Evaluation of Compliance and Applicability of Safety Nets Used in Construction Workplaces

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Abstract

As in other developed countries, the majority of fatal work accidents occur in the construction sector in our country. When the reasons for the occurrence of these accidents are analyzed, it is seen that most of them are due to falling from height. It is known that the use of unsafe work equipment that is not suitable for the standards and the work has an important place among the sub-causes of these falls. Within the scope of the Regulation on Occupational Health and Safety in Construction Works published in the Official Gazette dated 5/10/2013 and numbered 28786, in terms of material properties and installation conditions of safety nets, it has been compulsory to comply with TS EN 1263-1 and TS EN 1263-2 standards to prevent the use of work equipment that does not comply with the standards. In addition, the minimum health and safety requirements for safety nets have been extensively included in the Regulation on Occupational Health and Safety in Construction Works, which was amended on 31/12/2018 to improve work equipment that is widely used in the sector. Within the scope of this study, suggestions were made to expand the use of safety net in compliance with the legislation and standards by examining what should be considered in the installation and use of safety nets, which types of safety nets are frequently used in Ankara province and to what extent they are suitable, and the troubles and difficulties experienced in its installation and usage.

Keywords: *occupational health and safety in construction works, safety nets, TS EN 1263-1, TS EN 1263-2.*

Introduction

The construction industry, which has a huge share in the economic growth of countries, serves as a driving force in the development of Turkey with the demand for goods and services for many sub-sectors. However, in Turkey as well as all over the world one of the biggest problems of the construction industry are work accidents. The reason for this is that the job groups that have the highest risk in terms of fatal work accidents serve in the sector. In Turkey, construction industry is the sector with the most deaths with a rate of approximately

35% among the fatal work accidents in all sectors. In 2018, 591 fatal accidents occurred in the construction industry (SGK, 2018; Erdal et.al, 2018).

Research studies conducted worldwide reveal that most of the work accidents occurring in the construction industry are due to falling from height (OSHA, 2018). 40-45% of fatal accidents in the sector in Turkey is known to occur because of same reason. A large part of these accidents occurs in the form of falling from the edges of the floors, scaffolds, elevator shaft or other spaces in the building.

In Turkey's national legislation, work at height in construction works are comprehensively handled and detailed arrangements regarding measures and equipment are included. Within the scope of these regulations, many fall prevent and fall arrest measures are implemented to prevent the employees from falling at the construction sites. One of the most frequently used among these equipment is safety net. Safety net is an equipment designed to catch people falling from a height and supported by a rope or supporting elements. It is required to comply with the Occupational Health and Safety Regulations in Construction Works and TS EN 1263-1, TS EN 1263-2 standards in the installation, dismantling, use and controls of safety nets.

In order to prevent falls from height in Turkey, use of safety net has begun to become widespread, however, it has been observed that there are serious deficiencies in issues such as compliance of safety nets to standards, knowledge levels of occupational safety specialists and other employees on safety net and awareness of employers (Dursun, 2016). In our country, some incompatibilities are frequently encountered in the installation and use of safety nets especially the use of safety net not in compliance with the standards.

In this study, in order to increase both the level of technical knowledge and awareness in the sector about safety net, it has been tried to determine to what extent the safety net systems in compliance with the legislation and the matters in TS EN 1253-1 and TS EN 1253-2 standards by examining the condition of the safety net systems used in the constructions in Ankara province.

Safety Nets

Safety nets, which are collective protective measures, are a fall arrest system and provide passive protection against falls. Safety nets reduce the fall distance of employees and prevent undesired consequences such as injury and death by mitigate the impact of falling (DGOSH, 2018).

In the hierarchy of work at height measures, fall prevention systems that prevent employees from falling provide higher precautions than the fall arrest systems designed to reduce the severity of injury in case of an employee falling from height. Therefore, while taking precautions when working at heights, it is necessary to examine the applicability of fall prevention systems such as edge protection system and cover systems before safety nets which are a fall arrest system. Because safety nets which limit the falling distance, do not prevent the employee to fall, unlike edge protection systems (Celik & Aydinli, 2019).

Safety net is a collective protective measure and is preferred by employers as they provide protection for more than one employee at the construction sites. In addition, it is stated in the Occupational Health and Safety Regulation on Construction Works that the safety of the employees in the workplaces should be ensured primarily by collective protection measures instead of the personal fall arrest systems.

Another advantage of safety nets are that they are passive systems. Passive systems are fall protection systems that are sufficient to be mounted once or do not require any other adjustment, any changes or operations by the employee to perform their activities. In active systems, the intervention and control of the employee comes into prominence as the employee needs to be equipped with a seat belt, keeps himself connected to a solid anchorage point or lifeline and comprehensive training for employees is required for these systems. For this reason, safety nets, which are passive systems, are more common in construction sites than active systems.

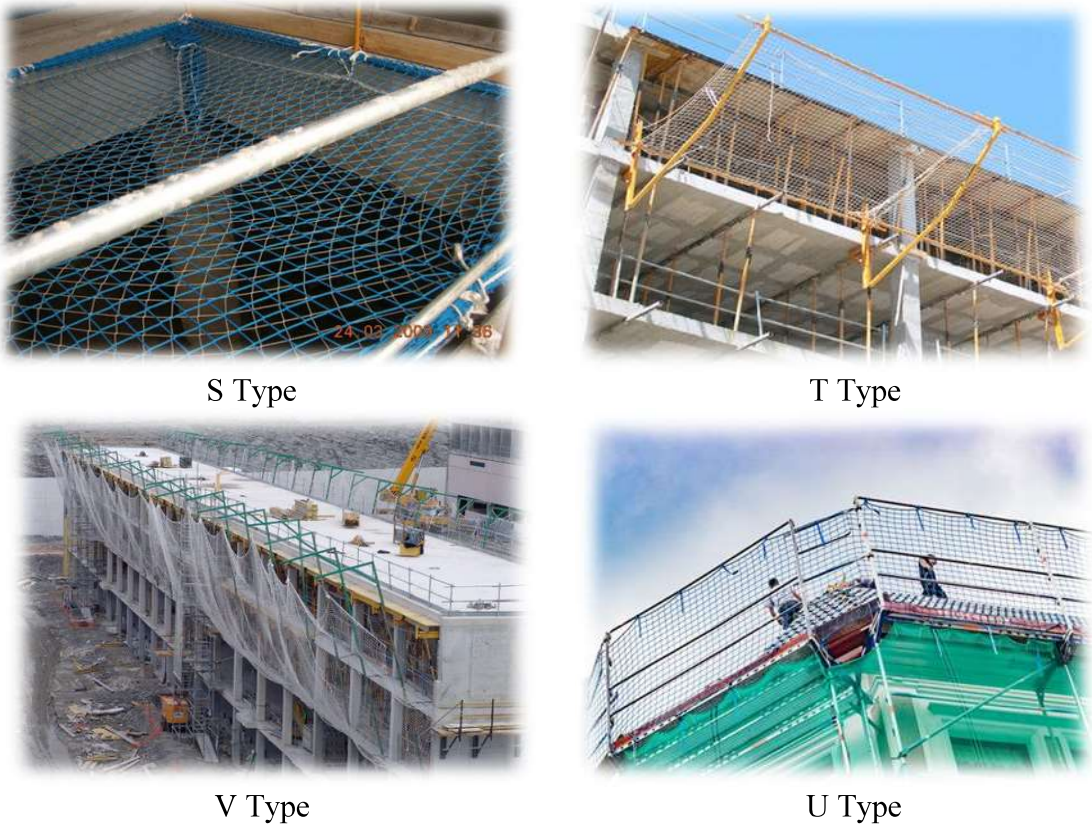


Figure 1: Types of safety nets.

Considering the current working conditions and the features of the installation area, it is necessary to choose the most suitable safety net system among the four system types in the TS EN 1263-1 standard (DGOSH, 2013). Safety nets have four system types: S type, T type, U type, and V type. S type safety nets are supported with edge rope and are generally used in the form of completely closing gaps that cause discontinuity in floors such as elevators, stairs, chimneys, shafts, lighting spaces. S type safety nets should be surrounded by edge ropes. TS EN 1263-1 standard does not cover small S type safety nets (less than 35 m2 and 5.0 m on the shortest side). T type safety nets are the type of net that are supported by connecting the net to the console and usually used along the perimeter of flooring edges. T type safety nets are for

horizontal use and the support structure should be positioned in such a way that in the event of a fall, the worker is not harmed. U type safety nets are attached to supporting framework for vertical use. It is generally used as a Class C edge protection system on sloping surfaces such as roofs. TS EN 13374 standard should be considered in the establishment of U type safety nets. V type safety nets, on the other hand, are a net type with border rope attached to a gallows type support. V type safety nets should be placed with the top edge at least 1 meter above the work area. The distance between supports should not exceed 5 m and the distance between anchorages used to connect the net to the building should not exceed 50 cm. The most commonly used types of safety net in our country are S type and T type.

Safety Nets in Legislation

With the amendment made in the Occupational Health and Safety Regulation on Construction Works on 31/12/2018, very comprehensive provisions regarding the safety nets were added. The provisions on safety nets in the legislation are generally based on TS EN 1263-1 and TS EN 1263-2 standards. In addition, it is stated in the Regulation that safety nets with a certificate of conformity to TS EN 1263-1 standard should be used in construction works and the safety net to be used should be established in accordance with TS EN 1263-2 standard. TS EN 1263-1 standard includes the classification and components of safety nets, test mesh, rope properties and requirements, and static and dynamic strength tests for each type of safety nets. In the TS EN 1263-2 standard, the safety requirements of the nets are generally determined and the standard includes instruction manual, fall height, catching width, linkage, installation, and fixing issues.

In accordance with the provisions of the aforesaid legislation, the primary and most important issue in the procurement and use of safety nets is that this safety nets must have a certificate of compliance with TS EN 1263-1 standard. The use of safety nets that do not meet the qualifications specified in the standard may cause the employee not to be held by the safety net in a possible fall and the employee to fall/crash to the ground or lower levels (DGOSH, 2018). In addition, in a study conducted by HSE in 2011 to determine the capacity of safety nets to prevent falling from height, it was revealed that the performance of safety nets that do not comply with the standards was very low (HSE, 2011).

Another important point in the legislation and TS EN 1263-2 standard related to safety nets is the issues to be considered during the installation of safety nets. First of all, the installation of safety nets should be performed by employees trained on safe working methods and in accordance with the manufacturer's instructions (DGOSH, 2013). However, the fall distance between the work platform and the safety net should be kept under maximum limits and at the minimum distance as far as possible. Because the bigger the fall height, the greater the effect will occur when the fall occurs. Another issue is the clearance distance under the safety net. When a worker falls, there must be sufficient clearance distance under the safety net so that the safety net can stretch and not hit any obstacles and not cause serious injury. In addition, it is necessary to carry out the installation in accordance with many more detailed issues in the legislation and standards.

Controls to be carried out after installation in the safety nets are also vital. In use of safety nets, primarily, it should be checked whether the current installation is correct, immediately after the installation. During the use of the safety nets that are installed correctly, it is

necessary to make controls both visually and by testing the test meshes. Visual checks include wear or cuts in the safety nets and visual inspection of deformations in the supporting structure and fasteners at regular intervals or in case of adverse weather conditions. The test meshes provided by the manufacturer with the safety nets and exposed to the same conditions as the safety net during use are determined to test once a year. Deteriorations due to aging are determined and it is confirmed that the minimum energy absorption capacity is met. In case of regular checks are not made, it is very likely that safety nets will not protect against falls, and therefore vital consequences met.

Findings

In order to determine the current condition of safety nets in Ankara province, investigations have been carried out in the constructions. For this purpose, due diligence has been made in 26 building constructions in different parts of the city. It was observed that 10 of these constructions were used only S type, 6 of them were used only T type, and 10 of them were used both types of safety net (S type and T type). In total, 36 safety nets (16 T-type and 20 S-type) were examined at the visited sites. In the construction sites visited in Ankara province, the type of safety net except S and T type was not found. Information about the checklist used for determining the condition of safety nets and their compliance status are given in Table 1.

Table 1. Findings on construction sites related to safety nets.

Criteria	Number of Construction Sites			
	T tipi		S Tipi	
	App.	Not App.	App.	Not App.
Does the safety net comply with the standards?	6	10	15	5
Has the safety net been set up by employees with sufficient knowledge?	11	5	12	8
Is the fall height of the safety net suitable? (Is it installed less than 6 meters away from the working area?)	7	9	11	9
Are S type safety nets installed in the appropriate area? (Areas with an area of more than 35 square meters or a short edge of more than 5 meters)	X	X	10	10
Is there sufficient clearance under the safety net?	16	0	15	5
Is the safety net regularly checked for deformation and corrosion?	8	8	9	11
Is there a test mesh with the safety net? If the period of use has exceeded 12 months, have the test eyes been tested?	2	14	4	16
Is it paid attention not to waste material or garbage on safety nets?	8	8	11	9

As a result of the examination made in a total of 36 safety nets found in construction sites, it was observed that the use of the S type safety net was more common than the T type safety

net. While S type safety nets can be used in buildings of any height, T type safety nets are generally preferred in high-rise buildings. It is known that the S type safety net is more cost-effective than T type safety net since structure of S type safety net does not require a supporting console. In addition, the fact that T type safety nets have some difficulties because they require relocation to maintain the fall height as the building rises, can be listed as the reasons for the use of S type safety nets more common.

In the examinations conducted, it was determined that 21 safety nets comply with the standards, and 15 of them did not comply with the standards. In S-type safety nets, access to standards-compliant safety net is higher due to both low cost and widespread nature. In some construction sites, it has been determined that in T-type safety nets, only the net is in compliance with the standard, but T-type safety nets do not have a certificate of conformity as a system with the steel console. It was realized that there is a lack of information about the need for standardization of safety nets according to the types at the construction sites, and it was concluded that construction sites need to be raised awareness of this issue.

There are also huge risks to the installation of safety nets. It is known that the installer should work in the most dangerous area in terms of fall risk. For this, it is of great importance to give special training to the installers. It has been declared that 23 of the safety nets examined within the scope of this study have been established by suppliers who have knowledge and experience in installation. It has been observed that the other 13 safety nets that do not comply with this criterion do not comply with the standards and were established by employees with different areas of expertise on the construction site.

Falling height of safety nets is very important especially in T type safety nets. As the building rises, the T type safety nets installed on the exterior must be moved to the closest possible distance to the working floor or closer than 6 meters. In the examinations, it has been observed that only 7 of the 16 T type safety nets were at a suitable distance. In S type safety nets, it has been observed that as the building rises, it is preferred to establish a new safety net by leaving sufficient clearance distance to the existing net and 9 S type safety nets do not meet the falling height criteria. It has been determined that the falling height is not suitable in half of the safety nets and there is a lack of information that safety nets do not provide protection at a falling distance of more than 6 meters and even cause serious injuries on sites with unsuitable safety nets installed.

Another important issue in S type safety nets is the size of the space where the safety net will be installed. If the employee falls into a net that is less than 35 square meters, it may cause serious injury or loss of employee due to less stretching and more limited energy damping of the smaller net area compared to the net with larger area. In the examinations conducted, it was determined that there was a low awareness in this issue and there were 10 out of 20 S type safety nets that did not meet this criterion.

It has been determined that 31 safety nets are suitable for leaving sufficient clearance distance under the safety net and there is no possibility of collision of the employee falling during the possible stretch of the safety net. It has been observed that the clearance distance is insufficient only under the 5 S type safety nets. Since the insufficient clearance distance creates a risk in S type safety nets installed in large areas, the clearance distance calculation is only given for S type safety nets in the legislation and in the TS EN 1263-2 standard.

Another important issue in safety nets is that the safety nets should be periodically checked and tested using the test mesh. In the examinations carried out, it was observed that 19 safety nets did not have visual controls and it was seen that there is an opinion at the workplaces that these equipment can be used for a long time without any control after the establishment of safety nets by suppliers. However, visual control is of great importance as safety nets can wear out in a very short time due to exposure to sun rays, weather conditions, sharp objects and similar reasons. Safety nets should also be tested once a year to have sufficient strength using test mesh. However, it was observed in the field visits that even many of the safety nets complying with the standards did not have a test mesh. Firms were told that the test mesh was offered as an option by the suppliers and it was stated that the issue of where the firms would perform the test of the test mesh was not explicitly stated in the legislation and it was stated that there is ambiguity in this regard. It was observed that the institutional companies visited renewed their safety nets annually without the need for testing and remained on the safe side without the need for a test mesh.

Finally, safety nets should not be used for waste material or garbage collection and storage, as it is an equipment designed to reduce damage in the fall of employees only. In this regard, it was observed that 19 safety nets out of 36 safety nets were appropriate and it was concluded that there is a need to inform employees more and the controls should be further increased at the construction sites to prevent waste materials from being thrown over the safety nets.

Results

In the current legislation in our country, there are detailed regulations regarding safety nets. However, the use of a safety nets that does not comply with the standards is frequently encountered at the construction sites. The sale of safety nets that do not comply with the standards need to be prevented from selling and being used as there will be ambiguity about their protection and this will lead to vital risks. In addition, as a result of the observations, it has been observed that the necessary measures against fall from height are not taken adequately in the gaps and the edges of the floor and there are some deficiencies in the safety nets installation, usage and control stages. In addition to this, it has been determined that there are no test meshes in safety nets in general, and it is believed that improvements should be made in this regard and the ambiguity related to testing of test meshes in legislation should be eliminated. Accordingly, it has been observed that it is necessary to increase the competencies of the people who will carry out the use and control works of safety nets that are in accordance with the relevant standard. Improvement in this regard will only be possible only if the technical personnel on site are trained more. Finally, before the safety nets are preferred, the availability of fall prevent measures such as edge protection systems that prevent employees from approaching unprotected edges or points should be considered. It should not be forgotten that safety nets should be used as an additional measure to other measures or in work areas where fall prevention is not possible with other measures.

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