sound working environment and the prevention of emergence of occupational injury.

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