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## RISK ASSESSMENT FOR SCAFFOLDS AND LADDERS

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**Abstract:** The subject of this paper is to give a brief overview of the risk assessment for the scaffolds and ladders workers as part of the risk assessment for the project comprising building of new motorway from the town of Demir Kapija down to the village of Smokvica, Republic of Macedonia. That is the last un-upgraded section of the existing motor road/motorway E-75, that runs through the Republic of Macedonia and connects Republic of Serbia and the Republic of Greece. Construction of the remaining section of this motorway will enable faster and more safe transportation of people and goods from Central Europe to Greece, or to Turkey and Near East since it will be connected to "Via Egnatia" (West-East) motorway in Greece. Team from the Faculty of Technical Sciences – Bitola prepared risk assessment for the whole project comprising 30 different work places and is constantly engaged as a consultant for Health and Safety at work related issues, [1]. According to identified risks (hazards) during works on the bridge constructions, scaffolds and ladders used very often and there is proposed some recommendations to reduce or eliminate these risks of falling from high.

**Keywords:** risk assessment, construction, scaffolds, ladders

### 1. INTRODUCTION

The motorway section is passing through the Demir Kapija canyon and the remaining gorge and through the more or less flat area from the village Miravci to the village Smokvica. In total, the project involves construction of 28.2 km of new dual carriageway, including two twin tunnels of a total length of 4.5 km, 6 major river bridges/viaducts, 2 interchanges and 12 overpasses/underpasses. The main Contractor on the project is AKTOR S.A., the largest construction company in Greece.

Risk Assessment is a structured process to identify risks, assess risks and define safety measures or arrangements to remove/isolate or reduce risk as far as it is reasonably practicable and control residual risks.



Figure 1. A distance view of a bridge No.5 at Motorway construction Demir Kapija - Smokvica



Figure 2. Scaffolds and ladders established on the bridge No.5 at Motorway construction Demir Kapija – Smokvica

This is confirmed by the fact that in 2011, 786 serious accidents at work and 16 fatal accidents are registered by the State Labor Inspectorate [7], while by the Institute for Public Health 1520 serious accidents are registered, [7]. In the annual report for accidents at work for 2011 by Macedonian Occupational Safety and Health Association were registered 79 serious and 44 fatal accidents at work, [7]. In the R. Macedonia, in 2012, the total number of accidents at work was 161 from which there were 116 serious accidents that resulted in more than three days of absence from work and 45 fatal accidents at work, [7], where the falling from the scaffolds produced 13 fatal accidents. For that reasons, the scaffolds must be treated separately, with the special risk assessment. There are different types of scaffolds like: stationary wooden or metallic scaffolds, mobile wooden or metallic scaffolds and suspended scaffolds. The selection of the appropriate type of scaffold to be used depends on the nature of the work, the activity itself and the height at which it is going to be executed. Usually for outdoor work at height of 4m and above, stationary scaffolds are used and for work height below 3,5 m indoors or outdoors mobile scaffolds. Usage of wooden scaffolds for work at height above 6m is not allowed. For the buildings such as bridges (Figure 1, 2), i.e. pillars, usually is practiced the usage of set of scaffoldings (Figure 2) to perform assembled steel construction. Working on the scaffoldings without proper measures result most often with fatal accidents, therefore the standard protection and working procedures of safety are essential of preventing accidents with death such as falling from heights.

## 2. THE RISK ASSESSMENT METHODOLOGY

The Risk Assessment methodology presented in this paper is comprised of four levels, [2, 3].

### » Hazard identification

At the first level, for each construction activity, a method statement has to be developed. Based on the method statement potential hazards are identified.

### » Risk assessment

After having identified the hazards we calculate the risk per hazard. This calculation can be a qualitative or quantitative or both, if practicable. It is proposed that the occupational risk assessment is calculated qualitative, but without excluding other forms of similar competence. According to the Risk Assessment methodology each activity is broken down to tasks, it considers the hazards associated with each task and assesses the risk by assessing the likelihood of an event of a particular severity to occur and multiplies this likelihood with the corresponding severity (see sample risk assessment in the next page). Always the worst case scenario is considered. The Severity is specified qualitatively by setting classification criteria which determine how serious the impact of a hazard is. Severity is rated into five levels as shown in Table 1. The assessment of the likelihood of a risk is made by using Table 2.

**Table 1. Rating Severity**

Rating	Severity
1	Trivial Trivial, minor first aid treatment. Back to work same day
2	Minor Minor wounds, first aid treatment. Back to work within three days from incident
3	Moderate First aid treatment. Hospital treatment. Back to work after 3 days from incident. No operation
4	Major Hospital treatment. Operation is required. Back to work after 60 days from incident or requirement for changing post due to injury
5	Severe Change work, Death

**Table 2. Rating Likelihood**

Rating	Likelihood
1	Almost zero Impossible or almost impossible to happen
2	Low The likelihood is very low
3	Possible It is possible to happen
4	High It is very likely to happen
5	Almost certain It is almost certain or certain

RISK = SEVERITY x LIKELIHOOD

**Table 3. Rating Risk Summary (see table 4)**

Assessment	Risk	Rating (Quantification)
Acceptable risk. No additional safety measures required.	Trivial	1 (1-2)
Acceptable risk. No additional safety measures required apart. A more close supervision and safety measures implementation might be required.	Minor	2 (3-5)
Not acceptable risk. Action is required. Measures should be fully implemented within a month.	Moderate	3 (6-8)
Not acceptable risk. Action is required. Measures should be fully implemented within a week.	Major	4 (9-14)
Not acceptable risk. Action is required. Works must be stopped immediately. Measures should be fully implemented immediately.	Severe	5 (15-25)

Table 3 is the Risk Matrix which incorporates the criteria for assessing the severity and the likelihood, and is an effective tool for assessing and presenting the risk that can be understood at all levels.

**Table 4.** Risk classification

Risk = Likelihood X Severity			Severity				
			Trivial	Minor	Moderate	Major	Severe
			1	2	3	4	5
Likelihood	Almost zero	1	1	2	3	4	5
	Low	2	2	4	6	8	10
	Possible	3	3	6	9	12	15
	High	4	4	8	12	16	20
	Almost certain	5	5	10	15	20	25

» **Safety measures evaluation**

Completing a risk assessment with safety measures proposed, it is expected that the residual risk is trivial or minor. If this is not the case, then further measures are proposed.

» **Safety measures reevaluation – revision**

The final stage of the Risk Assessment is about reevaluating and revising the assessment depending on the nature of the Hazards and the various changes in the method statements.

### 3. RISK ASSESSMENT FOR THE SCAFFOLDS AND LADDERS

#### A. SCAFFOLDS

##### A1) Before assembling

AKTOR SA discipline engineer responsible for scaffolds has to:

- » Ensure that the scaffold supplier has provided all necessary information concerning safety instructions for design and erection.
- » Verify that the type of scaffold selected is appropriate for the specific work to be performed.
- » Ensure that the scaffold is accompanied by all the necessary quality certificates, manuals providing information about assembly/dismantling etc.
- » Check and ensure that the required quantities of elements are available on site to erect a complete scaffold and all are good condition.
- » If it is a standard type (approved type) scaffold, follow the instructions of the manufacture to erect.
- » If the scaffold is not a standard type then calculate the structure. Make the calculation and ensure they are followed precisely.
- » Ensure the stability of the scaffold
- » Ensure the safe access to the scaffold.
- » Check and verify before safety of the scaffold before use.
- » Foremen are informed in details about:
  - ≡ The purpose for which the scaffolds is erected
  - ≡ The location of erection point
- » The materials to be used for its construction
- » The number of stages required
- » The suitability of the ground; any arrangements needed
- » Where and how the scaffold has to be anchored
- » The safe access and egress on the scaffold during erection, use and disassembly

##### A2) Assembling

During erection of the scaffold the foreman in cooperation ensures that:

- » The workers assembling the scaffold are trained and experienced and use the suitable
- » Personal Protective Equipment required.
- » Mobile scaffolds are secured against overturning and accidental dislocation. The scaffold brakes must be used and their good operating condition must be ensured.
- » The scaffold is put up on stable and even ground.
- » Stationary scaffolds are secured against horizontal shifting.
- » The scaffold is not used before assembly is completed.
- » Supervision during erection and implementation of instructions and calculations.

##### A3) Work on scaffolds

The engineers and foremen supervise works on scaffolds at all times and regular inspections are carried out in cooperation with the HSS Officer ensuring that:

- » Any other equipment used during civil works construction (electricity generators, mixers etc.) must be located at a place which does not interfere with the stability of scaffolds.
- » Workers use at all times the suitable Personal Protective Equipment according to the specific work activity.
- » Scaffolds must not be used for storing materials or equipment.
- » Loads on scaffolds will be evenly distributed to avoid disturbing of its stability.
- » Safe access and egress on scaffolds is available.
- » No work activities are performed with adverse weather conditions when working outdoors.
- » Scaffolds are fully boarded.
- » Full fall protection is provided.

#### A4) Dismantling

During scaffold dismantling the foremen have to make sure that:

- » No works are performed on the scaffold.
- » Trained and experienced workers are employed for this work.
- » Dismantling of the scaffold is done according to the supplier's/manufacturer's instructions.

**Table 5.** Recognizing the dangers and hazards and risk assessment at work – Activity / operation:  
Worker on static or mobile scaffold, worker that uses ladders embankment (Risk severity H)

Health & Safety (HS) and Environmental (E) risks	Protective Measures	Technical or Organizational Measures for the Control of the Remaining Risk
Mechanical hazards of fall from scaffolding	<p>Assembling the scaffolding is in accordance with the manufacturer's instructions.</p> <p>Tests by a certified engineer for installation of scaffolding and the properties of the base. No overload is permitted on the scaffold. Use of checked scaffolding only. No workers on the scaffolding when it moves.</p> <p>Probe-examination and properties of the base which will be a set scaffolding.</p> <p>Tests by a certified engineer for installation of scaffolding and the properties of the base. No overload is permitted on the scaffold. Use of respondents checked scaffolding. Dismantling of scaffolding to execute against previously written instructions. Parts of the scaffold to be checked before use.</p> <p>Setting warning for protection (barriers) in the area where outsiders have access. Check all components of scaffolding before its installation..</p> <p>Approvals for proper use of materials. Before using scaffolding to review by a panel of experts to determine whether the scaffold is designed for technical documentation, safety regulations at work, technical regulations and relevant standards. Assembling the record for review of scaffolding which is part of the documentation. Check the correctness of scaffolding periodically during operation and at least once a month. Mandatory inspection of scaffolding after repairs, renovations, weather and movement. Check to make head or a certain rootnik that results of the test should enter the control book.</p>	<p>To use appropriate and certified scaffolding. Assembling the scaffolding is in accordance with the manufacturer's instructions. Inspection by a civil engineer before using scaffolding whether it is correctly assembled. Do not overload the scaffolding. The ratio of the shorter side for height of the scaffolding is in 1:3 ratio. Check whether the selected type of scaffold match the specifics of the job. You have to use the brakes on the scaffolding and they should be in good working condition.</p> <p>Do not use scaffolding before it is fully assembled.</p> <p>Supervision of installation and implementation of instructions and calculations.</p> <p>The equipment used for the execution of construction works kit at all times (electricity generators, mixers, etc..) must be located on the site and shall not endanger the stability of the scaffold</p>
Mechanical hazards of stroke in structures with a height above the height of the scaffolding when moving the movable scaffolding	<p>Before moving the mobile scaffold always check if there is free space from the top of the roof or any other material, structure or equipment. When works are underway extending the scaffold installations near the scaffolding is not allowed. Before beginning work on the scaffolding (after completion of the shift or cessation of work) to check whether there is enough free space..</p>	<p>When working on scaffolding at night use proper lighting</p>
Hazards from falls when using ladders	<p>Ladder used to be in good condition. Ladder must be placed on a stable surface. The final part of the ladder is over 1 m above the highest point. When using the ladder, observe the location of other persons. Fix the ladder at the top end. The angle of inclination of the ladder should be approximately 75°. Ladder is secured or tied on the vertical side. When using ladders higher than 6 m, it should be tied to the middle (3 m), and workers must use protective elastic belt.</p>	<p>When using a ladder, use system (technique) with 3 contact points.</p> <p>Regular checking of ladder from damage or wear. Inform the engineer in charge about damages on the ladder. Ladder to be left in proper condition after its use. Workers must be trained in the proper methods of setting the ladder. Ladders should not pose an additional risk in the workplace. Regular and periodic control.</p>
Hazard of impact with the equipment used during lifting	<p>Safe placement of equipment used for lifting in order to impacts on mobile scaffold. Lifting operations always to be performed under supervision. To avoid similar activities. Supervision of work at all time.</p>	<p>Safe placement of equipment used for lifting in order to impacts on mobile scaffold. Lifting operations always to be performed under supervision. To avoid similar activities. Supervision of work at all time.</p>

**Table 5** (continuing). Recognizing the dangers and hazards and risk assessment at work – Activity / operation:  
Worker on static or mobile scaffold, worker that uses ladders embankment (Risk severity H)

Health & Safety (HS) and Environmental (E) risks	Protective Measures	Technical or Organizational Measures for the Control of the Remaining Risk
Mechanical hazards of breaking down the scaffolding (gear) fails	To use appropriate and certified scaffolding. Assembling the scaffolding is in accordance with the manufacturer's instructions. Inspection by a civil engineer before using scaffolding whether it is correctly assembled. Do not overload the scaffolding. The ratio of the shorter side for height of the scaffolding is in 1:3 ratio. Lighting to be in compliance with applicable standards. Check whether the selected type of scaffold match the specifics of the job. Scaffolding can not be used until it is checked by an authorized person.	To use appropriate and certified scaffolding. Assembling the scaffolding is in accordance with the manufacturer's instructions. Inspection by a civil engineer before using scaffolding, whether it is properly assembled. Do not overload the scaffolding done. The ratio of the shorter side for height of scaffolding is 1:3. Check whether the selected type of scaffold match the specifics of the job. The distance between the elements of the scaffolding should be used only with funds provided technical documentation and scaffolding conjunction with typical elements are made in accordance with the manufacturer's instructions. Binding of individual elements of scaffolding in general constructive is done in a way to reduce the payload or payload elements of scaffolding as a whole
Mechanical hazards due to fall of items and materials from scaffolding	Assembling the scaffolding is in accordance with the manufacturer's instructions. Using experienced installers of scaffolding. Continuous supervision. Providing safe transport of material at level. The area around scaffolding at a radius of 2 m to be fine. Monitor weather conditions-wind speed. Editing can be performed stage-by-stage. Use proper equipment for lifting. Workers who mounted the scaffold are trained and experienced in the use and personal protective equipment at work. Use of protective platforms and platforms for complete protection. Hand tools and other fine material is always stored in a box. Setting the fence (with warning tape) at a distance of 3 m around the scaffold platform. Scaffolding must not be used to store materials or equipment. Mandatory use of the funds for personal protection. Employees who work on scaffolding required to wear a helmet and protective shoes. As protection from falling material to use network, built protection, range, protective side panels.	As protection from falling material network, built protection, range, side protective boards etc., with width of at least 150 mm should be used. Use of protective scaffolding platform to accept or network level so that the receiving platform bearing scaffolding not less than 3 m from the edge through which employees can fall. Protective scaffold with overhang to protect workers from items can fall from the height should be at least the height of 2.5 m above the ground at which workers move. Protective scaffolding with overhang should be so dimensioned and designed so that they can maintain and heaviest object as well as to prevent its rejection and breaking up the surrounding area. The width of the receiving platform or protective overhang must not be less than 1,5 m.
Hazards that occur due to the workplace characteristics - risk of worker falling from height	Assembling the scaffolding is in accordance with the manufacturer's instructions. Using experienced installers of scaffolding. Continuous supervision. Providing safe transport of material at level. Monitor weather conditions-wind speed. Editing can be performed stage-by-stage. Use proper equipment for lifting. Workers who mounted the scaffold are trained and experienced in the use and personal protective equipment at work. Use of protective platforms and platforms for complete protection. Mandatory use of personal protective equipment. Employees who work on scaffolding required to wear a helmet and protective shoes. As protection from falling material to use network, built protection, range, protective side panels. Inspection by a civil engineer before using scaffolding whether it is correctly assembled. Use of access ladder in the phase of construction of scaffold. Secure safe access and egress to scaffold	It is prohibited to step down, hang or tilt over the platform of scaffolding. To use fixed ladders for approach and exit of scaffolding. Do not move the scaffolding when it is has workers on it. It is prohibited to use rafters for heights over 6 m. Workers at all times are required to wear appropriate personal protective equipment (especially safety protective belt, helmet and safety shoes) in accordance with specific conditions. It is prohibited to use docks on excavation places (trenches) where workers can fall from a height greater than 4.5 m. All handles over 3.6 m height must be fixed to the building or to provide stability otherwise. All platforms to have width of at least 450 mm

**B. LADDERS**

AKTOR SA foremen are responsible for ensuring that:

- » Ladders are of the appropriate type and in good condition. In any other case the ladders must be fixed (if repairable) or destroyed removed from site.
- » Ladders are put up on stable and even ground or surfaces. Use always the kerb stones.
- » They are put up away from openings or excavations and in a way that they do not obstruct other activities in the same space and there is no hazard of impact or destabilization.
- » The supporting angle of the ladders with the ground must be approximately 75 degrees.
- » Ladders are secured or tied by the vertical sides and not by the ladders' steps.

- » When larger than 6 meters ladders are used, these are also tied in the middle (3m) and employees using them are required to wear a safety harness.
- » Ladders are used by the separately by every worker and not at the same time.
- » Ladders project at least over one meter distance above the reaching point of the workplace to ease access to it.
- » Ladders are regularly inspected for damages or wear.
- » Electricians are required to use ladders only with all supporting points of the ladder insulated.

Employees are required to:

- » Use toolboxes or bags hanging by the solder when climbing a ladder with tools or equipment.
- » Not use equipment or tools that require the use of both hands on ladders
- » Check the ladder before use.
- » Inform their foreman for any damages.
- » Place the ladder properly before using it.
- » Fix ladder or get another person at the base to hold it before climbing.

Due to pages limitations, in this article only an excerpt from the detailed risks assessment for the static or mobile scaffold and worker that uses ladders is given in Table 5.

### **Dismantling**

During scaffold dismantling the foremen have to make sure that:

- » No works are performed on the scaffold.
- » Trained and experienced workers are employed for this work.
- » Dismantling of the scaffold is done according to the supplier's/manufacturer's instructions.

It should be noted that the conducted risk assessment is only part of the total H&S plan implemented by the Contractor which also involves permanent health and safety related campaigns, on-site trainings and education of the staff.

### **4. CONCLUSION**

There are several conclusion produced by the previous risk assessment of the scaffolds and ladders work places:

- » The scaffold is accompanied by all quality certificates, load bearing ability study, assembly/disassembly manuals, supplier/manufacturer safety instructions etc.
- » Only experienced personnel must be involved in scaffold assembly/disassembly operation.
- » The use of Personal Protective Equipment like hard hat and safety boots is compulsory for workers on scaffolds.
- » The scaffolds have guardrails and toe boards to prevent objects and people from falling.
- » The work floors have the appropriate width without any voids.
- » Safe access and egress is secured.
- » The scaffold is secured against overturning.
- » The parts of the scaffold are thoroughly checked before use.
- » Regular inspections of the scaffold are carried out by the HSS-Officer.
- » Ladders used for light and brief work activities.
- » Ladders must be regularly inspected.
- » Employees must be trained on the correct methods of putting up and fixing a ladder.
- » The ground must be stable and even.
- » Ladders must not create additional hazards to the workplaces.

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