REPUBLIC OF TURKEY
ADANA ALPARSLAN TÜRKEŞ SCIENCE AND TECHNOLOGY UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF CIVIL ENGINEERING

OCCUPATIONAL SAFETY REQUIREMENTS AND THE EFFECT OF EDUCATION ON RISK PERCEPTION IN CONSTRUCTION WORKS

KEREM NUR KÖKSAL

MASTER OF SCIENCE

ADANA 2019

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29/05/2019

I hereby declare that all information in this thesis has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all information that is not original to this work.

Kerem Nur KÖKSAL

ABSTRACT

OCCUPATIONAL SAFETY REQUIREMENTS AND THE EFFECT OF EDUCATION ON RISK PERCEPTION IN EXCAVATION WORKS

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May 2019, 87 pages

Following the accidents due to fall from heights, excavation works are the most dangerous area where there are many accidents experienced in construction sector. In order to prevent the accidents causing serious injuries and deaths during excavation works, there-should be a proper planning related to the excavation works. This plan should be implemented, and then the implementation should be controlled systematically. Finally, the measures should be taken about the defective points as a result of these controls.

In this study, occupational safety implementations have been investigated in excavation works and the official documents, codes and regulations related to occupational health and safety applications have been compared. As a result of these comparisons, a risk assessment form in "L Shaped Matrix" has been prepared. The risk assessment form has been applied to the civil engineering undergraduate students who have different education levels, technical staff working in the campus construction of a university, and the experienced civil engineers working in the construction sector so as to investigate the differences in risk perception of these workers. It has been observed at the end of the study that education has an effect on risk perception of students there are differences in risk perception of technical staff according to their tasks and responsibilities. Furthermore, important issues for a safer working environment in excavation works have been outlined by emphazising the missing points in official documents, related to excavation works.

Keywords: occupational health and safety, excavation work, OSHA, risk perception

ÖZET

KAZI İŞLERİNDE İŞ GÜVENLİĞİ GEREKLİLİKLERİ VE EĞİTİMİN RİSK ALGISINA ETKİSİ

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Mayıs 2019, 87 sayfa

Kazı işleri, inşaat sektöründe yüksekten düşmeden sonra en fazla kazanın yaşandığı işlerdir. Kazı çalışmaları sırasında oluşan ve ciddi yaralanmalara veya ölümlere neden olan kazaları önlemek için; kazı işi ile ilgili uygun planlama yapılmalı, planlar uygulamaya konulmalı ve uygulama sistematik olarak denetlenmeli, denetleme sonucunda aksayan yönlerle ilgili tedbirler alınmalıdır.

Bu çalışmada kazı işlerinde iş güvenliği uygulamaları incelenmiş, OSHA ve Türkiye'de uygulanan iş sağlığı ve güvenliğiyle alakalı resmi düzenlemeler karşılaştırılmıştır. Bu karşılaştırmalar sonucunda bir L Matris tipinde risk değerlendirme formu hazırlanmıştır. Hazırlanan risk değerlendirme formu farklı eğitim düzeyindeki inşaat mühendisliği lisans öğrencilerine, bir üniversite kampus inşaatındaki çalışanlara ve inşaat sektöründe çalışan tecrübeli mühendislere doldurtulmuş ve bu gurupların risk algılarındaki farklılıklar incelenmiştir. Çalışma sonucunda eğitimin risk algısında etkili olduğu ve sahada çalışanların aldıkları görevlere göre risk algılarında farklılık olduğu gözlenmiştir. Ayrıca kazı işleri ile ilgili resmi düzenlemelerdeki eksiklikler vurgulanarak kazı işlerinde daha emniyetli çalışılması için gerekli noktalara değinilmiştir.

Anahtar Kelimeler: iş sağlığı ve güvenliği, kazı işleri, OSHA, risk algısı

This dissertation is dedicated to Prof. Dr. Emel ORAL. I would like to thank to her because of whose great contributions.

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NOMENCLATURE

Asymp. Sig.	: Asymptotic Significance
CFR	: Code of Federal Regulations
OSHA	: The Occupational Safety and Health Administration
SPSS	: Statistical Package for the Social Sciences

1 INTRODUCTION

In our country, occupational accidents and professional diseases have caused many workers to become sick, get injured, become permanently disabled, and even pass away their life for a long time. This kind of events especially more occurs in the construction sector. The most important reasons for mentioned above are that the construction sector has its own specific working conditions and it has continued the production with manpower and manual labour since the first ages (Baradan, 2006).

According to the study carried out by Arslan and Ünsal, (2015), approximately 337 million of occupational accidents occur in a day around the world, almost 160 million of people get the professional diseases, and unfortunately, 2.3 million of these people pass away. In other words, this result shows that a person for every 14 seconds deceases (Arslan & Ünsal, 2015).

When considering 2012 records of Social Insurance Institution in the ranking of occupational accidents according to the activity groups, building construction with 4511 occupational accidents takes place to number four. If “The constructions of non-building, Special construction activities and Building and environmental plan activities” are taken also into consideration, it will be actually seen that the construction sector with 9846 occupational accidents is placed on the top of the Table. Occupational accidents occurring in the construction sector constitute 13.15% of all occupational accidents. The highest death as a result of occupational accidents has happened in the activity group of building construction with 127 people. If “The constructions of non-building, Special construction activities and Building and environmental plan activities” are taken also into consideration, the number of deaths reaches 262. 35.22% of the whole fatal occupational accidents have occurred in the construction sector, and this ratio has reached an alarming value. According to the same year records of Social Insurance Institution again, it occurs in the construction work approximately 27 occupational accidents for every working day, 3.38 occupational accidents for every working hour, one occupational accident for every 18 minutes. While 1% of the whole occupational accidents in Turkey have been concluded with death, 2.66% of occupational accidents in the construction sector have been concluded with death (Yılmaz et al, 2015).

The construction sector is a sector where momentary carelessness can lead to huge and irreversible results, small errors can cause major threats and material moral damages, and interdisciplinary communication difficulties and disconnections occur at every stage (Akkaya, 2012).

In the globalizing and industrializing world, occupational health and safety rises in importance day by day not only due to enacted compulsory laws but also due to raising awareness of both workers and employers as a result of the occupational accidents causing heavy and bad results, and the lessons learned from occupational diseases and the near-miss events. Furthermore, occupational safety implementations have achieved both lifesaving and preventing huge damage.

Although occupational safety implementations in the working area are evaluated as both an economic obligation and cause a loss of time, the damages caused by any possible accident will be more. Nowadays, occupational safety policies are based on the fundamental of efficiency. Hence, it is important that occupational safety evaluates together with the efficiency of construction work.

To be able to make actual of an active model of worker health and safety management in construction work, it should be determined how the construction project will be handled from the pre-design stage to all stages of the construction process, and it should be provided with the necessary organization in this regard (Uzun & Gürcanlı, 2015).

The excavation works are one of the areas where occupational accidents are experienced frequently in construction work (Taş & Coşkunses, 2012; Yavaş, 2016). The necessary measures should be taken in excavation works in order to decrease occupational accidents. The current implementations related to this subject carry out with the official document "Occupational Health and Safety Code in Construction Works" in our country. Moreover, "Occupational Health and Safety Regulation in Construction Works" and "OSHA Trenching and Excavation Safety" are preferred as supportive documents. These two documents are used as a guideway, but they are out of date. it is required that workers at each level should be educated in order to take the measures in these formal regulations.

In this study, it has been investigated by comparing the official documents, codes and regulations related to occupational health and safety “Occupational Health and Safety Code in Construction Works”, “Occupational Health and Safety Regulation in Construction Works”, and “OSHA Trenching and Excavation Safety”. In addition to this, it has been emphasized that the necessary measures in excavation work should be taken, and then a risk assessment form has been prepared.

The prepared risk assessment form has been applied to both civil engineering students having different levels of education and different occupational groups working in the construction field. Thus, it has been aimed to determine the effect of education related to excavation works.

In the study, it has been intended to contribute that occupational health and safety applications in excavation work perform most efficiently by considering from the pre-design stage to all stages of the construction process including project delivery and building use. It has been also aimed to contribute to the development and growth of the country by planning to do this with minimum time and money loss.

2 LITERATURE REVIEW

2.1 Definitions Related to the Excavation Works

Some definitions related to the excavation works are given in this section as below;

Excavation refers to man-made cut, cavity, trench, or depression formed by the removal of the soil from the ground (Osha, 1926).

Trench refers to a narrow excavation with the width not exceeding 4.5 meters and the depth more than the width (Osha, 1926).

Cave-in refers to sudden movement of the soil from the edge of the excavation is into the excavated area.

Narrow space refers to working space with a limited number of openings for entry and exit, poor and inadequate ventilation, and an area not designed for continuous work (Osha, 1926).

Soil sample refers to a piece of soil taken as a sample for the design of the required protective system.

Risk refers to a probability or threat of damage, injury, loss, or any other negative occurrence that is caused by external or internal vulnerabilities (Official Journal, 2012).

Hazard or danger is any source of potential damage, harm or adverse health effects on something or someone (Official Journal, 2012).

Excavation heap refers to materials such as gravel, stone, and soil removed from the excavated area.

2.2 Risks

Excavations cause accidents and severe injuries, many of which result in sudden death and contain many dangers. The deaths as a result of accidents in excavation works stem from asphyxiation which arises from lack of oxygen because of the weight of collapsed soil. Since, weight of the soil of 1 m^3 is approximately equal to the weight of 1-1.5 tons. This weight is equal to almost the weight of an automobile. Therefore, the risks should be identified and evaluated in excavation and underground works, and then the necessary measures should be taken.

In order to prevent injuries and deaths caused by accidents, during excavation works; appropriate planning, organization, and inspection should be done before and during the excavation works. It is necessary to do a safety plan which considers the following risks (Taş & Coşkunses, 2012).

Fundamental risks that may occur in excavation works are identified as given below;

- Cave-in or collapse
- Falling of the worker to excavation area
- Hazardous and harmful working environment (i.e. miasma)
- Falling of the material or equipment upon the workers
- Damaging to underground equipment
- Working under the high voltage
- Flooding to the excavation area

2.3 Cave-in

The largest risk in the trench is the cave-in, and most of the accidents that cause workers' deaths stem from the cave-ins. The sudden occurrence of the cave-in causes the workers to be caught unprepared and not to have enough time to leave the excavation, and therefore this leads to many deaths. OSHA statistics also confirm this information and show that the mortality rate in the excavations is 112% higher compared to the overall construction work, and almost half of the excavation fatalities result from cave-ins (Figure 2.1) (OSHA, 2007).

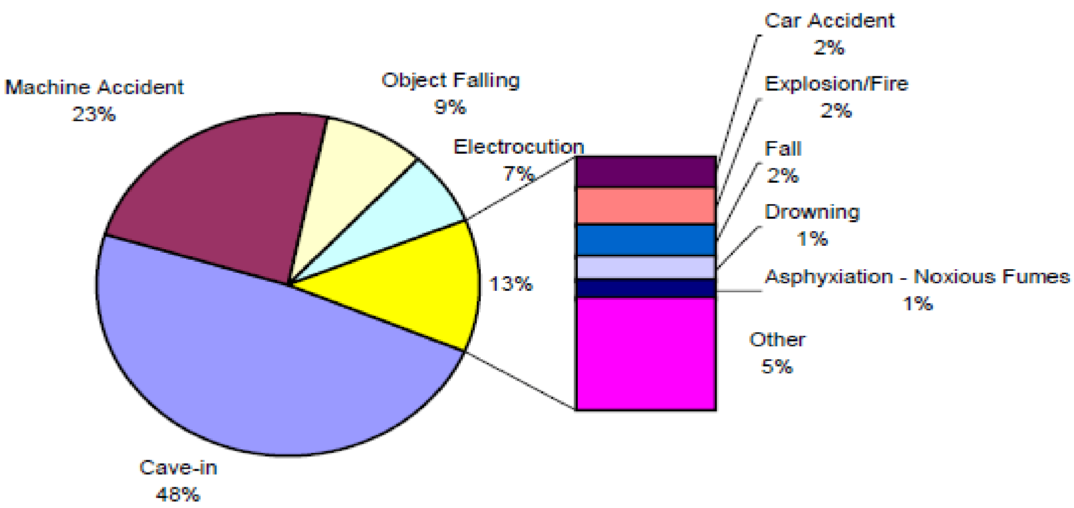

Figure 2.1. Distribution of Fatalities by Cause of Death

A worker in underground drowns in less than three minutes, and even if he survives, serious internal fractures and ruptures occur. Most of these deaths are seen in small and short-term works which are conducted related to water, gas, electricity and sewerage connections without any precaution. It is shown the situation before and after cave-in as below in Figure 2.2.

Figure 2.2. Before and after cave-in (Anonymous, 2016)

2.4 Causes of Cave-in Formation

There are a lot of factors triggering the cave-in which occurs as a result of the landslide, overturning, and falling of the material during channel excavation works. These factors, which are directly related to both the working environment and environmental effects, cause the cave-in by affecting excavation stability negatively (Figure 2.3).

These factors can be ranked as given below;

1. Soil type
2. Moisture content
3. Vibrations
4. Heavy loads (i.e. Surcharge)
5. Adjacent current buildings
6. Previous excavations
7. Weather conditions
8. The time period during which the excavation remains open

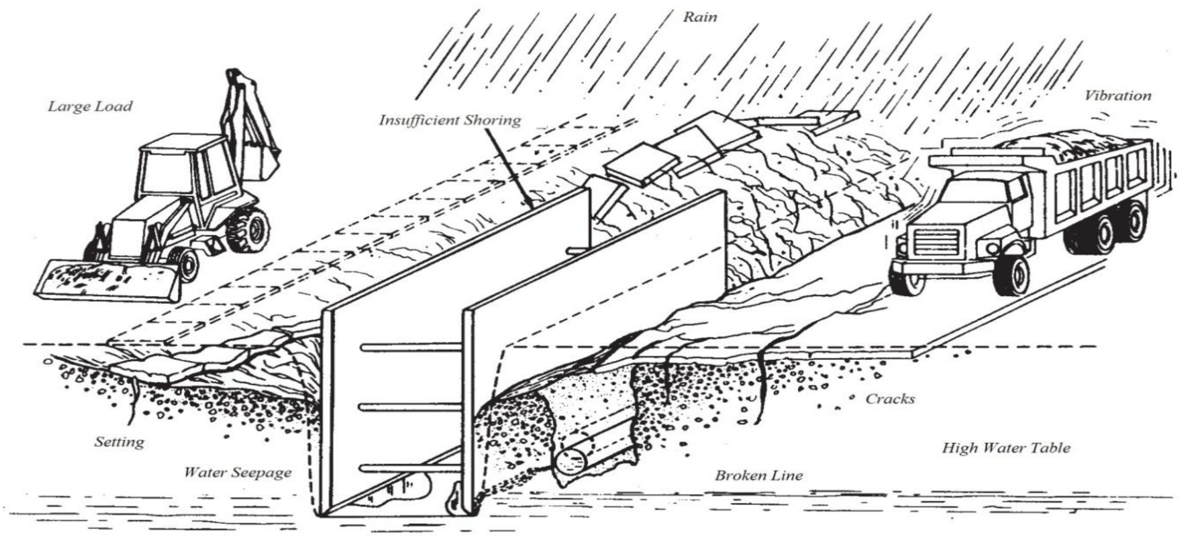

Figure 2.3. Factors affecting the excavation stability

2.4.1 Soil Type

Soil type is the most important factor that should be known in order to determine the strength and durability of the trench walls and to take necessary security measures against the cave-in. The OSHA classifies soil types according to various characteristics of soils, performance analysis and decreasing durability according to environmental exposure conditions ("Trenching and Excavation Safety," 2015). Classified soil types according to the decreasing strength used by OSHA are given as below;

- Stable Rock
- Soil Type A
- Soil Type B
- Soil Type C

The determination of soil and rock species should be carried out by an expert by taking into consideration the following characteristics as one of the hard rock, type A, type B or type C. In order to make this classification, at least one visual and one manual analysis results are required by the expert. The weakest layer should be considered in the case of layered systems. When the characteristics, factors and conditions affecting the classification of a classified soil or rock change in any way, the classification must be repeated by the expert.

Stable Rock refers to a natural, solid mineral substance that can be excavated vertically during the excavation.

Soil Type A is cohesive soil with the unconfined compressive strength of 144 kPa (1Pa=1N/m^2) or more. Clay, silty clay, clay mud, sandy clay and silt clay loam can be given as examples. Hard layers and cemented soils such as caliche are also of type A. But if;

- It is fissured.
- The soil has been exposed to vibrations caused by heavy traffic, pile driving or similar effects.
- It is distrurbed in advance.
- The soil is a part of a sloping or layered system (where the layers are four horizontally and one vertically).
- The soil material is exposed to other factors that would have to be clasified as a less durable materail.

Then, the soil cannot be considered as Type A.

Soil Type B is cohesive soil with the unconfined compressive strength which is higher than 48 kPa and lower than 144 kPa. Grained cohesionless soils, angular pebbles (like crushed stone), silt, silt sludge, sandy loam, and in some cases silty clay mud and sandy clay mud are classified as Type B. Contaminated soils other than Type C soil and non-resistant dry rocks that meet the unconfined compressive strength values of Type A but have not been subjected to vibration are also considered as Type B soil. Besides, some sloped layered systems are in this type.

Soil Type C is cohesive soil with the unconfined compressive strength of 48 kPa or less. In addition to this;

- Grained soils containing gravel and sand.
- Sunken soils or soils where water is freely leaked.
- Non-resistant sunken rocks.
- The soil material which is a part of a sloping or layered system (where the layers are four horizontally and one vertically) is also considered as Type C.

2.4.2 Moisture Content

The moisture content of the soil has a big effect on the strength of the soil. When the excavation with a narrow section is done, the edges (i.e. walls) of this excavation are exposed to air. The moisture content begins to change rapidly, and the strength of these walls may be affected. Therefore, the more how far open the excavation area remains, the more the risk of cave-in increases.

2.4.3 Vibrations

Vibrations from various sources can affect the durability of channel excavations. The walls of channel excavations generally subject to vibrations from construction work such as earthworks, compaction, pile driven and explosion as well as vehicle traffic stemming from trucks and engineering vehicles. As a result of these vibrations, the soil becomes loose, and therefore, the demolition risk of the walls of excavation increases (Taş, 2015).

2.4.4 Heavy Loads (Surcharge)

The surcharge is heavy load or weight which can affect the durability and strength of trenching (i.e. narrow deep excavation). For instance, the earthworks accumulating near to narrow section excavation can apply pressure to the walls of the excavation. Hence, it is important the placement of earthworks. Earthworks should be kept as far as possible from the edges of the narrow section excavation. Furthermore, the materials and mobile equipment near to narrow section excavation cause heavy loads which can affect the durability of trenching. (Taş & Coşkunses, 2012). The effect of heavy loads on the walls of excavation is shown in Figure 2.4.

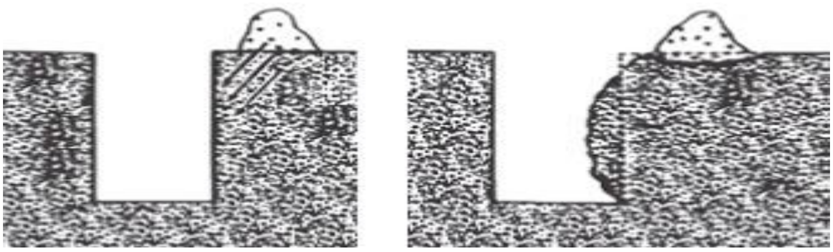

Figure 2.4. The effect of heavy loads on the walls of excavation

2.4.5 Adjacent Current Buildings

Most of the excavations and narrow section excavations have a failure zone, where heavy loads, changes in soil conditions, and other disturbances can cause collapse (i.e. cave-in). If this failure zone reaches the foundation of the adjacent building near to the excavation, this situation can cause the collapse or cave-in (Yavaş, 2016).

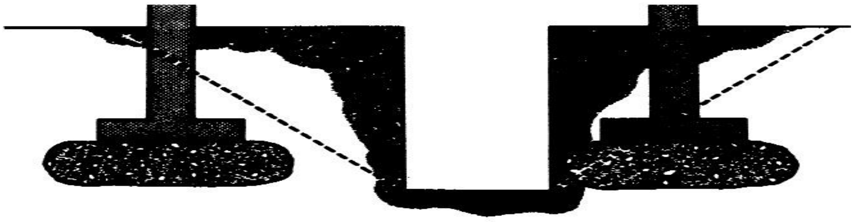

Figure 2.5. The failure zones reaching the foundations of the adjacent buildings near to the excavation

2.4.6 Previous Excavations

Previous excavations, which belong to underground services or cut new excavations, affect stability and strength. The fact that the soils around these previous excavations are loose and unstable can lead to the collapse or cave-in (Figure 2.6).

Figure 2.6. The effect of previous works on the excavations (Taş, 2015).

2.4.7 Weather Conditions

Rain, melting snow, dissolving the ground and the excess water stemming from rivers, waterfalls and sewage cause soil conditions to change. The soils whose conditions have changed can also create the collapse or cave-in.

2.4.8 Excavation Duration

When the soil is a cohesive soil, the soil has durability. In other words, the soil does not collapse under its own weight. In the case of the excavation is open for a long period, cohesion force decreases because of the weather conditions and this situation increases the risk of collapse or cave-in.

2.5 Precautions Taken Against the Cave-in

According to OSHA standards (Osha, 1926), each worker must be protected against the risk of the cave-in by appropriate protective systems. There are two exceptions where protective systems are not required;

- If the trench is done completely on the rock,
- The depth of the trench is less than 1.5 meters and the expert indicates that there is no trace of a possible cave-in hazard.

There are 3 different types of protective systems adopted by OSHA;

- Benching or sloping system
- Supporting the walls of the excavation
- Shielded system

2.5.1 Sloping System

This system is to slope the excavation walls away from the excavation in order to protect the workers. The slope required to prevent cave-in depends on various factors such as soil type and environmental conditions. Figure 2.7 shows the sloping system.

2.5.2 Benching System

In order to protect workers, it is separated into one or more steps of the excavation face between the walls and the system in which these steps are usually vertically or almost vertical. This system is not used in soil type C. Figure 2.8 shows the benching system.

2.5.3 Supporting the Walls of the Excavation

It is a system consisting of hydraulic or mechanical metal or wood structures where the excavation walls are supported.

Figure 2.7. Sloping System

Figure 2.8. Benching System

2.5.4 Shielded System

It is a system designed by professional engineers to keep the forces applied by the cave-in and protects the workers. Figure 2.9 shows the shielded system.

In the design of protective systems, many factors such as soil type, excavation depth, moisture content of soil, air and climate changes, additional loads, vibrations and other works in the excavation area should be taken into consideration. Excavations where the depth of the excavation with a narrow section exceeds 6.1 meters, should be designed according to the data prepared or approved by professional engineers. Figure 2.10 shows the excavations in soil type C.

According to OSHA standards, maximum acceptable slopes and excavation slopes applied for different soil types are given as in Table 2.1.

Figure 2.9. Shielded System (Yavaş, 2016)

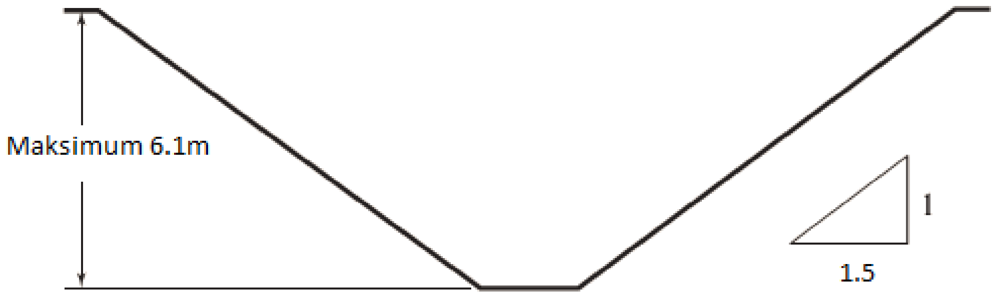

Figure 2.10. Excavations in soil type C (Yavaş, 2016)

Table 2.1. Maximum acceptable slopes for different soil types (Osha, 1926)

Soil or Rock Type	Maximum Allowable Splopes(H:V)[1] for Excavation Less Than 20 Feet Deep[3]
Stable Rock	Vertical (90^o)
Soil Type A[2]	3/4:1 (53^o)
Soil Type B	1:1 (45^o)
Soil Type C	1½:1 (34^o)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63^o) is allowed in excavations in Type A soil that is 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in deep shall be 3/4H:1V (53^o).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

Summary of precautions against cave-in;

- Benching system can be used,
- Shielded and the supporting system can be used,
- Groundwater must be resisted,
- No working in rain/snow conditions,
- The study area should be examined after rain/snow/frost,
- Excavation should be done more than 1.5 m of far from existing buildings,
- The traffic load to the ground should be calculated,
- Excavated soil should be discarded at least 1 m away from the excavation area.

2.6 Other Risks and Precautions

The cave-ins constitute the biggest hazard or danger in the excavations. There are many other hazards or dangers that can lead to serious injuries and deaths except for cave-ins. It has been mentioned about these dangers before. In order to carry out safe excavation work, it is necessary that each stage of the excavation is monitored and inspected by an expert person, and this expert should give the necessary safety instructions to workers in cooperation with them. In narrow-section excavations with more than 2 meters deep, barriers which surround the working area should be used in order to prevent workers from falling. In public places where people are crowded, this barrier should be done without consideration any depth. In order to be more recognizable, bright barriers and various signs are used. The markers can be also placed if signs are insufficient.

Figure 2.11. Barriers which surround the working area

Materials and equipment at risk of rolling or falling to the excavation area must be kept at least 0.6 meters away from the excavation walls or kept them with the necessary supports. Engineering vehicles and trucks should be kept much further away by using barriers, warning signs and signals. When the trucks are discharging soil to the excavation area, chocks should be placed on the rear of the vehicle wheels (Figure 2.12).

It should be paid attention to the falling materials, and also personal protective equipment such as a helmet and safety footwear should be worn. In addition to this, gloves, ear protection and high visibility clothes should also be used. Workers should not work near the excavator and anyone should not stand under any loads lifted by the crane. An expert should test any excavation area that exceeds 1.2 meters or has an oxygen deficiency or is expected to be a hazardous atmosphere before the worker enters this excavation area. The worker must not be allowed to enter the excavation area in case of a dangerous environment, proper ventilation should be provided, and the worker must enter the excavation are after receiving the necessary respiratory protective equipment. Moreover, the environment in these excavations should be tested and controlled regularly. These tests should be increased if there is an engineering vehicle working in the narrow-section excavation area, and all kinds of health and safety equipment should be provided.

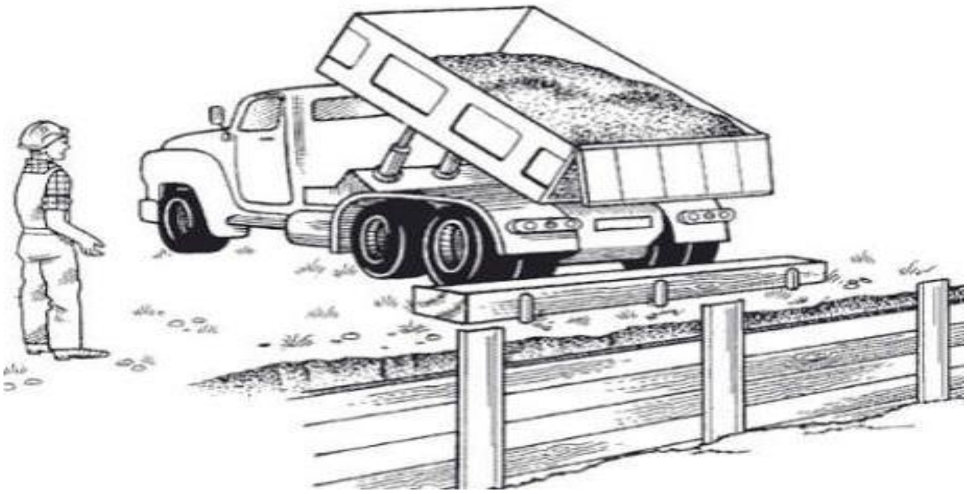

Figure 2.12. Chocks on the rear of the vehicle wheels

2.7 Precautions for Excavation Works

2.7.1 Precautions Related to Power Lines

- Maps should be taken from the relevant department and the locations of the lines should be determined.
- A detector can be used to detect electrical wiring.
- Electricity in the excavation area can be cut during excavation.
- If the electrical installation is above ground and the voltage range is between 750 and 150000 volts, it should not be approached more than 3 m. If the voltage range is between 150000 and 250000 volts, it should not be approached more than 4 m, and the voltage range is above 250000 volts, it should not be approached more than 6 m.

2.7.2 Precautions Related to Machines

- Workers should be prevented from entering the vehicle working area.
- The machine operator must be strictly qualified.
- An operator should be assigned to assist the operator in manoeuvring.
- Required signals and signs must be placed.

2.7.3 Precautions against Falling of the Material

- Workers should be prevented from entering the vehicle working area.
- Workers should wear helmets.
- Measures should be taken if working at height or working with the crane.

2.7.4 Precautions Related to Fall Into the Excavation Area

- There must be barriers around the excavation area.
- The barriers must be at least 2 m height.
- Passageways should be made.
- Workers must use ladders at the descent to the excavation area.

2.7.5 Precautions Related to Cutting Equipment in the Excavation Area

- Safety footwear should be used.
- Workers must be tetanus vaccine.

2.7.6 General Precautions

- Excavation area should be examined every day.
- The mask must be worn.

2.8 Risk Perception

The terms “risk and risk assessment” have gradually become crucial in recent years. The term “risk” is a statement that we can encounter in any sector and in our daily lives. There are a lot of hazards or dangers that can be encountered in all kinds of business from chemistry to food, from construction to electrical electronics, from hotel to the service industry. In order to eliminate these hazards or dangers, risk assessment studies were carried out and various methodologies were developed. Besides identifying and eliminating the hazards or dangers, it is extremely important to detect and prevent the risk beforehand. Therefore, some researches have been also conducted on risk perception recently. Furthermore, there is a human on the basis of risk. The events, where human consists of the basis of them, by nature of human are not constant, on the contrary, they are continuously changing. Hence, such events must be certainly taken into consideration a psychological and sociological perspective as well. People, who are not experts in risk analysis, have defined the risk as to the sum of hazards and extra factors by recognizing this necessity. These extra factors are related to the culture in which human grows, the society in which human grows, and also the psychological and sociological structure.

Risk analyses are different from according to the risk perception levels of people. Because people easily accept some risks while some risks resist. This situation is formed in consequence of some factors such as volunteering, familiarity, controllability, fearsomeness, recognizability and media effect. Social scientists have taken these factors that affect risk perception into two basic groups: fearsomeness (uncontrollability, unwillingness, fearsomeness) and obscurity (long-term effect, delay effect, obscurity). Risk perception examines the risk in terms of a cultural and social in the scope of danger and threat extent and places it at a different point. Nowadays, it is thought as a very important study area as well (Şen, 2014).

It will be extremely useful to detect these risks beforehand in order to eliminate the risks and to take necessary measures. The most important subjects at this stage are how the risk is perceived and evaluated by individuals and society. Many elements such as workers, society, environment, product, the reputation of a company, partners and customers can be affected by the risk factors. However, the risk is perceived differently by each individual. Just as everyone's fingerprint is different from each other, the perception level of each individual for a certain risk is different. Although the risk is a combination of the likelihood and severity of the occurrence of a dangerous event in engineering calculations, that may be inadequate in practice (Şen, 2014).

In this section it has been mentioned the factors which are affect the risk perception;

2.8.1 Fearsomeness Level of the Risk

The risk perception levels of people increase with the increase of the fearsomeness level of the risk. For instance, because the nuclear explosion that caused the death of thousands of people in Hiroshima is extremely frightening, the perception level of people against nuclear weapons risks is extremely high. The presence of tangible data related to the fearsomeness makes it easier for people to perceive the risks.

2.8.2 Number of People Affected by the Risk

The risk perception levels of people increase with the increase in the number of people affected by the risk because of the increase of fearsomeness and seriousness of the event. For example, a chemical fire affecting the whole city that can be killed thousands of people is extremely frightening, while the seriousness level of a kitchen fire occurring in an apartment that can cause injury to a family is lower.

2.8.3 Comprehensibility of the Hazard and Risk

How well understood what exactly the risk and hazard are, their source and who will affect, the risk perception levels of people increase such an extent. For instance, when it is not known anything about the characteristics and hazards of the chemicals, and also which chemicals should not be combined, it is unlikely to detect and prevent the risk in a laboratory.

2.8.4 Controllability of the Risk

People can easily volunteer for the risks they can control. When people feel an event under their own control, they tend to take more risk or worry less. Hence, risk is also defined as "insufficient controllability risk". Believing that it will be won if the lottery ticket is chosen by himself/herself, or else feeling more insecure in the vehicle if the car is driven by someone else is a good example of this situation. This is defined as the illusion of control.

2.8.5 Recognizability of the Risk

The risk perception levels of people increase with the increase of recognizability of the risk. The individual easily recalls and perceives a risk that he/she has previously encountered, and then he/she takes measures in a short time. However, it is almost impossible to perceive by the individual in advance a risk encountered for the first time.

2.8.6 Familiarity of the Risk

The risk perception levels of people increase with the increase of familiarity of the risk just as recognizability. Individuals can perceive much easier the risks they are familiar compared to the risks they did not encounter before, and they did not know the effect.

2.8.7 Volunteering Against the Risk

While the risk can be tolerated when the results are beneficial (i.e. lottery or gamble), sometimes acceptance of the risk comes into question due to the necessity (i.e. to help workers under the cave-in) as well. Some researches in this area have shown that people can accept more risk when they are voluntary behavior.

2.8.8 Velocity of the Risk Impact

The short-term or long-term impact of risk also affects the risk perception levels of people. The risks whose impacts seen in a short period of time can be easily perceived, while the risks whose impacts spread over many years are more difficult to detect. For example, this risk is easy to detect because an individual at the edge of the cliff knows that he will die if he falls from there. However, perceiving the risk is difficult for a person smoking a cigarette because he/she does not immediately fall sick with the danger of the poison.

2.8.9 Interest of Media to the Risk

The risk perception levels of people increase with the increase of the interest of media to the risk. The risks, which are introduced to people through ways such as television, the internet, newspapers, and magazines, provide to be taken measures against the risks by perceiving them.

2.8.10 Accident History of the Risk

Risks that cause major or significant accidents in the past are perceived more easily by individuals. For instance, the levels of earthquake risk perception of individuals in Turkey increased after the great Marmara earthquake.

2.8.11 Reversibility of the Risk After the Impact

Reversible or permanent effect of the risk affects the levels of risk perception of individuals. For example, when compared to a fungus which is known to kill immediately when eaten and a fungus which is known to cause temporary roseola when eaten, the former fungus is evaluated as riskier than the other one by individuals because of the temporary effects.

2.8.12 Source of the Risk

Whether the risk originates from nature or human error affects the level of risk perception of individuals. For example, the risks stemming from the nuclear plant are more frightening than the risks arising from the earthquake or volcano caused by nature.

2.8.13 Time

When a risk first occurs, the importance given by individuals to the risk is very high. But this importance decreases in time. This situation also observes in individuals after a serious accident (Figure 2.13). As seen in this figure, when the risk is first noticed, it is perceived at a certain level, but this perception tends to decrease over time.

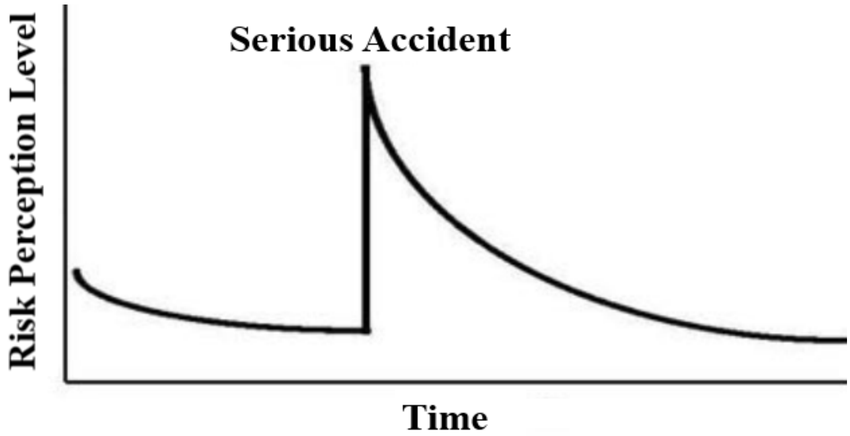

Figure 2.13. The effect of time on the risk perception

2.9 Previous Studies about Excavation and Risk Perception

In the study performed by Taş (2015), it was aimed to eliminate cave-in risk by measures of occupational safety in trenching operations which are an important part of infrastructure works including maintenance and alteration, to ensure that all workers in trenches work safely, and also to increase knowledge of cave-in as well as occupational health and safety consciousness. Therefore, some definitions related to cave-in risk and measures, the cave-in formation, factors triggering cave-in, also national and foreign regulations concerning the subject were presented in the study. Field visits were made in order to investigate current infrastructure works on site, and the specifications concerning with these works were examined. Related with infrastructure works by using the prepared check-lists data from the different public institutions were obtained and assessed considering cave-in risk. Furthermore, national standards and developed country regulations were investigated technically by taking account of measures against the cave-in risk.

In the study carried out by Taş and Coşkunses (2012), it was mentioned specifically narrow-section excavations, the hazards or dangers that may occur in these excavations and the measures to be taken. Excavation works should be carried out in a planned manner by making risk assessments under the supervision of an expert, avoiding individual movements during the working. In addition to this, it was mentioned that information exchange with the necessary institutions and authorities should be provided by being cooperated. The authorities should also keep in touch with the workers and these workers should be supervised through checklists.

Yavaş (2016) performed a study about risks and measures for the excavations conducting in the field according to soil types. In the study, it was mentioned the excavations, and the hazards or dangers that may occur in these excavations and the measures to be taken.

Yavan (2017) carried out a study in order to reveal the effects of the effect of the risk perception and fatalism (i.e. predestinarianism) stemming from the accidents and injuries in underground mining on the perception of occupational health and safety. As a result of the factor analyses, the risk perception is divided into two categories as an internal and external risk. It has been understood that internal risk perception and fatalism have a statistically significant positive effect on the occupational safety perception, and the external risk perception does not have a statistically significant effect on the occupational safety perception.

In the study carried out by Şen (2014), the contribution of risk perception and risk perception level to the risk assessment was explained by examining the terms "hazard, risk, risk analysis and risk assessment", and by mentioning the purpose and importance of risk assessment methods. However, the factors affecting the risk perception level were examined and explained with individual examples. Moreover, the method of "psychometric paradigm" was investigated by dividing into two groups the factors affecting the risk perception level.

Yamankaradeniz et al. (2015) was performed a study in order to determine the physical risk perception of female workers working in the automotive and metal sectors and being exposed to various work environment conditions such as noise, temperature, lighting, electrical hazards. According to the survey results from 582 female workers, the most important factor was found to be the education on occupational health and safety that affect the physical risk perception of women workers. It was also understood that safety training strongly increases the risk perceptions of workers.

With the study conducted by Tülü (2014), it has been aimed the occupational safety experts and occupational physicians operating in different sectors are grouped. It has been also aimed to analyze perceptions and expectations in the department of occupational health and safety services. The changes and policies about the education and implementation related to occupational health and safety services are discussed together with the performed analyses.

The purpose of the study carried out by Uslu (2014) is to analyze the relationship between the perception of the occupational safety culture and the occupational safety performance of the workers. Besides, in the study, the consistency between the perception of safety culture and the real occupational safety risk level in companies is also compared. In accordance with the results of the conducted analysis, it is concluded that safety culture perceptions of workers do not change according to gender, age, employment period, marital status and experience. On the other hand, safety culture perceptions of workers differ according to their positions, educational status, experiences related to the accidents in the past and near-miss events that they experienced. There is a positive relationship between safety culture and secure behaviour as a component of a safety performance scale. However, a tangible relation between risk averages determined by risk analysis reports and safety culture could not be found.

In the study performed by Aytaç et al. (2017), it was aimed to reveal the risk perception of the women working in the metal industry and to emphasize the importance of safety culture. The sample of the study consisted of total of 1918 woman workers in the metal industry in Bursa city. In this study, factor analysis, reliability analysis, correlation and regression analysis were used. According to the findings obtained, a statistically significant relationship between safety behaviour and risk perceptions was determined for safety culture.

Sjöberg (1998) presented a paper about worry and risk perception. Risk perception is sometimes measured by means of judgments about worry, sometimes as perceived risk more directly. However, the perceived level of risk calls for a more intellectual judgment and worry tends to refer to emotional reactions. These two are therefore not the same and need not be strongly correlated. According to the results reported showed that perceived risk and worry are indeed weakly correlated, both for generalized worry and for more specific measures of worry matched with the same hazard as risk ratings.

In the study condected by Sjöberg (2000), a model was proposed in which attitude, risk sensitivity, and specific fear are used as explanatory variables; this model seems to explain well over 30–40% of the variance and thus it is more promising than previous approaches. The model offers a different type of psychological explanation of risk perception, and it has many implications, e.g., a different approach to the relationship between attitude and perceived risk as compared with the usual cognitive analysis of attitude.

Hussin and Wang (2010) carried out a study related to industrial safety perception among post-graduate engineering students. The main objective of the research was to identify safety perceptions of different high-risk occupational industries. Results obtained were analyzed and compared with Health and Safety Executives (HSE) reports as well as the Oil and Gas Producer Safety Performance Report. According to the results, the participants perceive that the Oil and Gas Industry is safe. The research also concluded that participants' perceptions were more influenced by the concept of accident severity/dread rather than the concept of accident probability.

In the study performed by Slovic and Peters (2006), it was discussed some of the important ways that it affects how people perceive and evaluate risk. The research found that whereas risk and benefit tend to be positively correlated across hazardous activities in the world, they are negatively correlated in people's minds and judgments.

Marzaleh et al. (2016) investigated the relationship between the level of awareness around the Health, Safety and Environment Management System. It was also studied its effects on safety climate and risk perception by employees in an Iran Oil Refinery. Results showed that the relationship between safety climate and awareness level of the HSE management system, and also the relationship between safety climate and perception of risk were getting significant. However, the relationship between perception of risk and awareness level of the HSE management system was not significant.

The aim of the paper presented by Deery (1999) is to propose a model of the processes mediating behaviour around traffic hazards and to critically review the literature on novice drivers within the framework provided by the model. Compared to experienced drivers, novice drivers detect hazards less quickly and efficiently and perceived them less holistically. Research indicates that young drivers underestimate the risk of an accident in a variety of hazardous situations. At the same time, they overestimate their own driving skill. Young drivers are also more willing to accept risk while driving than experienced drivers. These factors are likely to contribute to young novice driver's overrepresentation in accidents.

The study performed by Basha and Maiti (2013) examined the associations amongst job-risk perception, work injuries and demographic variables like age, experience, designation and location of work in an integrated steel plant in India. The job-risk perception was measured using “job safety” questionnaire and actual safety performance was measured using “self-reported injury experiences”. The sample consisted of 135 employees selected based on stratified sampling from different sections of a steel melting shop (SMS) of the steel plant. The results revealed that four distinct factors namely general-risk, deadly-risk, health-risk and safety-perception, together explain 82.35% of the total variance. A work injury was associated with general-risk and safety-perception factors and was not associated with deadly-risk and health-risk factors. The demographic variable location significantly affects both job-risk perception and work injuries, whereas age, experience and designation of employees do not have significant effects.

Cedrone et al. (2018) presented a paper in order to evaluate the perception of psychosocial risks in a population. 54 technicians of Neurophysiopathology were enrolled, consisting of 23 males (42,6 %) and 31 females (57,4%). It was performed a statistical analysis provided for the assessment of the reliability of the questionnaires and the non-parametric analysis of gender differences. The study highlights the exposure to psychosocial risks by technicians of neuropsychology able to mediate the phenomenon of WRS. Furthermore, its ability to capture elements of the work context significantly increases if an analysis is carried out that takes into account the worker’s gender.

The aim of the paper presented by Cohn et al. (1995) is to investigate age changes in risk perception and unrealistic optimism. Teenagers (n=376) and parents (n=160) evaluated the risk of experimental, occasional, and regular involvement in 14 health-related activities (e.g., getting drunk). Respondents also evaluated their comparative chances of encountering the leading causes of morbidity and mortality. Compared with adults, teenagers minimized the perceived risk of experimental and occasional involvement in health-threatening activities. Notably, teenagers were less optimistic about avoiding injury and illness than were their parents, and teenagers at greatest risk for such misfortunes were the least optimistic about avoiding them.

The study carried out by Pandit et al. (2019) evaluated the effect of safety climate –a validated leading indicator of safety performance– on hazard recognition and safety risk perception levels. This was accomplished by gathering empirical data from over 280 workers employed in 57 construction workplaces in the United States. More specifically, after gathering safety climate data from the participating workers, the workers were engaged in hazard recognition and safety risk perception activity. The study findings revealed that workers representing workplaces with a more positive safety climate demonstrate higher levels of hazard recognition and safety risk perception. In addition, the effect of safety climate on safety risk perception was mediated by hazard recognition performance. In other words, the safety climate affected hazard recognition performance, which in turn affected safety risk perception levels. Apart from the indirect effect of safety climate on safety risk perception through hazard recognition performance, safety climate also affected safety risk perception independently of hazard recognition performance.

3 MATERIALS AND METHODS

In this study, the official documents related to occupational health and safety have been investigated, and a risk assessment form (Appendix 1) has been prepared in the light of these observations. The risk assessment form was applied to five different groups in order to evaluate the risk perception of different groups. These groups are given in detail as follows;

1. Seventeen third-grade students who have no education on occupational safety in civil engineering bachelor's degree (Firstly, the related risk assessment form was applied to this group without any training. After the necessary education was given, the risk assessment form was applied to the group again.)
2. Sixty second-grade students who have education three months ago on occupational safety in civil engineering bachelor’s degree.
3. Forty-eight fourth-grade students who have education two years ago on occupational safety in civil engineering bachelor’s degree.
4. Technical staff working in the campus construction of a university (2 civil engineers, 1 B-class occupational health and safety expert, 2 foreman, 2 operators, 3 construction workers)
5. Seven experienced civil engineers working in the construction sector

Kruskal-Wallis and Wilcoxon Signed Rank Tests have been used so as to evaluate the perception differences about the topic of risk.

3.1 Official Documents Related to Excavation Work

In this study, it has been investigated the official documents used in our country “Occupational Health and Safety Code in Construction Works” and “Occupational Health and Safety Regulation in Construction Works”. In addition to this, "The Occupational Safety and Health Administration’s (OSHA) Excavation Standards, 29 Code of Federal Regulations (CFR) Part 1926, Subpart P which contains requirements for excavation and trenching operations" has been also investigated.

3.1.1 Occupational Health and Safety Code in Construction Works

The objective of this Regulation is to determine the minimum occupational health and safety requirements to be taken in construction work. This Regulation is applied in the workplaces where it is done all the construction work within the scope of the Occupational Health and Safety Law No:6331 (Bakanlar Kurulu Kararı, 2003).

3.1.2 Occupational Health and Safety Regulation in Construction Works

Although it is not officially valid after the coming into force of the Occupational Health and Safety Regulation in Construction Works, it has a qualification which guides in the practices. Except for those stated in the Occupational Health and Safety Regulation in Construction Works, this regulation includes the complement practice details (Bakanlar Kurulu Kararı, 1974).

3.1.3 Occupational Safety and Health Administration (OSHA) Standards

The Occupational Safety and Health Administration's (OSHA) Excavation Standards of America, 29 Code of Federal Regulations (CFR) Part 1926, Subpart P contains requirements for excavation and trenching (i.e. narrow deep excavation) operations (Osha, 1926).

3.2 The Risks in Excavation Work

In this study, the excavation work has been studied under ten different working groups. The groups have been determined according to the nature of the work done and the way or manner of work. These working groups are given in terms of itemised as follows;

1. General excavating
2. Excavating with heavy engineering vehicles
3. Excavating with the dynamite
4. Excavating in the darkness
5. Excavating while raining
6. Working in the watery area
7. Working in the excavation area
8. Working under the ground
9. Transportation to the excavation area
10. Transportation over the excavation area

These identified working groups are classified according to the hazards that may occur during the performing of the work and the risks that may arise as a result of these hazards are defined.

3.3 Risk Analysis and Assessment

3.3.1 Using of L Shaped Matrix Method in Risk Assessment

A risk assessment form in "L Shaped Matrix" related to excavation work has been prepared as a result of the foregoing evaluations (The form is in Appendix 1). The matrix method (L shaped) is a systematic approach commonly used in the risk assessment of occupational health and safety. By using this method, it can be done the grading (i.e. scoring) and measurement of its result in case of the possibility of occurrence of an event and the occurrence of an event (Ceylan & Başhelvacı, 2011). The risk score values are calculated by the multiplying of likelihood and severity as shown on Eq. (1). Graphical representation of the likelihood and consequence scores of a risk has been shown in Table 3.1.

Risk Score = Likelihood x Severity (1)

Table 3.1. 5x5 L shaped risk decision matrix

		Severity				
		Very light (1)	Light (2)	Medium (3)	Serious (4)	Very serious (5)
Likelihood	Very small (1)	1 Negligible	2 Low	3 Low	4 Low	5 Low
	Small (2)	2 Low	4 Low	6 Low	8 Middle	10 Middle
	Medium (3)	3 Low	6 Low	9 Middle	12 Middle	15 High
	High (4)	4 Low	8 Middle	12 Middle	16 High	20 High
	Very high (5)	5 Low	10 Middle	15 High	20 High	25 Not tolerated

The likelihood of risk and the severity of risk can be determined by using Table 3.2 and Table 3.3, respectively. After calculating the possible risk scores, the risk assessment is made by taking as a reference to Table 3.4. The risk assessment tables are then prepared, and the risks are classified as “not tolerated, high, middle, low, and negligible” risk degrees concerning with the occupational and safety risk management system.

Table 3.2. Risk probability

Score	Likelihood	Rating Steps for Likelihood
1	Very small	So unlikely
2	Small	Very few (once a year), only in abnormal cases
3	Medium	Few (several times a year)
4	High	Often (monthly)
5	Very high	Very often (once a week, every day), normal working conditions

Table 3.3. Risk severity

Score	Severity	
1	Very light	No loss of work time, not require medical treatment
2	Light	No loss of working day, require outpatient treatment
3	Medium	Light injury, inpatient treatment
4	Serious	Severe injury, long-term treatment, occupational disease
5	Very serious	Death, permanent disability

Table 3.4. Risk assessment and the actions to be taken

Risk score	Risk degree	Actions
25	Not tolerated	The process must not be run until the risk is reduced to an acceptable level. If the risk cannot be avoided, the activities must be cancelled.
15-20	High	The situation is urgent or necessary measures must be taken as soon as possible. If the risk does not have dangerous potential, the action can be sustained under supervision and control.
8-12	Middle	Necessary protective actions must be taken to reduce the risk level.
2-6	Low	There is no need for emergency measures, but the ruling measures must continue.
1	Negligible	Taking precaution is not priority.

In this context, the risk assessment form has been prepared as given in Appendix 1, and the participants were presented in this format.

3.4 Implementation of the Risk Assessment Form

The sample (paradigm) groups listed above were asked to fill in the risk assessment form given in Appendix 1 based on the assumption that the building within the red circle in Figure 3.1 will be demolished and replaced with a new building on the Turgut Ozal Boulevard of Adana province, and all participants know exactly where that building is located.

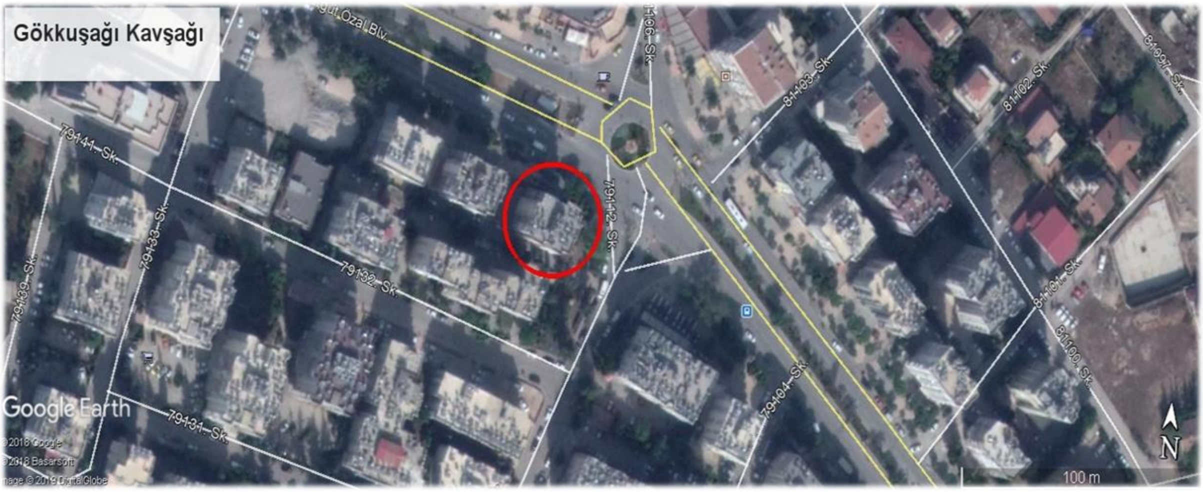

Figure 3.1. The locating of the building on the Turgut Ozal Boulevard of Adana province

3.4.1 First Implementation (Comparison in Sample 1)

The first implementation of the risk assessment study was carried out in two stages to the third-grade students of civil engineering who had not received any training on occupational health and safety. In the first stage, the prepared survey was filled by the students, and immediately after it was mentioned some important information on occupational health and safety in excavation work. In the second stage, the same survey was filled by the same students again. The aim of this study is to see the difference between the answers which are given by students before and after the training. For this purpose, the related hypotheses were established, and they were analysed by using Wilcoxon Test.

3.4.2 Second Implementation (Comparison among Samples 1, 2 and 3)

In the second implementation of the risk assessment study, three student groups from different levels of education were used as a sample (paradigm). These groups are given below;

11. First group: Seventeen third-grade students who were trained only about excavation work for a while ago.
12. Second group: Sixty second-grade students who were trained on occupational safety three months ago
13. Third group: Forty-eight fourth-grade students who were trained on occupational safety two years ago

The aim of this study is to reveal the differences in risk perception of the students who have different education levels. For this purpose, the related hypotheses were established, and they were analysed by using Kruskal Wallis Test.

3.4.3 Third Implementation (Analysis of Samples 4 and 5)

In this section, the technical staffs working in the campus construction of an university and the experienced civil engineers working in the construction sector have been used as the sample (paradigm). The obtained data were only evaluated by doing the descriptive analysis since they were small for the statistical analysis of the sample sizeableness.

3.5 Statistical Analysis

3.5.1 Wilcoxon Signed Rank Test

Wilcoxon signed rank test is used for repeated values. This test can be used if the sample, which is the subject of the investigation, is measured in two different conditions. The Wilcoxon signed rank test is the nonparametric test equivalent to the dependent t-test. This test converts the values two different periods of time (i.e. Time 1 and Time 2) in order to reset and compare them instead of the comparison of the average of them. Then, the Wilcoxon signed test calculates the absolute differences between both periods of time, and it investigates if there is any changing (Ahad et al, 2014).

3.5.2 The Kruskal Wallis Test

The Kruskal-Wallis test is a nonparametric (distribution free) test and it is used when the assumptions of one-way ANOVA are not met. The Kruskal-Wallis test assesses for significant differences on a continuous dependent variable by a categorical independent variable (with two or more groups). The values are sorted, and the ordered averages are compared for each group. That is an analysis between groups, and therefore, different people should be in each of the different groups (Ostertagová, et al, 2014).

4 RESULTS AND DISCUSSIONS

4.1 Comparison of Official Documents Related to Excavation Work

The official documents or arrangements using in the excavation works and the risks have been mentioned above. Table 4.1 has been prepared in the light of these, and the official documents and arrangements foregoing mentioned have been compared in this table. This prepared table consists of thirty-one articles (i.e. items), and the article number in the relevant official documents related to each risk is written in front of these articles. If the information given in the article is technical or general knowledge, it is written "T (for technical) and G (for general)" near it, respectively. Thus, it is aimed to give information about the relevant official documents.

When the official documents or regulations are examined according to the table prepared, The Occupational Health and Safety Code in Construction Works answer 23 of the 31 articles in the table, and 19 of them are general information while 4 of them are in the form of technical information. The Occupational Health and Safety Regulation in Construction Works answer 26 of the 31 articles in the table, and 14 of them are general information while 12 of them are in the form of technical information. On the other hand, when the Occupational Safety and Health Regulations for Construction OSHA 29 CFR 1926 is examined, it is observed to be answering 21 of the 31 articles in the table, while12 of them are general information and 9 of them are in the form of technical information.

No information has been found in any of the three official documents mentioned above related to the excavation works under the voltage line, which is the 12th article of the table. No information related to the injury of workers due to materials and equipment during excavation has been found either in the Occupational Health and Safety Code in Construction Works or the Occupational Health and Safety Regulation in Construction Works.

No information has been found in the Occupational Health and Safety Code in Construction Works related to the items “trenching without slope (i.e. narrow deep excavation without slope)”, “vehicle traffic during excavation”, “excavation in dark”, “working in watery areas”, “asphyxiation and falling of the workers during underground works”, and “vehicles working in underground works”.

No information has been found in the Occupational Health and Safety Regulation in Construction Works related to the items “falling of the material from the height while working in the excavation area”, “working in the inclination part of the excavation area” and “transportation over the excavation area”.

No information has been found in the Occupational Safety and Health Regulations for Construction OSHA 29 CFR 1926 related to the items “excavation with dynamite”, “working in dark”, “excavation while raining”, “presence of hazardous substances such as chemicals”, “toxic and gases in the working area”, and “working underground”. In addition to the above mentioned, it is only explained in detail in “Occupational Safety and Health Regulations for Construction OSHA 29 CFR 1926” how to be classified the soil which is excavated, how to be performed the excavation work, and how to be given an incline according to this classified soil type.

4.2 Results of Implementation of the Risk Assessment Forms

4.2.1 First Implementation

The first implementation of the risk assessment study was carried out in two stages to seventeen third-grade students in civil engineering bachelor's degree who had no previous education on occupational health and safety. These students were asked to complete the risk assessment forms, later lectured about safety rules during excavation works and then asked to complete the forms again. The hypothesis about this implementation was as given below;

H_0: There is not any significant difference in the risk assessments before and after the education.

H_1: There is a significant difference in the risk assessments before and after the education.

Risk assessment of the students before and after the education have been analysed by Wilcoxon Test by the help of SPSS Version 22 statistical package. The value of $p \leq 0.05$ has been accepted as a statistical asymptotic significance. The analysis results have been

Table 4.1. Comparison of Official Documents Related to Excavation Work

NO	WORK DONE	DANGER	RISK	CODE	T/G	REGULATION	T/G	OSHA	T/G
1	General excavating	Structures adjacent to the excavation area	Settlement, slide or collapse of the structures adjacent to the excavation area	62a	G	33	G	1i	G
2	General excavating	Damage to the infrastructure	Leakage, poisoning, explosion, electric shock and sewerage explosion	62b	G	20	G	1b	T
3	General excavating	Trenching without slope (i.e. narrow deep excavation without slope)	Collapse or cave-in			23	T	1a	G
4	General excavating	Working without the steps or excavation without inclination	Landslide, material falls on the workers and collapse or cave-in	63c	G	22	G	2b	T
5	General excavating	Not being observed by a competent person	Not being determined the insecure working environments	63a	G	21 34	T	1k	G
6	General excavating	Trenching (i.e. narrow deep excavation)	Be buried in the cave-in	67	T	24	T	2b 2c	T
7	General excavating	Falling or entering of the people the excavation area	Injuring	62c 62ç	G	18	T		
8	General excavating	Falling or entering of the engineering vehicle into the excavation area	Injuring and financial loss	62c 62ç	G	19	T	1d	G
9	General excavating	Vehicle traffic	Crashing to the workers			19	T	1d	G
10	General excavating	Material and equipment	Injuring of the workers					2d	G
11	Excavating with heavy engineering vehicles	Crashing of the vehicle to the workers, traffic accidents	Injuring of the workers, financial loss and Be buried in the cave-in	71	G	30	T	1f	G
12	Excavating with heavy engineering vehicles	Working under high voltage	Electric shock and fire						
13	Excavating with heavy engineering vehicles	Working of the engineering vehicles and trucks near to the excavation area	Landslide, collapse or cave-in and traffic accidents	68	G	31	T	1f	G
14	Excavating with heavy engineering vehicles	Pouring of the earthworks near to the excavation area	Landslide, collapse or cave-in	68	G	32	G	1j	T
15	Excavating with the dynamite	Dynamite explosion	The collapse or cave-in, splashing of the materials	74	G	35 40	T		
16	Excavating in the dark	Working in the dark	Stopping of the work, inaccurate implementation			44 47	T T		
17	Excavating while raining	The landslide, collapse or cave-in	Be buried in the cave-in	69	T	27 28	T		

Table 4.1. (Continued)

NO	WORK DONE	DANGER	RISK	CODE	T/G	REGULATION	T/G	OSHA	T/G
18	Working in the watery area	Wetting of the workers	Sickness of the workers			29	G	2a	T
19	Working in the excavation area	Working in the excavation area	Injuring or death as a result of be buried in the cave-in	64	T	23	T	§1926.652	G
20	Working in the excavation area	Hazardous and harmful working environment	Drowning, poisoning	63d	G	20 36	G	1g	T
21	Working in the excavation area	The presence of hazardous substances such as chemicals, toxic and gases or free silica dust in the working area	Dust exposure and the poisoning of workers	65	G	20 39 40	G		
22	Working in the excavation area	Falling down the material from the height	Injuring of the workers as a result of the falling of the material	63ç	G			1e	T
23	Working in the excavation area	Insecure excavation area	Falling of the materials or workers and flood	63ç	G	34 43	G	1h	T
24	Working in the excavation area	Working in the inclination part of the excavation area	Landslide and collapse or cave-in	64	G			2f	G
25	Working under the ground	Underground work	Inadequate respiration with ventilation origin, losing of the communication, be buried in the wreckage (collapse or cave-in)	72	G	20 36 41 42	G		
26	Working under the ground	Working in underground work where various gases can form an explosive mixture with air	Fire and explosion	73	G	37	G		
27	Working under the ground	The well and sewage pit work	Asphyxiation and falling of the workers			26	G		
28	Working under the ground	The engineering vehicles working underground work	Crashing of the engineering vehicles in the dark, crashing of the vehicles to the workers, falling of the vehicles to the working area			45 46	G		
29	Transportation to the excavation area	Entering and exiting to the excavation area	being stuck in, falling and be buried in the cave-in	63b 70	G G	25	G	1c	G
30	Transportation to the excavation area	The emergency situations such as fire, explosion, flood and collapse or cave-in	Workers not rescued in case of the emergency situations	63e	G	43	G	1c	G
31	Transportation over the excavation area	Insecure gateway	Falling down of the workers from the height, being stuck in	66	T			1l	T

presented in Appendix 2 in detail. According to this analysis results, it has been observed that there is a significant difference in 2 of the answers given by students to the “severity” section, in 9 of the answers given by students to the “likelihood” section and in 12 of the answers given by the students to the “risk score” section on the risk assessment forms (Table 4.2).

After observing the table given below which shows Wilcoxon test results, the questions that are found to have a significant difference in the analysis result has been examined in detail.

Table 4.2. Wilcoxon test results

	LIKELIHOOD	SEVERITY	RISK
QUESTION			1
	3		
	4		4
		5	5
	6		6
	9		9
			11
		12	
	14		14
	15		15
	21		21
			26
	35		35
	37		37
TOTAL	**9**	**2**	**12**

4.2.1.1 Likelihood

Question 3: Collapse or cave-in during trenching (i.e. narrow deep excavation without slope)

Question 4: Landslide, cave-in or material falls on the workers because of either working without benching or-excavation without sloping

Question 6: Injuries to people and material damages as a result of vehicles falling or entering into the excavation area

Question 9: Injuring of the people as a result of the crashing of the engineering vehicles and trucks

Question 14: The landslide, collapsing or cave-in because of the working of the engineering vehicles and trucks near to the excavation area

Question 15: Landslide, collapse or cave-in because of the pouring of the earthworks near to the excavation area

Question 21: Workers getting injured or buried as a result of collapse or cave-in while working in the excavation area

Question 35: Worker falls during access and egress to the excavation areas

Question 37: Worker falls from heights during transportation over the excavation area due to insecure passageways

4.2.1.2 Severity

Question 5: Injuries as a result of people falling or entering the excavation area

Question 12: Electric shock to the workers as a result of excavation with the engineering vehicles under high voltage

4.2.1.3 Risk

Question 1: Settlement, slide or collapse of the structures adjacent to the excavation area

Question 4: Landslide, cave-in or material falls on the workers because of either working without benching or-excavation without sloping

Question 5: Injuries as a result of people falling or entering the excavation area

Question 6: Injuries to people injuries and material damages as a result of vehicles falling or entering into the excavation area

Question 9: Injuring of the people as a result of the crashing of the engineering vehicles and trucks

Question 11: Occurring the collapse or cave-in as a result of the crashing of the engineering vehicles and trucks in the excavation area

Question 14: The landslide, collapsing or cave-in because of the working of the engineering vehicles and trucks near to the excavation area

Question 15: Landslide, collapse or cave-in because of the pouring of the earthworks near to the excavation area

Question 21: Workers getting injured or buried as a result of collapse or cave-in while working in the excavation area

Question 26: Occurring the landslide, collapsing or cave-in while working on the inclined area of the excavation area

Question 35: Worker falls during access and egress to the excavation areas.

Question 37: Worker falls from heights during transportation over the excavation area due to insecure passageways

As seen above, the most change occurs in the risk scores, the second biggest change occurs in the possibility of occurrence, the third biggest change occurs in the effect of it when happened. As can be understood from this point of view, it has a significant effect on the risk score which is the most important part of the education risk assessment form.

4.2.2 Second Implementation

In this risk assessment study where 3 groups of students at different levels of education have been used as a sample (i.e. paradigm), the related hypothesis was established as follows;

H_0: There is not any significant difference between risk perceptions of students at different levels of education.

H_1: There is a significant difference between risk perceptions of students at different levels of education.

If it is mentioned the groups once again;

- *First group:* Seventeen third-grade students who were just trained only about excavation works.
- *Second group:* Sixty second-grade students who were trained on occupational safety three months ago
- *Third group:* Forty-eight fourth-grade students who were trained on occupational safety two years ago

The risk assessment forms applied to the students at different levels of education have been analysed by Kruskal Wallis Test by the help of SPSS Version 22 statistical package. The value of $p \leq 0.05$ has been accepted as a statistical asymptotic significance. The analysis results have been presented in Appendix 3 in detail. According to this analysis results, it has been observed that there is a significant difference in 5 of the answers given by students to the "severity" section, in 7 of the answers given by students to the "likelihood" section and in 6 of the answers given by the students to the "risk score" section on the risk assessment form (Table 4.3). After observing the table given below which shows Kruskal Wallis test results, the questions that are found to have a significant difference in the analysis result has been examined in detail.

Table 4.3. Kruskal Wallis test results

	LIKELIHOOD	SEVERITY	RISK
QUESTION	12	12	12
	16	16	16
	17		17
	28		28
	29	29	29
	31		
	34	34	34
		36	
TOTAL	**7**	**5**	**6**

4.2.2.1 Likelihood

Question 12: Electric shock to the workers as a result of excavation with the engineering vehicles under high voltage

“The possibility of occurrence of this question is evaluated by the first group compared to other groups as the high probability, however; it is evaluated by the second group compared to other groups as the low probability”.

Question 16: The collapsing or cave-in as a result of the excavation with dynamite

“The possibility of occurrence of this question is evaluated by the second group compared to other groups as the high probability, however; it is evaluated by the first group compared to other groups as the low probability”.

Question 17: Splashing of the soil particles as a result of the excavation with dynamite

“The possibility of occurrence of this question is evaluated by the third group compared to other groups as the high probability, however; it is evaluated by the first group compared to other groups as the low probability”.

Question 28: Losing of the communication with the workers in underground work

“The possibility of occurrence of this question is evaluated by the third group compared to other groups as the high probability, however; it is evaluated by the first group compared to other groups as the low probability”.

Question 29: Be buried in the cave-in or collapsing in underground work because of the collapsing

“The possibility of occurrence of this question is evaluated by the third group compared to other groups as the high probability, however; it is evaluated by the first group compared to other groups as the low probability”.

Question 31: Falling of the workers while working in underground work such as the well and sewage pit work

“The possibility of occurrence of this question is evaluated by the third group compared to other groups as the high probability, however; it is evaluated by the first group compared to other groups as the low probability”.

Question 34: Engineering vehicles crashing the workers while working in underground works

“The possibility of occurrence of this question is evaluated by the second group compared to other groups as the high probability, however; it is evaluated by the first group compared to other groups as the low probability”.

Consequently, in this section, the third group with four items evaluates the events as more likely while the first group with at least one item evaluates the events as less likely.

4.2.2.2 Severity

Question 12: Electric shock to the workers as a result of excavation with the engineering vehicles under high voltage

“The effect of this question when it happens is evaluated by the first group compared to other groups as the high severity, however; it is evaluated by the second group compared to other groups as the low severity”.

Question 16: The collapsing or cave-in as a result of the excavation with dynamite

“The effect of this question when it happens is evaluated by the second group compared to other groups as the high severity, however; it is evaluated by the third group compared to other groups as the low severity”.

Question 29: Be buried in the cave-in or collapsing in underground work because of the collapsing

“The effect of this question when it happens is evaluated by the third group compared to other groups as the high severity, however; it is evaluated by the first group compared to other groups as the low severity”.

Question 34: Engineering vehicles crashing the workers while working in underground works

“The effect of this question when it happens is evaluated by the second group compared to other groups as the high severity, however; it is evaluated by the first group compared to other groups as the low severity”.

Question 36: Workers not rescued in case of emergency situations such as fire, explosion

“The effect of this question when it happens is evaluated by the second group compared to other groups as the high severity, however; it is evaluated by the first group compared to other groups as the low severity”.

Consequently, in this section, the second group with three items evaluates the events as more effective while the third and first group with at least one item evaluates the events as less effective.

4.2.2.3 Risk

Question 12: Electric shock to the workers as a result of excavation with the engineering vehicles under high voltage

“When the risk assessment scores are examined of this question, it is evaluated by the first group -compared to other groups- as too risky, however; it is evaluated by the second group compared to other groups as less risky”.

Question 16: The collapsing or cave-in as a result of the excavation with dynamite

“When the risk assessment scores are examined of this question, it is evaluated by the second group compared to other groups as too risky, however; it is evaluated by the first group -compared to other groups- as less risky”.

Question 17: Splashing of the soil particles as a result of the excavation with dynamite

“When the risk assessment scores are examined of this question, it is evaluated by the second group compared to other groups as too risky, however; it is evaluated by the first group -compared to other groups- as less risky”.

Question 28: Losing of the communication with the workers in underground work

“When the risk assessment scores are examined of this question, it is evaluated by the third group compared to other groups as too risky, however; it is evaluated by the first group -compared to other groups- as less risky”.

Question 29: Be buried in the cave-in or collapsing in underground work because of the collapsing

“When the risk assessment scores are examined of this question, it is evaluated by the third group compared to other groups as too risky, however; it is evaluated by the first group -compared to other groups- as less risky”.

Question 34: Engineering vehicles crashing the workers while working in underground works

“When the risk assessment scores are examined of this question, it is evaluated by the second group -compared to other groups- as too risky, however; it is evaluated by the first group compared to other groups as less risky”.

Consequently, in this section, the second group with three items evaluates the events as too risky while the first group with at least one item evaluates the events as less risky.

4.2.3 Third Implementation

The risk assessment form was applied to technical staff working in the campus construction of an university (2 civil engineers, 1 B-class occupational health and safety expert, 2 foreman, 2 operators, 3 construction workers) and seven experienced civil engineers working in the construction sector. However, it is evaluated only by performing the descriptive analysis, because the sample size is not big enough for the statistical analysis.

As a result of the comparison of the averages (i.e. mean) of given answers for each article (i.e. item) in the risk assessment form by participants, operators, workers, foreman, and civil engineers evaluate respectively 13, 12, 5, and 3 items as more likely compared to other groups. In the section of severity, civil engineers, operators, workers, and foreman evaluate respectively 17, 9, 4, and 1items more effective compared to other groups. When the risk assessment scores are examined, it has been understood that operators, civil engineers, workers, and foreman evaluate respectively 13, 11, 7, and 4 as too risky compared to other groups (Table 4.4).

Table 4.4. The comparison of the averages of given answers for each item in the risk assessment form by participants

	CIVIL ENGINEERS, OCCUPATIONAL HEALTH AND SAFETY EXPERT	FOREMAN	OPERATOR	WORKER
LIKELIHOOD	3	5	13	12
SEVERITY	17	1	9	4
RISK	11	4	13	7

When the averages of given whole answers for each item by participants are examined, the workers with the average of 3.69 evaluate as the most possible, the engineers and operators with the average of 3.51 follow the workers, and finally, the foreman with the average of 3.00 follows them.

In the section of the severity of items, the engineers with the average of 4.21 evaluate as more effective, the operators with the average of 4.04, the workers with the average of 3.53 and the foreman with the average of 3.41 follow the engineers.

When the average of risk assessment scores is examined, the engineers with the average of 15.10 evaluate as too risky, the operators with the average of 14.54, the workers with the average of 13.32 and the foreman with the average of 12.11 follow the engineers (Table 4.5).

Table 4.5. The comparison of the averages of given whole answers for each item by participants

	CIVIL ENGINEERS, OCCUPATIONAL HEALTH AND SAFETY EXPERT	FOREMAN	OPERATOR	WORKER
LIKELIHOOD	3,51	3,00	3,51	3,69
SEVERITY	4,21	3,41	4,04	3,53
RISK	15,10	12,11	14,54	13,32

5 CONCLUSIONS

Occupational safety requirements have vital importance in construction works, especially in the “excavation works” which is one of the areas where occupational accidents are experienced frequently. Thus, the most appropriate measures should be determined, and the necessary steps should be taken. Therefore, knowledge about the official documents or regulations is very important.

In this study, “Occupational Health and Safety Code in Construction Works”, “Occupational Health and Safety Regulation in Construction Works” and “The Occupational Safety and Health Regulations for Construction OSHA 29 CFR 1926”, which are formal and guiding regulations for the occupational health and safety, have been compared by dealing with the headings involved related to the excavation works. The prepared table has been investigated in 31 articles (i.e. items) in the total under 10 headings, according to the shape and condition of the excavation works. While Occupational Health and Safety Code in Construction Works is able to contain 23 of these articles, Occupational Health and Safety Regulation in Construction Works contains 26 of these articles. On the other hand, The Occupational Safety and Health Regulations for Construction OSHA 29 CFR 1926 contains 21 of these articles. Moreover, no information related to excavation works under high voltage has been found in any of the three documents.

The comparative table created in the scope of this study is valuable in terms of the showing what measures should be taken by the contractor and subcontractors doing excavation work and which documents should be followed about the details related the measures.

A risk assessment form in "L Shaped Matrix" has been prepared in the light of this table. The risk perception of civil engineering students having different levels of education and of different occupational groups working in the construction field have been tried to evaluate via this form.

It has been asked from all participants to fill in the risk assessment form based on the assumption that the building will be demolished and replaced with a new building on the

Turgut Ozal Boulevard of Adana province, and all participants know exactly where that building is located.

In this context, the first implementation of the risk assessment study was carried out in two stages to the third-grade students of civil engineering who had not received any training on occupational health and safety. In the first stage, the prepared survey was filled by the students, and immediately after it was mentioned some important information on occupational health and safety in excavation work. In the second stage, the same survey was filled by the same students again. The aim of this study is to see the difference between the answers which are given by students before and after the training.

The risk assessment forms filled by the students before and after the training have been analyzed with Wilcoxon Test. According to this analysis, it has been evaluated that nine of the answers given by the students after the training evaluate more likely, two of them evaluate more effective and twelve of them evaluate too risky. When these articles (i.e. items) have been examined in detail, it has been observed that these items such as "*the collapse or cave-in, working with the steps, the excavation with the inclination, how close the engineering vehicles should approach to the excavation area, how far the earthworks should be from the excavation area, and how the entering and exiting to the excavation area should be done*" only can be learned with the training. This result serves an example of the effect of education on risk perception.

In the second implementation of the risk assessment study, three student groups from different levels of education were used as a sample (paradigm). These groups consist of the students who were just trained about safety requirements during only excavation works (i.e. first group), the students who were trained on occupational safety requirements during all construction works three months ago (i.e. second group) and the students who were trained on occupational safety requirements during all construction works two years ago (i.e. third group). The aim of this study is to reveal the differences in risk perception of the students who have different education levels.

The risk assessment forms applied to the students have been analyzed with Kruskal Wallis Test. According to this analysis, it has been observed that there is a perception difference between students in seven of the answers related to the “likelihood” of risks, in five of the answers related to the “severity” of risks, and in six of the answers related to the overall risk scores. In this context, it was observed that the students who were trained on occupational safety two years ago approached the events as “more likely”. However, the students who were just trained only about excavation works approached the risks as the least possible. This result indicates that the consolidation of knowledge over time has a positive effect on the perception of the students related to the possibility of occurrence of risky events.

The students who were trained on occupational safety three months ago evaluated the events more “severe” than the students who were trained on occupational safety two years ago. According to this result, the perception of the students related to the effects caused by the risky events increases after the training or the crisis but after a while this perception regresses.

The students who were trained on occupational safety three months ago evaluated the events more risky than other students. However, it was observed that the students who were just trained only about excavation works evaluated the events less risky. According to this result, it can be said that students' risk perceptions become stronger after training but as time progresses, there is a decline in risk perception.

In the light of the risk assessment applications, it has been observed that the risk perception related to the excavation works increases immediately after the training, gets stronger for a while however decreases after a certain period of time. This decreasing trend of perception through time would more likely stop and move into a reverse direction if only training is repeated over time. Therefore training should be repeated periodically for the people who will work in this field.

In the third implementation of the risk assessment study, the technical staffs working in a university campus construction and the experienced civil engineers working in different construction sites have been used as the sample. However, it is evaluated only by performing the descriptive analysis, because the sample size is not large enough for the statistical analysis. When the values have been investigated, it has been understood that the group consisting of the engineers, the occupational health and safety expert and the operators evaluate the excavation work as too risky compared to the labourer and foreman. According to this result, because the priority contact people (i.e. responsible) are the engineers and the occupational health and safety experts in a potential negative situation related to occupational health and safety in excavation works, it can be understood that these people evaluate the excavation work as “very risky” . Moreover, it can be also said that the operators evaluate to the excavation work as “very risky” compared to the workers and foreman, since the operators are at the forefront of the excavation works and are aware of the potential damages if an accident happens during their work.

The comparative table created in the scope of this study is valuable in terms of showing both the measures that should be taken by the contractors/subcontractors undertaking excavation works and the documents that should be followed.

It has been observed through the risk assessment form applied to the students and workers that there are differences in the risk perception of people according to their education levels and their occupations. Repetition of the necessary trainings at certain intervals would affect the risk perception of the workers at all levels.

Some other parameters affecting the risk perception in excavation works can be suggested as a research subject for future studies. Furthermore, the effect of education on the risk perception can be investigated in other construction works.

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APPENDIX

Appendix 1 Risk Assessment Form and Its Ethical Committee Decision

No	The event	The possibility of occurrence	The effect of it when happened
1	Settlement, slide or collapse of the structures adjacent to the excavation area		
2	Leakage, poisoning, explosion, electric shock and sewerage explosion as a result of the damage to infrastructure during excavation		
3	Collapse or cave-in during trenching (i.e. narrow deep excavation without slope)		
4	Landslide, cave-in or material falls on the workers because of either working without benching or excavation without sloping		
5	Injuries as a result of people falling or entering the excavation area		
6	Injuries to people and material damages as a result of vehicles falling or entering into the excavation area		
7	Vehicles crashing to the workers		
8	Injuries to workers as a result of improper use of materials and equipment		
9	Injuring of the people as a result of the crashing of the engineering vehicles and trucks		
10	Occurring the people injuries and material damage as a result of the crashing of the engineering vehicles and trucks in the excavation area		
11	Occurring the collapse or cave-in as a result of the crashing of the engineering vehicles and trucks in the excavation area		
12	Electric shock to the workers as a result of excavation with the engineering vehicles under high voltage		
13	Fire outbreak as a result of the excavation with the engineering vehicles under high voltage		
14	The landslide, collapsing or cave-in because of the working of the engineering vehicles and trucks near to the excavation area		
15	Landslide, collapse or cave-in because of the pouring of the earthworks near to the excavation area		
16	The collapsing or cave-in as a result of the excavation with dynamite		
17	Splashing of the soil particles as a result of the excavation with dynamite		
18	The inaccurate implementation due to the excavation in the dark		
19	Occurring the landslide, collapsing or cave-in as a result of the excavation while it is raining		
20	Workers getting wet and sick as a result of working in wet areas.		
21	Workers getting injured or buried as a result of collapse or cave-in while working in the excavation area		
22	Drowning and poisoning due to the hazardous and harmful working environment in the excavation		
23	Dust exposure and the poisoning of workers due to the presence of hazardous substances such as chemicals, toxic and gases or free silica dust in the working area		
24	Injuring of the workers as a result of the falling of the material while working in the excavation area		
25	Falling of the materials due to the insecure working environment in the excavation, the risk of flooding and the risk of falling the people		
26	Occurring the landslide, collapsing or cave-in while working on the inclined area of the excavation area		
27	Inadequate respiration with ventilation origin in underground work		
28	Losing of the communication with the workers in underground work		
29	Be buried in the cave-in or collapsing in underground work because of the collapsing		
30	Fire and explosion while working in underground work in which various gases can form an explosive mixture with air		
31	Falling of the workers while working in underground work such as the well and sewage pit work		
32	Asphyxiation of the workers while working in underground works like the well and sewage pit work.		
33	Accidents between engineering vehicles while working underground in the dark		
34	Engineering vehicles crashing the workers while working in underground works		
35	Worker falls during access and egress to the excavation areas.		
36	Workers not rescued in case of emergency situations such as fire, explosion		
37	Worker falls from heights during transportation over the excavation area due to insecure passageways		

T.C.
ADANA BİLİM VE TEKNOLOJİ ÜNİVERSİTESİ
Bilimsel Araştırma ve Yayın Etiği Kurulu

Sayı : 76907350-050.01.04-E.2711

20/02/2019

Konu : Etik Kurulu Kararı

Sayın Arş. Gör. Kerem Nur KÖKSAL

Üniversitemiz Etik Kurulunun 20.02.2019 tarihli toplantısında "Applications of Information Technologies, Occupational Safety Requirements and the Effect of Education Risk Perception in Excavation Works" başlıklı çalışma önerisi Kurulumuzca incelenmiş olup anket ve içeriğinin, etik açıdan uygun görüldüğüne ilişkin alınan 20.02.2019 tarihli ve 3/1 sayılı karar ekte bulunmaktadır.

Bilgilerinizi rica ederim.

e-imzalıdır
Prof. Dr. Yıldırım Beyazıt ÖNAL
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Cemile GÜNDOĞDU
Bilgisayar İşletmeni Dahili
No.1500

Appendix 2 Wilcoxon test Analysis Results (First Implementation)

Instructions; BE_1: Before Education Question 1

AE_1: After Education Question 1

LIKELIHOOD

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum		N	Mean	Std. Deviation	Minimum	Maximum
BE_1	17	2,35	,786	1	4	**AE_1**	17	2,65	,996	1	4
BE_2	17	2,82	,728	2	4	**AE_2**	17	2,88	,600	2	4
BE_3	17	2,59	,618	2	4	**AE_3**	17	3,24	,970	1	5
BE_4	17	2,18	,728	1	4	**AE_4**	17	2,82	1,015	1	5
BE_5	17	2,47	1,281	1	5	**AE_5**	17	2,76	,831	1	4
BE_6	17	2,12	,781	1	3	**AE_6**	17	2,71	,686	2	4
BE_7	17	2,00	1,225	1	4	**AE_7**	17	2,24	,903	1	4
BE_8	17	3,76	1,147	2	5	**AE_8**	17	3,59	1,176	1	5
BE_9	17	2,00	,866	1	4	**AE_9**	17	2,41	1,004	1	5
BE_10	17	1,82	1,074	1	4	**AE_10**	17	2,06	1,029	1	4
BE_11	17	1,71	,920	1	3	**AE_11**	17	2,24	1,200	1	4
BE_12	17	2,24	,664	1	3	**AE_12**	17	2,53	1,007	1	4
BE_13	17	2,06	,748	1	3	**AE_13**	17	2,24	,970	1	4
BE_14	17	2,29	,920	1	4	**AE_14**	17	3,24	1,147	1	5
BE_15	17	2,06	1,088	1	5	**AE_15**	17	3,00	1,173	1	5
BE_16	17	1,18	,529	1	3	**AE_16**	17	1,12	,485	1	3
BE_17	17	1,29	,588	1	3	**AE_17**	17	1,18	,728	1	4
BE_18	17	2,24	1,251	1	5	**AE_18**	17	2,24	1,251	1	5
BE_19	17	2,24	1,147	1	5	**AE_19**	17	2,59	1,121	1	5
BE_20	17	2,53	1,375	1	5	**AE_20**	17	2,41	1,278	1	5
BE_21	17	2,18	,809	1	4	**AE_21**	17	2,94	,899	2	5
BE_22	17	1,88	,993	1	4	**AE_22**	17	2,12	,928	1	4
BE_23	17	1,53	,624	1	3	**AE_23**	17	1,76	,831	1	3
BE_24	17	2,88	,993	2	5	**AE_24**	17	3,24	1,033	2	5
BE_25	17	2,71	,920	1	5	**AE_25**	17	3,06	,899	2	5
BE_26	17	2,12	1,054	1	5	**AE_26**	17	2,76	,970	1	5
BE_27	17	1,76	,752	1	3	**AE_27**	17	1,65	,702	1	3
BE_28	17	2,06	1,345	1	5	**AE_28**	17	1,71	1,105	1	5
BE_29	17	1,76	,752	1	3	**AE_29**	17	2,12	1,166	1	5
BE_30	17	1,71	,772	1	3	**AE_30**	17	1,76	,831	1	3
BE_31	17	1,82	,809	1	3	**AE_31**	17	2,00	,791	1	4
BE_32	17	1,71	,920	1	4	**AE_32**	17	1,71	,686	1	3
BE_33	17	1,47	1,068	1	5	**AE_33**	17	1,71	1,047	1	5
BE_34	17	1,24	,437	1	2	**AE_34**	17	1,41	1,004	1	5
BE_35	17	1,65	,493	1	2	**AE_35**	17	2,59	,939	1	5
BE_36	17	2,41	1,326	1	5	**AE_36**	17	2,29	1,312	1	5
BE_37	17	2,12	1,111	1	5	**AE_37**	17	3,00	1,173	1	5

WILCOXON SIGNED RANKS TEST

		N	Mean Rank	Sum of Ranks
AE_1 - BE_1	Negative Ranks (A<B)	1	4,00	4,00
	Positive Ranks (A>B)	6	4,00	24,00
	Ties (A=B)	10		
	Total	17		
AE_2 - BE_2	Negative Ranks (A<B)	2	3,00	6,00
	Positive Ranks (A>B)	3	3,00	9,00
	Ties (A=B)	12		
	Total	17		
AE_3 - BE_3	Negative Ranks (A<B)	2	4,00	8,00
	Positive Ranks (A>B)	9	6,44	58,00
	Ties (A=B)	6		
	Total	17		
AE_4 - BE_4	Negative Ranks (A<B)	0	,00	,00
	Positive Ranks (A>B)	10	5,50	55,00
	Ties (A=B)	7		
	Total	17		
AE_5 - BE_5	Negative Ranks (A<B)	3	5,00	15,00
	Positive Ranks (A>B)	7	5,71	40,00
	Ties (A=B)	7		
	Total	17		
AE_6 - BE_6	Negative Ranks (A<B)	0	,00	,00
	Positive Ranks (A>B)	7	4,00	28,00
	Ties (A=B)	10		
	Total	17		
AE_7 - BE_7	Negative Ranks (A<B)	3	4,50	13,50
	Positive Ranks (A>B)	6	5,25	31,50
	Ties (A=B)	8		
	Total	17		
AE_8 - BE_8	Negative Ranks (A<B)	4	6,00	24,00
	Positive Ranks (A>B)	4	3,00	12,00
	Ties (A=B)	9		
	Total	17		
AE_9 - BE_9	Negative Ranks (A<B)	1	5,00	5,00
	Positive Ranks (A>B)	8	5,00	40,00
	Ties (A=B)	8		
	Total	17		
AE_10 - BE_10	Negative Ranks (A<B)	4	3,00	12,00
	Positive Ranks (A>B)	4	6,00	24,00
	Ties (A=B)	9		
	Total	17		
AE_11 - BE_11	Negative Ranks (A<B)	2	5,75	11,50
	Positive Ranks (A>B)	8	5,44	43,50
	Ties (A=B)	7		
	Total	17		
AE_12 - BE_12	Negative Ranks (A<B)	4	3,50	14,00
	Positive Ranks (A>B)	5	6,20	31,00
	Ties (A=B)	8		
	Total	17		

WILCOXON SIGNED RANKS TEST (Continued)

		N	Mean Rank	Sum of Ranks
AE_13 - BE_13	Negative Ranks (A<B)	4	4,50	18,00
	Positive Ranks (A>B)	5	5,40	27,00
	Ties (A=B)	8		
	Total	17		
AE_14 - BE_14	Negative Ranks (A<B)	1	5,00	5,00
	Positive Ranks (A>B)	12	7,17	86,00
	Ties (A=B)	4		
	Total	17		
AE_15 - BE_15	Negative Ranks (A<B)	2	4,00	8,00
	Positive Ranks (A>B)	11	7,55	83,00
	Ties (A=B)	4		
	Total	17		
AE_16 - BE_16	Negative Ranks (A<B)	1	1,00	1,00
	Positive Ranks (A>B)	0	,00	,00
	Ties (A=B)	16		
	Total	17		
AE_17 - BE_17	Negative Ranks (A<B)	3	2,50	7,50
	Positive Ranks (A>B)	1	2,50	2,50
	Ties (A=B)	13		
	Total	17		
AE_18 - BE_18	Negative Ranks (A<B)	5	4,80	24,00
	Positive Ranks (A>B)	4	5,25	21,00
	Ties (A=B)	8		
	Total	17		
AE_19 - BE_19	Negative Ranks (A<B)	3	5,50	16,50
	Positive Ranks (A>B)	7	5,50	38,50
	Ties (A=B)	7		
	Total	17		
AE_20 - BE_20	Negative Ranks (A<B)	4	4,00	16,00
	Positive Ranks (A>B)	3	4,00	12,00
	Ties (A=B)	10		
	Total	17		
AE_21 - BE_21	Negative Ranks (A<B)	0	,00	,00
	Positive Ranks (A>B)	8	4,50	36,00
	Ties (A=B)	9		
	Total	17		
AE_22 - BE_22	Negative Ranks (A<B)	2	2,50	5,00
	Positive Ranks (A>B)	4	4,00	16,00
	Ties (A=B)	11		
	Total	17		
AE_23 - BE_23	Negative Ranks (A<B)	1	1,50	1,50
	Positive Ranks (A>B)	3	2,83	8,50
	Ties (A=B)	13		
	Total	17		
AE_24 - BE_24	Negative Ranks (A<B)	1	3,50	3,50
	Positive Ranks (A>B)	6	4,08	24,50
	Ties (A=B)	10		
	Total	17		
AE_25 - BE_25	Negative Ranks (A<B)	2	4,50	9,00
	Positive Ranks (A>B)	7	5,14	36,00
	Ties (A=B)	8		
	Total	17		

WILCOXON SIGNED RANKS TEST (Continued)

		N	Mean Rank	Sum of Ranks
AE_26 - BE_26	Negative Ranks (A<B)	3	4,17	12,50
	Positive Ranks (A>B)	8	6,69	53,50
	Ties (A=B)	6		
	Total	17		
AE_27 - BE_27	Negative Ranks (A<B)	4	3,25	13,00
	Positive Ranks (A>B)	2	4,00	8,00
	Ties (A=B)	11		
	Total	17		
AE_28 - BE_28	Negative Ranks (A<B)	6	4,42	26,50
	Positive Ranks (A>B)	2	4,75	9,50
	Ties (A=B)	9		
	Total	17		
AE_29 - BE_29	Negative Ranks (A<B)	3	4,50	13,50
	Positive Ranks (A>B)	6	5,25	31,50
	Ties (A=B)	8		
	Total	17		
AE_30 - BE_30	Negative Ranks (A<B)	4	4,00	16,00
	Positive Ranks (A>B)	4	5,00	20,00
	Ties (A=B)	9		
	Total	17		
AE_31 - BE_31	Negative Ranks (A<B)	4	6,00	24,00
	Positive Ranks (A>B)	7	6,00	42,00
	Ties (A=B)	6		
	Total	17		
AE_32 - BE_32	Negative Ranks (A<B)	4	5,63	22,50
	Positive Ranks (A>B)	5	4,50	22,50
	Ties (A=B)	8		
	Total	17		
AE_33 - BE_33	Negative Ranks (A<B)	2	4,50	9,00
	Positive Ranks (A>B)	6	4,50	27,00
	Ties (A=B)	9		
	Total	17		
AE_34 - BE_34	Negative Ranks (A<B)	1	1,00	1,00
	Positive Ranks (A>B)	1	2,00	2,00
	Ties (A=B)	15		
	Total	17		
AE_35 - BE_35	Negative Ranks (A<B)	0	,00	,00
	Positive Ranks (A>B)	9	5,00	45,00
	Ties (A=B)	8		
	Total	17		
AE_36 - BE_36	Negative Ranks (A<B)	4	4,38	17,50
	Positive Ranks (A>B)	3	3,50	10,50
	Ties (A=B)	10		
	Total	17		
AE_37 - BE_37	Negative Ranks (A<B)	1	3,50	3,50
	Positive Ranks (A>B) (A>B)	10	6,25	62,50
	Ties (A=B)	6		
	Total	17		

Test Statistics[a]

	Z	Asymp. Sig. (2-tailed)
AE_1 - BE_1	-1,890[b]	0,059
AE_2 - BE_2	-,447[b]	0,655
AE_3 - BE_3	-2,299[b]	0,022
AE_4 - BE_4	-3,051[b]	0,002
AE_5 - BE_5	-1,387[b]	0,166
AE_6 - BE_6	-2,428[b]	0,015
AE_7 - BE_7	-1,155[b]	0,248
AE_8 - BE_8	-,866c	0,386
AE_9 - BE_9	-2,333[b]	0,02
AE_10 - BE_10	-,863[b]	0,388
AE_11 - BE_11	-1,674[b]	0,094
AE_12 - BE_12	-1,040[b]	0,298
AE_13 - BE_13	-,577[b]	0,564
AE_14 - BE_14	-2,944[b]	0,003
AE_15 - BE_15	-2,684[b]	0,007
AE_16 - BE_16	-1,000[c]	0,317
AE_17 - BE_17	-1,000c	0,317
AE_18 - BE_18	-,187[c]	0,852
AE_19 - BE_19	-1,165b	0,244
AE_20 - BE_20	-,351c	0,726
AE_21 - BE_21	-2,565[b]	0,01
AE_22 - BE_22	-1,190[b]	0,234
AE_23 - BE_23	-1,300[b]	0,194
AE_24 - BE_24	-1,897[b]	0,058
AE_25 - BE_25	-1,732[b]	0,083
AE_26 - BE_26	-1,865[b]	0,062
AE_27 - BE_27	-,541[c]	0,589
AE_28 - BE_28	-1,222[c]	0,222
AE_29 - BE_29	-1,155[b]	0,248
AE_30 - BE_30	-,289[b]	0,773
AE_31 - BE_31	-,905[b]	0,366
AE_32 - BE_32	,000[d]	1
AE_33 - BE_33	-1,414[b]	0,157
AE_34 - BE_34	-,447[b]	0,655
AE_35 - BE_35	-2,701[b]	0,007
AE_36 - BE_36	-,632[c]	0,527
AE_37 - BE_37	-2,683[b]	0,007

a. Wilcoxon Signed Ranks Test
b. Based on Negative Ranks
c. Based on Positive Ranks.
d. The sum of Negative Ranks equals the sum of Positive Ranks.

SEVERITY

Descriptive Statistics											
	N	Mean	Std. Deviation	Minimum	Maximum		N	Mean	Std. Deviation	Minimum	Maximum
BE_1	17	4,35	1,057	1	5	**AE_1**	17	4,35	1,057	1	5
BE_2	17	4,18	,728	2	5	**AE_2**	17	4,41	,712	3	5
BE_3	17	3,65	,931	2	5	**AE_3**	17	3,76	,903	2	5
BE_4	17	4,24	,831	3	5	**AE_4**	17	4,18	,728	3	5
BE_5	17	3,24	,664	2	4	**AE_5**	17	3,71	,849	2	5
BE_6	17	3,47	1,007	2	5	**AE_6**	17	3,59	,618	3	5
BE_7	17	3,76	,903	2	5	**AE_7**	17	3,94	,748	3	5
BE_8	17	3,24	1,200	1	5	**AE_8**	17	3,41	1,228	1	5
BE_9	17	3,71	,686	3	5	**AE_9**	17	3,71	,920	2	5
BE_10	17	2,71	,920	1	4	**AE_10**	17	3,00	1,225	1	5
BE_11	17	3,29	1,160	1	5	**AE_11**	17	3,35	1,320	1	5
BE_12	17	4,47	,624	3	5	**AE_12**	17	4,88	,332	4	5
BE_13	17	4,12	,697	3	5	**AE_13**	17	4,24	,903	2	5
BE_14	17	3,41	1,176	1	5	**AE_14**	17	3,82	1,015	2	5
BE_15	17	3,35	1,115	2	5	**AE_15**	17	3,71	,920	2	5
BE_16	17	3,71	1,649	1	5	**AE_16**	17	3,65	1,579	1	5
BE_17	17	3,24	1,200	1	5	**AE_17**	17	3,53	1,375	1	5
BE_18	17	2,35	1,057	1	5	**AE_18**	17	2,94	1,144	1	5
BE_19	17	3,18	1,074	1	5	**AE_19**	17	3,59	1,004	2	5
BE_20	17	2,18	1,131	1	5	**AE_20**	17	2,29	,920	1	4
BE_21	17	3,76	,903	2	5	**AE_21**	17	4,12	,857	3	5
BE_22	17	3,94	1,298	1	5	**AE_22**	17	4,00	,866	2	5
BE_23	17	4,00	1,118	1	5	**AE_23**	17	4,12	1,054	1	5
BE_24	17	3,94	,659	3	5	**AE_24**	17	3,88	,781	2	5
BE_25	17	3,94	,659	3	5	**AE_25**	17	4,00	,791	2	5
BE_26	17	3,41	1,004	2	5	**AE_26**	17	4,00	,791	2	5
BE_27	17	3,47	1,375	1	5	**AE_27**	17	3,00	1,500	1	5
BE_28	17	2,53	1,586	1	5	**AE_28**	17	2,12	1,317	1	5
BE_29	17	4,00	1,500	1	5	**AE_29**	17	3,71	1,359	1	5
BE_30	17	4,24	1,033	2	5	**AE_30**	17	4,06	1,345	1	5
BE_31	17	3,12	1,269	1	5	**AE_31**	17	3,41	1,176	1	5
BE_32	17	3,47	1,663	1	5	**AE_32**	17	3,24	1,562	1	5
BE_33	17	2,65	1,222	1	4	**AE_33**	17	2,82	1,185	1	5
BE_34	17	3,29	1,263	1	5	**AE_34**	17	2,94	1,298	1	5
BE_35	17	3,82	1,237	1	5	**AE_35**	17	4,29	,588	3	5
BE_36	17	4,29	,920	2	5	**AE_36**	17	4,06	,899	2	5
BE_37	17	3,82	1,237	1	5	**AE_37**	17	4,06	,966	1	5

WILCOXON SIGNED RANKS TEST

		N	Mean Rank	Sum of Ranks
AE_1 - BE_1	Negative Ranks (A<B)	4	3,50	14,00
	Positive Ranks (A>B)	3	4,67	14,00
	Ties (A=B)	10		
	Total	17		
AE_2 - BE_2	Negative Ranks (A<B)	3	6,17	18,50
	Positive Ranks (A>B)	7	5,21	36,50
	Ties (A=B)	7		
	Total	17		
AE_3 - BE_3	Negative Ranks (A<B)	3	6,50	19,50
	Positive Ranks (A>B)	6	4,25	25,50
	Ties (A=B)	8		
	Total	17		
AE_4 - BE_4	Negative Ranks (A<B)	4	5,00	20,00
	Positive Ranks (A>B)	4	4,00	16,00
	Ties (A=B)	9		
	Total	17		
AE_5 - BE_5	Negative Ranks (A<B)	2	4,50	9,00
	Positive Ranks (A>B)	8	5,75	46,00
	Ties (A=B)	7		
	Total	17		
AE_6 - BE_6	Negative Ranks (A<B)	6	4,50	27,00
	Positive Ranks (A>B)	5	7,80	39,00
	Ties (A=B)	6		
	Total	17		
AE_7 - BE_7	Negative Ranks (A<B)	3	5,00	15,00
	Positive Ranks (A>B)	6	5,00	30,00
	Ties (A=B)	8		
	Total	17		
AE_8 - BE_8	Negative Ranks (A<B)	3	5,33	16,00
	Positive Ranks (A>B)	6	4,83	29,00
	Ties (A=B)	8		
	Total	17		
AE_9 - BE_9	Negative Ranks (A<B)	4	4,50	18,00
	Positive Ranks (A>B)	4	4,50	18,00
	Ties (A=B)	9		
	Total	17		
AE_10 - BE_10	Negative Ranks (A<B)	2	1,50	3,00
	Positive Ranks (A>B)	3	4,00	12,00
	Ties (A=B)	12		
	Total	17		
AE_11 - BE_11	Negative Ranks (A<B)	5	4,30	21,50
	Positive Ranks (A>B)	4	5,88	23,50
	Ties (A=B)	8		
	Total	17		
AE_12 - BE_12	Negative Ranks (A<B)	1	5,00	5,00
	Positive Ranks (A>B)	8	5,00	40,00
	Ties (A=B)	8		
	Total	17		

WILCOXON SIGNED RANKS TEST (Continued)

		N	Mean Rank	Sum of Ranks
AE_13 - BE_13	Negative Ranks (A<B)	4	6,50	26,00
	Positive Ranks (A>B)	7	5,71	40,00
	Ties (A=B)	6		
	Total	17		
AE_14 - BE_14	Negative Ranks (A<B)	3	6,00	18,00
	Positive Ranks (A>B)	7	5,29	37,00
	Ties (A=B)	7		
	Total	17		
AE_15 - BE_15	Negative Ranks (A<B)	5	6,20	31,00
	Positive Ranks (A>B)	8	7,50	60,00
	Ties (A=B)	4		
	Total	17		
AE_16 - BE_16	Negative Ranks (A<B)	2	2,75	5,50
	Positive Ranks (A>B)	2	2,25	4,50
	Ties (A=B)	13		
	Total	17		
AE_17 - BE_17	Negative Ranks (A<B)	1	5,50	5,50
	Positive Ranks (A>B)	5	3,10	15,50
	Ties (A=B)	11		
	Total	17		
AE_18 - BE_18	Negative Ranks (A<B)	3	4,00	12,00
	Positive Ranks (A>B)	8	6,75	54,00
	Ties (A=B)	6		
	Total	17		
AE_19 - BE_19	Negative Ranks (A<B)	1	2,50	2,50
	Positive Ranks (A>B)	5	3,70	18,50
	Ties (A=B)	11		
	Total	17		
AE_20 - BE_20	Negative Ranks (A<B)	3	5,17	15,50
	Positive Ranks (A>B)	5	4,10	20,50
	Ties (A=B)	9		
	Total	17		
AE_21 - BE_21	Negative Ranks (A<B)	3	3,50	10,50
	Positive Ranks (A>B)	5	5,10	25,50
	Ties (A=B)	9		
	Total	17		
AE_22 - BE_22	Negative Ranks (A<B)	3	4,00	12,00
	Positive Ranks (A>B)	4	4,00	16,00
	Ties (A=B)	10		
	Total	17		
AE_23 - BE_23	Negative Ranks (A<B)	2	3,50	7,00
	Positive Ranks (A>B)	4	3,50	14,00
	Ties (A=B)	11		
	Total	17		
AE_24 - BE_24	Negative Ranks (A<B)	4	3,88	15,50
	Positive Ranks (A>B)	3	4,17	12,50
	Ties (A=B)	10		
	Total	17		
AE_25 - BE_25	Negative Ranks (A<B)	2	4,50	9,00
	Positive Ranks (A>B)	4	3,00	12,00
	Ties (A=B)	11		
	Total	17		

WILCOXON SIGNED RANKS TEST (Continued)

		N	Mean Rank	Sum of Ranks
AE_26 - BE_26	Negative Ranks (A<B)	4	5,00	20,00
	Positive Ranks (A>B)	9	7,89	71,00
	Ties (A=B)	4		
	Total	17		
AE_27 - BE_27	Negative Ranks (A<B)	7	5,57	39,00
	Positive Ranks (A>B)	3	5,33	16,00
	Ties (A=B)	7		
	Total	17		
AE_28 - BE_28	Negative Ranks (A<B)	4	5,50	22,00
	Positive Ranks (A>B)	3	2,00	6,00
	Ties (A=B)	10		
	Total	17		
AE_29 - BE_29	Negative Ranks (A<B)	7	4,93	34,50
	Positive Ranks (A>B)	3	6,83	20,50
	Ties (A=B)	7		
	Total	17		
AE_30 - BE_30	Negative Ranks (A<B)	4	6,50	26,00
	Positive Ranks (A>B)	5	3,80	19,00
	Ties (A=B)	8		
	Total	17		
AE_31 - BE_31	Negative Ranks (A<B)	2	4,00	8,00
	Positive Ranks (A>B)	6	4,67	28,00
	Ties (A=B)	9		
	Total	17		
AE_32 - BE_32	Negative Ranks (A<B)	3	6,17	18,50
	Positive Ranks (A>B)	5	3,50	17,50
	Ties (A=B)	9		
	Total	17		
AE_33 - BE_33	Negative Ranks (A<B)	6	4,83	29,00
	Positive Ranks (A>B)	5	7,40	37,00
	Ties (A=B)	6		
	Total	17		
AE_34 - BE_34	Negative Ranks (A<B)	6	5,50	33,00
	Positive Ranks (A>B)	3	4,00	12,00
	Ties (A=B)	8		
	Total	17		
AE_35 - BE_35	Negative Ranks (A<B)	1	3,00	3,00
	Positive Ranks (A>B)	6	4,17	25,00
	Ties (A=B)	10		
	Total	17		
AE_36 - BE_36	Negative Ranks (A<B)	4	3,13	12,50
	Positive Ranks (A>B)	1	2,50	2,50
	Ties (A=B)	12		
	Total	17		
AE_37 - BE_37	Negative Ranks (A<B)	5	5,50	27,50
	Positive Ranks (A>B)	6	6,42	38,50
	Ties (A=B)	6		
	Total	17		

Test Statistics[a]

	Z	Asymp. Sig. (2-tailed)
AE_1 - BE_1	,000[b]	1
AE_2 - BE_2	-,973[c]	0,331
AE_3 - BE_3	-,368[c]	0,713
AE_4 - BE_4	-,302[d]	0,763
AE_5 - BE_5	-1,999[c]	0,046
AE_6 - BE_6	-,558[c]	0,577
AE_7 - BE_7	-1,000[c]	0,317
AE_8 - BE_8	-,796[c]	0,426
AE_9 - BE_9	,000[b]	1
AE_10 - BE_10	-1,225[c]	0,221
AE_11 - BE_11	-,122[c]	0,903
AE_12 - BE_12	-2,333[c]	0,02
AE_13 - BE_13	-,663[c]	0,507
AE_14 - BE_14	-,980[c]	0,327
AE_15 - BE_15	-1,054[c]	0,292
AE_16 - BE_16	-,184[d]	0,854
AE_17 - BE_17	-1,063[c]	0,288
AE_18 - BE_18	-1,925[c]	0,054
AE_19 - BE_19	-1,725[c]	0,084
AE_20 - BE_20	-,355[c]	0,722
AE_21 - BE_21	-1,100[c]	0,271
AE_22 - BE_22	-,378[c]	0,705
AE_23 - BE_23	-,816[c]	0,414
AE_24 - BE_24	-,264[d]	0,792
AE_25 - BE_25	-,333[c]	0,739
AE_26 - BE_26	-1,854[c]	0,064
AE_27 - BE_27	-1,217[d]	0,223
AE_28 - BE_28	-1,367[d]	0,172
AE_29 - BE_29	-,721[d]	0,471
AE_30 - BE_30	-,424[d]	0,672
AE_31 - BE_31	-1,508[c]	0,132
AE_32 - BE_32	-,073[d]	0,942
AE_33 - BE_33	-,367[c]	0,714
AE_34 - BE_34	-1,310[d]	0,19
AE_35 - BE_35	-1,930[c]	0,054
AE_36 - BE_36	-1,414[d]	0,157
AE_37 - BE_37	-,511[c]	0,609

a. Wilcoxon Signed Ranks Test
b. The sum of Negative Ranks equals the sum of Positive Ranks.
c. Based on Negative Ranks.
d. Based on Positive Ranks.

RISK

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum		N	Mean	Std. Deviation	Minimum	Maximum
BE_1	17	10,35	3,807	1	16	**AE_1**	17	11,71	4,921	1	20
BE_2	17	11,71	3,738	8	20	**AE_2**	17	12,82	3,795	6	20
BE_3	17	9,53	3,923	6	20	**AE_3**	17	12,53	5,875	3	25
BE_4	17	9,12	3,333	5	16	**AE_4**	17	11,76	4,956	5	25
BE_5	17	8,29	5,312	2	20	**AE_5**	17	10,18	4,004	4	20
BE_6	17	7,71	3,965	2	15	**AE_6**	17	9,59	2,347	6	12
BE_7	17	7,71	5,531	2	20	**AE_7**	17	8,94	4,380	3	20
BE_8	17	12,35	6,499	4	25	**AE_8**	17	12,29	5,709	1	25
BE_9	17	7,41	3,658	3	15	**AE_9**	17	9,00	4,472	3	20
BE_10	17	4,94	3,799	1	16	**AE_10**	17	6,35	4,743	1	20
BE_11	17	5,41	3,572	2	15	**AE_11**	17	7,88	5,544	1	20
BE_12	17	9,94	3,071	4	15	**AE_12**	17	12,35	5,086	5	20
BE_13	17	8,41	3,280	4	15	**AE_13**	17	9,59	4,836	3	20
BE_14	17	7,06	2,193	4	10	**AE_14**	17	12,82	6,307	2	25
BE_15	17	6,71	3,704	2	15	**AE_15**	17	11,53	6,404	3	25
BE_16	17	4,59	3,483	1	15	**AE_16**	17	4,12	2,571	1	12
BE_17	17	4,35	2,849	1	12	**AE_17**	17	4,24	3,327	1	16
BE_18	17	5,88	5,644	1	25	**AE_18**	17	7,24	6,310	1	25
BE_19	17	7,71	5,987	1	25	**AE_19**	17	9,76	5,506	2	20
BE_20	17	5,76	4,671	1	15	**AE_20**	17	5,65	4,030	1	15
BE_21	17	8,29	3,917	3	16	**AE_21**	17	12,29	5,265	6	25
BE_22	17	7,88	5,384	1	20	**AE_22**	17	8,82	4,990	2	20
BE_23	17	6,24	3,401	1	15	**AE_23**	17	7,41	4,139	1	15
BE_24	17	11,24	3,833	6	20	**AE_24**	17	12,65	4,663	4	20
BE_25	17	10,71	3,965	3	20	**AE_25**	17	12,29	4,135	4	20
BE_26	17	7,24	4,381	2	20	**AE_26**	17	11,06	4,879	4	25
BE_27	17	6,29	3,601	1	12	**AE_27**	17	5,18	3,264	1	10
BE_28	17	4,53	3,064	1	12	**AE_28**	17	3,35	2,473	1	9
BE_29	17	7,59	4,529	1	15	**AE_29**	17	8,47	6,286	1	25
BE_30	17	7,06	3,269	2	12	**AE_30**	17	7,47	4,446	1	15
BE_31	17	5,88	3,295	1	12	**AE_31**	17	6,94	3,230	1	12
BE_32	17	6,41	5,280	1	20	**AE_32**	17	6,06	4,100	1	15
BE_33	17	4,35	4,690	1	20	**AE_33**	17	5,47	5,680	1	25
BE_34	17	4,12	2,205	1	8	**AE_34**	17	4,76	5,652	1	25
BE_35	17	6,41	2,808	1	10	**AE_35**	17	11,00	4,373	5	25
BE_36	17	10,53	6,385	2	25	**AE_36**	17	9,41	5,874	3	25
BE_37	17	8,41	5,669	1	25	**AE_37**	17	12,65	6,254	2	25

WILCOXON SIGNED RANKS TEST

		N	Mean Rank	Sum of Ranks
AE_1 - BE_1	Negative Ranks (A<B)	1	3,50	3,50
	Positive Ranks (A>B)	8	5,19	41,50
	Ties (A=B)	8		
	Total	17		
AE_2 - BE_2	Negative Ranks (A<B)	3	7,00	21,00
	Positive Ranks (A>B)	8	5,63	45,00
	Ties (A=B)	6		
	Total	17		
AE_3 - BE_3	Negative Ranks (A<B)	4	6,63	26,50
	Positive Ranks (A>B)	11	8,50	93,50
	Ties (A=B)	2		
	Total	17		
AE_4 - BE_4	Negative Ranks (A<B)	1	9,00	9,00
	Positive Ranks (A>B)	11	6,27	69,00
	Ties (A=B)	5		
	Total	17		
AE_5 - BE_5	Negative Ranks (A<B)	3	2,67	8,00
	Positive Ranks (A>B)	7	6,71	47,00
	Ties (A=B)	7		
	Total	17		
AE_6 - BE_6	Negative Ranks (A<B)	4	3,50	14,00
	Positive Ranks (A>B)	8	8,00	64,00
	Ties (A=B)	5		
	Total	17		
AE_7 - BE_7	Negative Ranks (A<B)	3	7,50	22,50
	Positive Ranks (A>B)	9	6,17	55,50
	Ties (A=B)	5		
	Total	17		
AE_8 - BE_8	Negative Ranks (A<B)	4	8,25	33,00
	Positive Ranks (A>B)	7	4,71	33,00
	Ties (A=B)	6		
	Total	17		
AE_9 - BE_9	Negative Ranks (A<B)	2	3,50	7,00
	Positive Ranks (A>B)	9	6,56	59,00
	Ties (A=B)	6		
	Total	17		
AE_10 - BE_10	Negative Ranks (A<B)	5	4,50	22,50
	Positive Ranks (A>B)	6	7,25	43,50
	Ties (A=B)	6		
	Total	17		
AE_11 - BE_11	Negative Ranks (A<B)	3	5,17	15,50
	Positive Ranks (A>B)	10	7,55	75,50
	Ties (A=B)	4		
	Total	17		
AE_12 - BE_12	Negative Ranks (A<B)	5	6,10	30,50
	Positive Ranks (A>B)	9	8,28	74,50
	Ties (A=B)	3		
	Total	17		

WILCOXON SIGNED RANKS TEST (Continued)

		N	Mean Rank	Sum of Ranks
AE_13 - BE_13	Negative Ranks (A<B)	6	6,83	41,00
	Positive Ranks (A>B)	8	8,00	64,00
	Ties (A=B)	3		
	Total	17		
AE_14 - BE_14	Negative Ranks (A<B)	1	4,50	4,50
	Positive Ranks (A>B)	13	7,73	100,50
	Ties (A=B)	3		
	Total	17		
AE_15 - BE_15	Negative Ranks (A<B)	3	3,67	11,00
	Positive Ranks (A>B)	11	8,55	94,00
	Ties (A=B)	3		
	Total	17		
AE_16 - BE_16	Negative Ranks (A<B)	3	3,83	11,50
	Positive Ranks (A>B)	2	1,75	3,50
	Ties (A=B)	12		
	Total	17		
AE_17 - BE_17	Negative Ranks (A<B)	3	7,33	22,00
	Positive Ranks (A>B)	6	3,83	23,00
	Ties (A=B)	8		
	Total	17		
AE_18 - BE_18	Negative Ranks (A<B)	5	4,20	21,00
	Positive Ranks (A>B)	6	7,50	45,00
	Ties (A=B)	6		
	Total	17		
AE_19 - BE_19	Negative Ranks (A<B)	3	5,83	17,50
	Positive Ranks (A>B)	8	6,06	48,50
	Ties (A=B)	6		
	Total	17		
AE_20 - BE_20	Negative Ranks (A<B)	5	4,80	24,00
	Positive Ranks (A>B)	4	5,25	21,00
	Ties (A=B)	8		
	Total	17		
AE_21 - BE_21	Negative Ranks (A<B)	2	1,50	3,00
	Positive Ranks (A>B)	9	7,00	63,00
	Ties (A=B)	6		
	Total	17		
AE_22 - BE_22	Negative Ranks (A<B)	5	4,90	24,50
	Positive Ranks (A>B)	6	6,92	41,50
	Ties (A=B)	6		
	Total	17		
AE_23 - BE_23	Negative Ranks (A<B)	3	4,33	13,00
	Positive Ranks (A>B)	6	5,33	32,00
	Ties (A=B)	8		
	Total	17		
AE_24 - BE_24	Negative Ranks (A<B)	3	4,17	12,50
	Positive Ranks (A>B)	7	6,07	42,50
	Ties (A=B)	7		
	Total	17		
AE_25 - BE_25	Negative Ranks (A<B)	4	4,25	17,00
	Positive Ranks (A>B)	8	7,63	61,00
	Ties (A=B)	5		
	Total	17		

WILCOXON SIGNED RANKS TEST (Continued)

		N	Mean Rank	Sum of Ranks
AE_26 - BE_26	Negative Ranks (A<B)	3	6,17	18,50
	Positive Ranks (A>B)	11	7,86	86,50
	Ties (A=B)	3		
	Total	17		
AE_27 - BE_27	Negative Ranks (A<B)	10	7,05	70,50
	Positive Ranks (A>B)	4	8,63	34,50
	Ties (A=B)	3		
	Total	17		
AE_28 - BE_28	Negative Ranks (A<B)	8	8,44	67,50
	Positive Ranks (A>B)	5	4,70	23,50
	Ties (A=B)	4		
	Total	17		
AE_29 - BE_29	Negative Ranks (A<B)	7	4,93	34,50
	Positive Ranks (A>B)	4	7,88	31,50
	Ties (A=B)	6		
	Total	17		
AE_30 - BE_30	Negative Ranks (A<B)	7	7,14	50,00
	Positive Ranks (A>B)	7	7,86	55,00
	Ties (A=B)	3		
	Total	17		
AE_31 - BE_31	Negative Ranks (A<B)	5	4,90	24,50
	Positive Ranks (A>B)	8	8,31	66,50
	Ties (A=B)	4		
	Total	17		
AE_32 - BE_32	Negative Ranks (A<B)	6	6,75	40,50
	Positive Ranks (A>B)	6	6,25	37,50
	Ties (A=B)	5		
	Total	17		
AE_33 - BE_33	Negative Ranks (A<B)	6	5,00	30,00
	Positive Ranks (A>B)	7	8,71	61,00
	Ties (A=B)	4		
	Total	17		
AE_34 - BE_34	Negative Ranks (A<B)	6	5,42	32,50
	Positive Ranks (A>B)	4	5,63	22,50
	Ties (A=B)	7		
	Total	17		
AE_35 - BE_35	Negative Ranks (A<B)	0	,00	,00
	Positive Ranks (A>B)	10	5,50	55,00
	Ties (A=B)	7		
	Total	17		
AE_36 - BE_36	Negative Ranks (A<B)	5	6,00	30,00
	Positive Ranks (A>B)	4	3,75	15,00
	Ties (A=B)	8		
	Total	17		
AE_37 - BE_37	Negative Ranks (A<B)	3	2,00	6,00
	Positive Ranks (A>B)	9	8,00	72,00
	Ties (A=B)	5		
	Total	17		

Test Statistics[a]

	Z	Asymp. Sig. (2-tailed)
AE_1 - BE_1	-2,275[b]	0,023
AE_2 - BE_2	-1,073[b]	0,283
AE_3 - BE_3	-1,911[b]	0,056
AE_4 - BE_4	-2,360[b]	0,018
AE_5 - BE_5	-1,993[b]	0,046
AE_6 - BE_6	-1,969[b]	0,049
AE_7 - BE_7	-1,298[b]	0,194
AE_8 - BE_8	,000[c]	1
AE_9 - BE_9	-2,328[b]	0,02
AE_10 - BE_10	-,939[b]	0,348
AE_11 - BE_11	-2,103[b]	0,035
AE_12 - BE_12	-1,390[b]	0,165
AE_13 - BE_13	-,724[b]	0,469
AE_14 - BE_14	-3,018[b]	0,003
AE_15 - BE_15	-2,608[b]	0,009
AE_16 - BE_16	-1,084[d]	0,279
AE_17 - BE_17	-,060[b]	0,953
AE_18 - BE_18	-1,073[b]	0,283
AE_19 - BE_19	-1,380[b]	0,168
AE_20 - BE_20	-,178[d]	0,859
AE_21 - BE_21	-2,681[b]	0,007
AE_22 - BE_22	-,759[b]	0,448
AE_23 - BE_23	-1,128[b]	0,259
AE_24 - BE_24	-1,534[b]	0,125
AE_25 - BE_25	-1,736[b]	0,083
AE_26 - BE_26	-2,138[b]	0,033
AE_27 - BE_27	-1,134[d]	0,257
AE_28 - BE_28	-1,545[d]	0,122
AE_29 - BE_29	-,134[d]	0,894
AE_30 - BE_30	-,158[b]	0,875
AE_31 - BE_31	-1,478[b]	0,14
AE_32 - BE_32	-,118[d]	0,906
AE_33 - BE_33	-1,092[b]	0,275
AE_34 - BE_34	-,517[d]	0,605
AE_35 - BE_35	-2,807[b]	0,005
AE_36 - BE_36	-,893[d]	0,372
AE_37 - BE_37	-2,595[b]	0,009

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.
c. The sum of negative ranks equals the sum of positive ranks.
d. Based on positive ranks.

Appendix 3 Kruskal Wallis test Analysis Results (Second Implementation)

LIKELIHOOD

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
QUESTION1	125	2,68	1,021	1	5
QUESTION2	125	2,71	,982	1	5
QUESTION3	125	2,92	1,147	1	5
QUESTION4	125	2,73	1,180	1	5
QUESTION5	125	2,90	1,224	1	5
QUESTION6	125	2,50	1,140	1	5
QUESTION7	125	2,37	1,208	1	5
QUESTION8	125	3,33	1,098	1	5
QUESTION9	125	2,51	1,037	1	5
QUESTION10	125	2,10	1,007	1	5
QUESTION11	125	1,79	,927	1	4
QUESTION12	125	2,30	1,100	1	5
QUESTION13	125	1,97	,991	1	5
QUESTION14	125	2,71	,957	1	5
QUESTION15	125	2,55	1,027	1	5
QUESTION16	125	1,78	1,197	1	5
QUESTION17	125	1,86	1,306	1	5
QUESTION18	125	2,46	1,195	1	5
QUESTION19	125	2,66	1,121	1	5
QUESTION20	125	2,69	1,310	1	5
QUESTION21	125	2,63	,876	1	5
QUESTION22	125	1,80	,773	1	4
QUESTION23	125	1,79	,855	1	5
QUESTION24	125	3,10	1,015	1	5
QUESTION25	125	2,84	1,003	1	5
QUESTION26	125	2,64	,962	1	5
QUESTION27	125	2,18	1,136	1	5
QUESTION28	125	2,14	1,194	1	5
QUESTION29	125	2,33	1,061	1	5
QUESTION30	125	1,98	1,043	1	5
QUESTION31	125	2,54	1,043	1	5
QUESTION32	125	2,17	1,014	1	5
QUESTION33	125	2,02	1,074	1	5
QUESTION34	125	1,89	1,057	1	5
QUESTION35	125	2,48	,947	1	5
QUESTION56	125	2,24	,928	1	5
QUESTION37	125	2,71	1,149	1	5
GROUP	125	2,25	,680	1	3

KRUSKAL WALLIS TEST

	GROUP	N	Mean Rank
QUESTION1	1	17	62,65
	2	60	56,68
	3	48	71,02
	Total	125	
QUESTION2	1	17	71,15
	2	60	64,65
	3	48	58,05
	Total	125	
QUESTION3	1	17	73,38
	2	60	57,01
	3	48	66,81
	Total	125	
QUESTION4	1	17	66,62
	2	60	58,56
	3	48	67,27
	Total	125	
QUESTION5	1	17	60,82
	2	60	56,37
	3	48	72,06
	Total	125	
QUESTION6	1	17	73,12
	2	60	64,73
	3	48	57,25
	Total	125	
QUESTION7	1	17	61,79
	2	60	60,38
	3	48	66,71
	Total	125	
QUESTION8	1	17	70,94
	2	60	56,32
	3	48	68,54
	Total	125	
QUESTION9	1	17	59,21
	2	60	58,84
	3	48	69,54
	Total	125	
QUESTION10	1	17	61,94
	2	60	63,33
	3	48	62,96
	Total	125	
QUESTION11	1	17	75,56
	2	60	59,43
	3	48	63,01
	Total	125	
QUESTION12	1	17	71,71
	2	60	54,23
	3	48	70,89
	Total	125	

KRUSKAL WALLIS TEST (Continued)

	GROUP	N	Mean Rank
QUESTION13	1	17	73,53
	2	60	55,98
	3	48	68,05
	Total	125	
QUESTION14	1	17	80,06
	2	60	61,20
	3	48	59,21
	Total	125	
QUESTION15	1	17	75,65
	2	60	64,44
	3	48	56,72
	Total	125	
QUESTION16	1	17	43,71
	2	60	67,92
	3	48	63,69
	Total	125	
QUESTION17	1	17	44,18
	2	60	65,43
	3	48	66,64
	Total	125	
QUESTION18	1	17	55,03
	2	60	59,79
	3	48	69,83
	Total	125	
QUESTION19	1	17	60,97
	2	60	59,96
	3	48	67,52
	Total	125	
QUESTION20	1	17	55,59
	2	60	61,03
	3	48	68,09
	Total	125	
QUESTION21	1	17	74,24
	2	60	56,88
	3	48	66,68
	Total	125	
QUESTION22	1	17	75,21
	2	60	58,56
	3	48	64,23
	Total	125	
QUESTION23	1	17	62,50
	2	60	57,23
	3	48	70,40
	Total	125	
QUESTION24	1	17	66,35
	2	60	63,34
	3	48	61,39
	Total	125	
QUESTION25	1	17	70,18
	2	60	62,36
	3	48	61,26
	Total	125	

KRUSKAL WALLIS TEST (Continued)

	GROUP	N	Mean Rank
QUESTION26	1	17	66,68
	2	60	60,35
	3	48	65,01
	Total	125	
QUESTION27	1	17	47,82
	2	60	63,58
	3	48	67,65
	Total	125	
QUESTION28	1	17	49,12
	2	60	58,45
	3	48	73,60
	Total	125	
QUESTION29	1	17	54,56
	2	60	56,68
	3	48	73,89
	Total	125	
QUESTION30	1	17	57,62
	2	60	61,67
	3	48	66,57
	Total	125	
QUESTION31	1	17	44,15
	2	60	62,81
	3	48	69,92
	Total	125	
QUESTION32	1	17	47,85
	2	60	65,50
	3	48	65,24
	Total	125	
QUESTION33	1	17	51,29
	2	60	66,82
	3	48	62,38
	Total	125	
QUESTION34	1	17	44,09
	2	60	66,73
	3	48	65,03
	Total	125	
QUESTION35	1	17	65,38
	2	60	60,12
	3	48	65,76
	Total	125	
QUESTION36	1	17	59,56
	2	60	60,78
	3	48	67,00
	Total	125	
QUESTION37	1	17	71,82
	2	60	60,18
	3	48	63,41
	Total	125	

Test Statistics[a,b]

	Chi-Square	df	Asymp. Sig.
QUESTION1	4,613	2	0,1
QUESTION2	2,066	2	0,356
QUESTION3	3,801	2	0,149
QUESTION4	1,852	2	0,396
QUESTION5	5,381	2	0,068
QUESTION6	2,88	2	0,237
QUESTION7	0,906	2	0,636
QUESTION8	4,268	2	0,118
QUESTION9	2,816	2	0,245
QUESTION10	0,022	2	0,989
QUESTION11	3,092	2	0,213
QUESTION12	7,363	2	0,025
QUESTION13	5,174	2	0,075
QUESTION14	4,915	2	0,086
QUESTION15	3,899	2	0,142
QUESTION16	7,997	2	0,018
QUESTION17	7,178	2	0,028
QUESTION18	3,234	2	0,198
QUESTION19	1,312	2	0,519
QUESTION20	1,929	2	0,381
QUESTION21	4,454	2	0,108
QUESTION22	3,39	2	0,184
QUESTION23	4,098	2	0,129
QUESTION24	0,268	2	0,875
QUESTION25	0,87	2	0,647
QUESTION26	0,714	2	0,7
QUESTION27	4,118	2	0,128
QUESTION28	8,313	2	0,016
QUESTION29	7,645	2	0,022
QUESTION30	1,035	2	0,596
QUESTION31	6,898	2	0,032
QUESTION32	3,794	2	0,15
QUESTION33	2,732	2	0,255
QUESTION34	6,263	2	0,044
QUESTION35	0,814	2	0,666
QUESTION36	1,084	2	0,581
QUESTION37	1,468	2	0,48

a. Kruskal Wallis Test
b. .Grouping Variable: GROUP

SEVERITY

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
QUESTION1	125	4,16	1,019	1	5
QUESTION2	125	4,00	,950	1	5
QUESTION3	125	3,81	,922	1	5
QUESTION4	125	3,89	,900	1	5
QUESTION5	125	3,45	,979	1	5
QUESTION6	125	3,70	,882	1	5
QUESTION7	125	3,94	,940	1	5
QUESTION8	125	3,16	1,019	1	5
QUESTION9	125	4,00	,833	2	5
QUESTION10	125	3,39	1,046	1	5
QUESTION11	125	3,59	1,158	1	5
QUESTION12	125	4,60	,741	1	5
QUESTION13	125	4,19	,922	1	5
QUESTION14	125	3,71	,841	2	5
QUESTION15	125	3,40	,871	1	5
QUESTION16	125	3,54	1,489	1	5
QUESTION17	125	3,75	1,366	1	5
QUESTION18	125	2,71	1,237	1	5
QUESTION19	125	3,44	1,058	1	5
QUESTION20	125	2,19	,939	1	5
QUESTION21	125	4,20	,907	1	5
QUESTION22	125	4,04	1,011	1	5
QUESTION23	125	3,93	1,116	1	5
QUESTION24	125	3,95	,792	1	5
QUESTION25	125	3,79	,786	1	5
QUESTION26	125	3,59	,843	1	5
QUESTION27	125	3,48	1,189	1	5
QUESTION28	125	2,75	1,441	1	5
QUESTION29	125	4,35	1,042	1	5
QUESTION30	125	4,46	1,036	1	5
QUESTION31	125	3,56	,874	1	5
QUESTION32	125	3,77	1,086	1	5
QUESTION33	125	3,14	1,159	1	5
QUESTION34	125	3,71	1,135	1	5
QUESTION35	125	4,06	,776	2	5
QUESTION36	125	4,46	,799	1	5
QUESTION37	125	4,21	,786	1	5
GROUP	125	2,25	,680	1	3

KRUSKAL WALLIS TEST

	GROUP	N	Mean Rank
QUESTION1	1	17	71,06
	2	60	67,88
	3	48	54,04
	Total	125	
QUESTION2	1	17	77,97
	2	60	62,41
	3	48	58,44
	Total	125	
QUESTION3	1	17	60,06
	2	60	62,37
	3	48	64,83
	Total	125	
QUESTION4	1	17	73,21
	2	60	61,61
	3	48	61,13
	Total	125	
QUESTION5	1	17	72,21
	2	60	61,17
	3	48	62,03
	Total	125	
QUESTION6	1	17	56,62
	2	60	59,89
	3	48	69,15
	Total	125	
QUESTION7	1	17	61,15
	2	60	59,81
	3	48	67,65
	Total	125	
QUESTION8	1	17	73,44
	2	60	58,57
	3	48	64,84
	Total	125	
QUESTION9	1	17	51,26
	2	60	63,67
	3	48	66,32
	Total	125	
QUESTION10	1	17	51,09
	2	60	64,51
	3	48	65,33
	Total	125	
QUESTION11	1	17	56,44
	2	60	61,63
	3	48	67,04
	Total	125	
QUESTION12	1	17	74,24
	2	60	56,93
	3	48	66,60
	Total	125	

KRUSKAL WALLIS TEST (Continued)

	GROUP	N	Mean Rank
QUESTION13	1	17	64,29
	2	60	62,30
	3	48	63,42
	Total	125	
QUESTION14	1	17	68,29
	2	60	57,85
	3	48	67,56
	Total	125	
QUESTION15	1	17	73,50
	2	60	58,13
	3	48	65,38
	Total	125	
QUESTION16	1	17	67,15
	2	60	70,78
	3	48	51,80
	Total	125	
QUESTION17	1	17	55,38
	2	60	69,25
	3	48	57,89
	Total	125	
QUESTION18	1	17	70,94
	2	60	63,74
	3	48	59,26
	Total	125	
QUESTION19	1	17	68,12
	2	60	61,94
	3	48	62,51
	Total	125	
QUESTION20	1	17	67,82
	2	60	58,85
	3	48	66,48
	Total	125	
QUESTION21	1	17	58,41
	2	60	64,09
	3	48	63,26
	Total	125	
QUESTION22	1	17	59,35
	2	60	63,55
	3	48	63,60
	Total	125	
QUESTION23	1	17	69,12
	2	60	63,19
	3	48	60,59
	Total	125	
QUESTION24	1	17	59,68
	2	60	63,98
	3	48	62,96
	Total	125	
QUESTION25	1	17	72,76
	2	60	62,33
	3	48	60,39
	Total	125	

KRUSKAL WALLIS TEST (Continued)

	GROUP	N	Mean Rank
QUESTION26	1	17	80,09
	2	60	59,00
	3	48	61,95
	Total	125	
QUESTION27	1	17	52,21
	2	60	65,22
	3	48	64,05
	Total	125	
QUESTION28	1	17	47,03
	2	60	64,83
	3	48	66,38
	Total	125	
QUESTION29	1	17	43,97
	2	60	60,57
	3	48	72,78
	Total	125	
QUESTION30	1	17	51,85
	2	60	61,15
	3	48	69,26
	Total	125	
QUESTION31	1	17	62,26
	2	60	61,73
	3	48	64,84
	Total	125	
QUESTION32	1	17	52,88
	2	60	61,58
	3	48	68,35
	Total	125	
QUESTION33	1	17	52,82
	2	60	66,64
	3	48	62,05
	Total	125	
QUESTION34	1	17	41,35
	2	60	66,83
	3	48	65,89
	Total	125	
QUESTION35	1	17	72,65
	2	60	62,75
	3	48	59,90
	Total	125	
QUESTION36	1	17	45,71
	2	60	66,42
	3	48	64,85
	Total	125	
QUESTION37	1	17	58,68
	2	60	63,85
	3	48	63,47
	Total	125	

Test Statistics[a,b]

	Chi-Square	df	Asymp. Sig.
QUESTION1	5,688	2	0,058
QUESTION2	4,164	2	0,125
QUESTION3	0,286	2	0,867
QUESTION4	1,786	2	0,409
QUESTION5	1,422	2	0,491
QUESTION6	2,668	2	0,263
QUESTION7	1,443	2	0,486
QUESTION8	2,696	2	0,26
QUESTION9	2,491	2	0,288
QUESTION10	2,331	2	0,312
QUESTION11	1,344	2	0,511
QUESTION12	6,021	2	0,049
QUESTION13	0,059	2	0,971
QUESTION14	2,641	2	0,267
QUESTION15	3,118	2	0,21
QUESTION16	8,195	2	0,017
QUESTION17	3,846	2	0,146
QUESTION18	1,438	2	0,487
QUESTION19	0,429	2	0,807
QUESTION20	1,687	2	0,43
QUESTION21	0,383	2	0,826
QUESTION22	0,229	2	0,892
QUESTION23	0,778	2	0,678
QUESTION24	0,231	2	0,891
QUESTION25	1,814	2	0,404
QUESTION26	5,369	2	0,068
QUESTION27	1,901	2	0,387
QUESTION28	4,054	2	0,132
QUESTION29	11,337	2	0,003
QUESTION30	4,803	2	0,091
QUESTION31	0,236	2	0,889
QUESTION32	2,718	2	0,257
QUESTION33	2,133	2	0,344
QUESTION34	7,761	2	0,021
QUESTION35	1,817	2	0,403
QUESTION36	6,069	2	0,048
QUESTION37	0,336	2	0,845

a. Kruskal Wallis Test
b. Grouping Variable: GROUP

RISK

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
QUESTION1	125	11,22	5,509	1	25
QUESTION2	125	10,95	4,889	1	25
QUESTION3	125	11,41	5,934	2	25
QUESTION4	125	10,90	5,873	1	25
QUESTION5	125	10,36	5,972	1	25
QUESTION6	125	9,45	5,554	2	25
QUESTION7	125	9,60	5,871	1	25
QUESTION8	125	10,79	5,445	1	25
QUESTION9	125	10,11	4,934	2	25
QUESTION10	125	7,31	4,589	1	25
QUESTION11	125	6,62	4,246	1	20
QUESTION12	125	10,66	5,632	1	25
QUESTION13	125	8,38	4,928	1	25
QUESTION14	125	10,12	4,401	2	25
QUESTION15	125	8,80	4,685	1	25
QUESTION16	125	6,66	5,687	1	25
QUESTION17	125	7,34	6,226	1	25
QUESTION18	125	7,07	5,461	1	25
QUESTION19	125	9,42	5,472	1	25
QUESTION20	125	6,27	4,624	1	25
QUESTION21	125	11,18	4,875	2	25
QUESTION22	125	7,35	3,848	1	20
QUESTION23	125	7,08	3,989	1	25
QUESTION24	125	12,39	4,953	1	25
QUESTION25	125	10,90	4,813	1	25
QUESTION26	125	9,69	4,648	1	25
QUESTION27	125	7,90	5,412	1	25
QUESTION28	125	6,15	4,968	1	20
QUESTION29	125	10,52	5,724	1	25
QUESTION30	125	9,01	5,363	1	25
QUESTION31	125	9,10	4,290	1	20
QUESTION32	125	8,37	4,807	1	25
QUESTION33	125	6,76	5,050	1	25
QUESTION34	125	7,26	4,974	1	25
QUESTION35	125	10,07	4,462	3	25
QUESTION36	125	10,06	4,545	1	25
QUESTION37	125	11,54	5,689	2	25
GROUP	125	2,25	,680	1	3

KRUSKALWALLIS TEST

	GROUP	N	Mean Rank
QUESTION1	1	17	70,12
	2	60	60,67
	3	48	63,40
	Total	125	
QUESTION2	1	17	79,03
	2	60	64,89
	3	48	54,96
	Total	125	
QUESTION3	1	17	70,50
	2	60	58,35
	3	48	66,16
	Total	125	
QUESTION4	1	17	70,50
	2	60	58,15
	3	48	66,41
	Total	125	
QUESTION5	1	17	66,65
	2	60	57,56
	3	48	68,51
	Total	125	
QUESTION6	1	17	73,56
	2	60	62,52
	3	48	59,86
	Total	125	
QUESTION7	1	17	61,91
	2	60	59,01
	3	48	68,38
	Total	125	
QUESTION8	1	17	74,35
	2	60	55,64
	3	48	68,18
	Total	125	
QUESTION9	1	17	54,56
	2	60	58,76
	3	48	71,29
	Total	125	
QUESTION10	1	17	53,76
	2	60	64,32
	3	48	64,63
	Total	125	
QUESTION11	1	17	70,53
	2	60	58,97
	3	48	65,38
	Total	125	
QUESTION12	1	17	76,03
	2	60	52,86
	3	48	71,06
	Total	125	

KRUSKALWALLIS TEST (Continued)

	GROUP	N	Mean Rank
QUESTION13	1	17	72,68
	2	60	56,14
	3	48	68,15
	Total	125	
QUESTION14	1	17	80,21
	2	60	59,88
	3	48	60,81
	Total	125	
QUESTION15	1	17	78,68
	2	60	62,00
	3	48	58,70
	Total	125	
QUESTION16	1	17	50,41
	2	60	71,03
	3	48	57,43
	Total	125	
QUESTION17	1	17	41,79
	2	60	69,44
	3	48	62,46
	Total	125	
QUESTION18	1	17	62,32
	2	60	62,63
	3	48	63,70
	Total	125	
QUESTION19	1	17	67,18
	2	60	58,75
	3	48	66,83
	Total	125	
QUESTION20	1	17	59,38
	2	60	59,20
	3	48	69,03
	Total	125	
QUESTION21	1	17	69,12
	2	60	58,88
	3	48	65,98
	Total	125	
QUESTION22	1	17	71,85
	2	60	60,15
	3	48	63,43
	Total	125	
QUESTION23	1	17	66,62
	2	60	58,54
	3	48	67,29
	Total	125	
QUESTION24	1	17	65,68
	2	60	63,17
	3	48	61,84
	Total	125	
QUESTION25	1	17	75,32
	2	60	61,23
	3	48	60,85
	Total	125	

KRUSKALWALLIS TEST (Continued)

	GROUP	N	Mean Rank
QUESTION26	1	17	72,41
	2	60	59,13
	3	48	64,50
	Total	125	
QUESTION27	1	17	45,91
	2	60	63,54
	3	48	68,38
	Total	125	
QUESTION28	1	17	42,29
	2	60	61,13
	3	48	72,68
	Total	125	
QUESTION29	1	17	47,44
	2	60	56,85
	3	48	76,20
	Total	125	
QUESTION30	1	17	54,79
	2	60	61,03
	3	48	68,38
	Total	125	
QUESTION31	1	17	45,85
	2	60	62,59
	3	48	69,58
	Total	125	
QUESTION32	1	17	46,44
	2	60	64,30
	3	48	67,24
	Total	125	
QUESTION33	1	17	49,62
	2	60	67,88
	3	48	61,65
	Total	125	
QUESTION34	1	17	35,59
	2	60	67,91
	3	48	66,57
	Total	125	
QUESTION35	1	17	70,38
	2	60	60,18
	3	48	63,92
	Total	125	
QUESTION36	1	17	54,35
	2	60	61,94
	3	48	67,39
	Total	125	
QUESTION37	1	17	70,85
	2	60	60,86
	3	48	62,90
	Total	125	

Test Statistics[a,b]

	Chi-Square	df	Asymp. Sig.
QUESTION1	0,923	2	0,63
QUESTION2	5,942	2	0,051
QUESTION3	2,115	2	0,347
QUESTION4	2,251	2	0,324
QUESTION5	2,677	2	0,262
QUESTION6	1,84	2	0,399
QUESTION7	1,818	2	0,403
QUESTION8	5,248	2	0,073
QUESTION9	4,33	2	0,115
QUESTION10	1,295	2	0,523
QUESTION11	1,706	2	0,426
QUESTION12	9,523	2	0,009
QUESTION13	4,415	2	0,11
QUESTION14	4,549	2	0,103
QUESTION15	3,982	2	0,137
QUESTION16	6,262	2	0,044
QUESTION17	7,922	2	0,019
QUESTION18	0,03	2	0,985
QUESTION19	1,607	2	0,448
QUESTION20	2,19	2	0,335
QUESTION21	1,614	2	0,446
QUESTION22	1,423	2	0,491
QUESTION23	1,781	2	0,41
QUESTION24	0,146	2	0,929
QUESTION25	2,328	2	0,312
QUESTION26	1,96	2	0,375
QUESTION27	4,893	2	0,087
QUESTION28	9,252	2	0,01
QUESTION29	11,454	2	0,003
QUESTION30	2,181	2	0,336
QUESTION31	5,52	2	0,063
QUESTION32	4,338	2	0,114
QUESTION33	3,524	2	0,172
QUESTION34	11,443	2	0,003
QUESTION35	1,123	2	0,57
QUESTION36	1,775	2	0,412
QUESTION37	1,022	2	0,6

a. Kruskal Wallis Test
b. Grouping Variable: GROUP

CURRICULUM VITAE

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2008-2013	Faculty of Engineering / Department of Civil Engineering (English)

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Papers Presented at International Scientific Meetings and Published in Proceedings

1. GEREK İBRAHİM HALİL,KORKUT AHMET ESAT,KÖKSAL KEREM NUR (2017). Ülkemizde Ts En 13374 Standardına Göre Üretilen Korkuluk Sistemlerinin Uygulanabilirliğinin İrdelenmesi. Uluslararsı Katılımlı7. İnşaat Yönetimi Kongresi, 203-209. (Tam Metin Bildiri/Sözlü Sunum)(Yayın No:3645666)
2. KÖKSAL KEREM NUR,GEREK İBRAHİM HALİL (2017). YAPI BİLGİ MODELLEMESİNDE İŞ GÜVENLİĞİ UYGULAMALARI. Uluslararsı Katılımlı7. İnşaat Yönetimi Kongresi, 55-62. (Tam Metin Bildiri/Sözlü Sunum)(Yayın No:3645655)
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1. Erzurumluoğlu Kamer,KÖKSAL KEREM NUR,GEREK İBRAHİM HALİL (2015). İnşaat Sektöründe Fine Kinney Metodu Kullanılarak Risk Analizi Yapılması. 5. İŞÇİ SAĞLIĞI VE İŞ GÜVENLİĞİ SEMPOZYUMU (Tam Metin Bildiri/Sözlü Sunum)(Yayın No:1830841)