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# Architectural Fire Standards in the Scope of "Regulation on Fire Protection of Buildings" Applied in Türkiye: Kocaeli Metal Factory Case

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**Abstract**
Fire is a fact of our lives and causes significant loss of life and property. We can be caught in a fire in any place at any time. For this reason, structural measures must be taken in terms of fire safety in spaces. The measures to be taken are vitally important. One of these places is the metal workshop. Evaluations must be made with respect to fire safety when designing a workshop. Because more than one person will work in this place simultaneously, it poses a high danger during a fire. Necessary precautions should be taken during the design process of the building. Escape scenarios should be created in advance of any fire. When designing all these measures, the 'Regulation on the Protection of Buildings from Fire' published on 19.12.2007 has set some standards for us. By using these design criteria, buildings are made safer from fire. This regulation is audited by the Fire Brigade Project Units in line with the headings in the regulation during the design process. After the approved projects are built, they are checked on-site and conformity reports are written. In this study, the application of this regulation at the project level in a metal factory, located in Kocaeli, designed as an industrial building will be examined. Thus, the application of the fire protection standards, that should be considered in architectural designs for an industrial building, will be analyzed. The application of fire standards in architectural designs for an industrial building is investigated, and an example is presented.

**Keywords**
fire, industrial building, fire safety measures, steel structures, fire design measures, fire escape methods

## 1. Introduction

Throughout history, fires have been one of the leading types of disasters that have caused not only physical destruction but also social trauma and indelible traces in urban memory. Especially today, when modern cities are shaped by dense construction, complex infrastructure systems, and increasing population density, the risk of fire is not limited to individual buildings; it threatens the entire urban organism. The causes, effects, and spread of fires are directly related to spatial organization, and the responsibility of directing this relationship belongs largely to architects. No matter how much fire is defined as a technical problem, it will always be an architect who constructs the spaces that will prevent or control it.

Especially in post-industrial cities where energy consumption, production activities, and building density have increased dramatically, fire risk has become layered. As Gültek and Özkaya point out, there is a significant correlation between the amount of energy use per capita and the loss of life and property due to fire; this is a clear indication that the fire hazard grows in direct proportion to industrialization. Therefore, fire safety is no longer a reactive chain of measures that only adheres to regulations, but a proactive strategy that should be considered from the very beginning of design [1].

In Turkey, there is a serious gap in this regard. Fire safety in architectural education is still considered a subject that is often overlooked and delegated to the fields of civil engineering or building inspection.

However, in this interdisciplinary issue, it is undoubtedly the architects themselves who can best interpret the relationship that fire establishes with space, user, and material. However, to make this interpretation, knowledge and awareness of fire must be an integral part of architectural pedagogy.

As Gültek and Özkaya emphasize, "studies at the undergraduate, graduate and doctoral level have started to be carried out in the architecture departments of a small number of universities, but the resources and information that can be accessed on this subject are still very insufficient" [1].

Architecture is a discipline that inherently involves multi-layered decision processes. While factors such as aesthetics, function, environmental impact, and sustainability shape architectural decisions, fire safety is often limited to the minimum conditions imposed by regulations. However, fire safety is not only an "obligation" but also a fundamental component that guarantees the vital continuity of the building. Architectural design should be considered together with the measures to be taken against fire, as a well-designed space can play a resilient and guiding role not only aesthetically but also in times of disaster. Issues such as continuity of escape routes, efficiency of smoke evacuation, and preservation of structural stability should be integral parts of the design.

Fire safety is also directly related to material selection. The fire behavior of traditional materials should be reinterpreted with modern building technologies. Innovative solutions such as high-temperature resistant glass systems and composite facade panels insulated with rock wool should be incorporated into architectural design. While materials such as reinforced concrete and steel maintain their form at high temperatures and gain evacuation time, fire-resistant coatings and sealed detail solutions limit the spread of fire within the building. At this point, the architect's task is to create a holistic design fiction by taking into account not only the technical properties of these materials, but also their spatial, visual, and symbolic meanings. As Cingi Yurdakul points out [2], fire safety is not only a technical necessity but also a fundamental responsibility of architectural design; the fire resistance of building materials is of great importance for both life safety and the longevity of the building. Therefore, fire safety criteria should be given as much attention as aesthetics and functionality in the material selection process. In Korkmaz's study [3], the importance of integrating fire safety into the architectural design process is emphasized, and it is stated that this integration plays a critical role in increasing user safety during a fire [2, 3]. Fire safety is not only a structural, but also a behavioral issue. How the users experience the building, the clarity and legibility of the guidance systems during escape, and the spatial transitions designed to provide safe evacuation even in panic situations are among the elements that the architect will directly design. For this reason, fire should be addressed not only with technical equipment, but also with spatial psychology, concepts of light and direction, and flow continuity. This situation becomes even more critical in public buildings with complex interior volumes or industrial buildings that have undergone a change of function. At the city scale, fire safety goes far beyond individual design decisions. Macro-level decisions such as transportation infrastructure, density of building islands, distances between buildings, street widths, and fire brigade access are parameters that directly affect the success of fire response. Major fires in history – for example, the Great Fire of London in 1666 or the Chicago Fire in the 19th century – have shown that not only individual buildings but also the urban organization must be replanned to prevent fire. Today, especially in cities with dense urban fabric and uncontrolled growth, this risk continues, and it becomes imperative to evaluate construction decisions together with fire dynamics [4].

In this context, the discipline of architecture is not only responsible for designing "beautiful" buildings, but also for producing "safe", "habitable" and "resilient" spaces. Fire safety is one of the most visible, challenging, and vital forms of this responsibility. Reshaping architectural education, practice, and institutional culture with this awareness will make the cities of the future safer, more liveable, and more sustainable. The aim of this study is to examine compliance with standards by analyzing measures at a metal factory in Kocaeli, in line with the standards set in the Regulation on Fire Protection of Buildings implemented in Türkiye. At the same time, it aims to determine how fire standards affect the design of the building. Thus, this study aims to contribute to the development of sustainable and holistic architectural solutions compatible with fire safety in new projects, by highlighting design strategies that can be applied in similar industrial buildings.

## 2. Application of Fire Safety Standards in the Case of Industrial Building Designed for Kocaeli Province

Within the scope of this study, chosen as the project's design location, Kocaeli is in the Marmara Region of Türkiye and is of great importance in terms of industry and trade. The city, with an area of 3,623 km$^2$ and about 2 million inhabitants, consists of 12 districts. The city lies between 40°45' - 41°13'.

It is located between northern latitudes and 29°22' - 30°21' eastern longitudes.

It is geographically surrounded by Sakarya to the east, Istanbul to the west, Bursa and Yalova to the south, and the Black Sea to the north. It is under the influence of the Black Sea, and Marmara climates. Kocaeli, which is the center of industry, has industrial areas. It also holds an important position in maritime trade due to its ports. Kocaeli, which has a great potential in the fields of industry, transportation, education, and tourism, is one of Türkiye's most strategic cities with its proximity to Istanbul and developed infrastructure.

### 2.1. Project Design Approach

While selecting the land for the project in Kartepe district of Kocaeli province, considerations included its location in an industrial area, its access to a good transportation network, its size being open to development in line with contemporary needs, and its overall usefulness. Thus, the location of the land also increased the competitiveness of the factory in the market.

During the design in terms of fire safety, we must first determine the hazard class of our building. It should be determined what kind of activities will be carried out in this space, who will use it, and for how long. Following the analysis of these data, the structure should be thoroughly analyzed, and the fire resistance times of the materials to be used should be investigated. If there are easily flammable and explosive materials, in the workshop, the fire resistance times of the building materials used will change accordingly. In this study, we have examined the measures taken for fire safety in the metal processing workshop project, which we take as an example. The measures taken and design criteria are examined under these headings in conjunction with the 'Regulation on Fire Protection of Buildings' [5].

**-Part One** General Provisions, Use and Hazard Classes of Buildings
**-Second Part:** General Fire Safety Provisions for Buildings
**-Part Three** Escape Routes, Escape Stairs and Special Cases
**-Part Four** Regulations on Building Sections and Facilities
**-Part Five** Electrical Installations and Systems
**-Part Six** Smoke Control Systems
**-Part Seven** Fire Extinguishing Systems
**-Eighth Chapter** Storage and Use of Dangerous Goods

This project, Figure 1, which was prepared for Kocaeli province, was examined for its compliance with the fire protection standards applied in Türkiye in accordance with the "Regulation on Fire Protection of Buildings". The applications implemented within the scope of the project and the regulation are explained in the following sections. The measures taken in the building have affected many areas from the entry and exit points of the land to the selection of the panels. Evidently, our building, Figures 2 and 3, is an Industrial Building according to the Building Use Class regulation, and the Building Hazard Class is Medium Hazard 3.

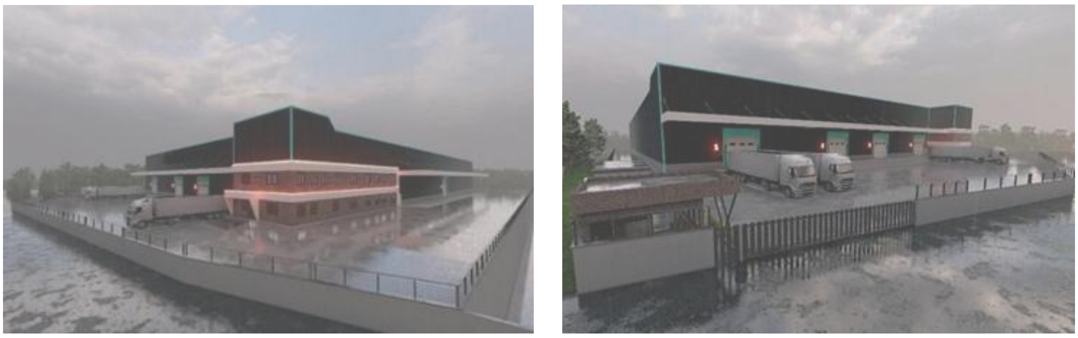

Fig. 1. Visuals of the building

### 2.2. Measures Taken in the Position Plane

The most important of the measures to be taken at ground level is allowing fire brigade vehicles to circulate around the building in case of a fire. Therefore, in buildings exceeding 40 m in length, a vehicle ring road of at least 4 m in width surrounding the building should be provided on the site plan. Due to the land selection of our building here and the parcel withdrawal distances deemed appropriate by the municipality, the ring road around the building was designed to be 5 meters wide, and a width of 12 meters was provided as a parcel entrance. The ring line has been appropriately encircled the entire building, Figure 4. In case of a fire, fire trucks will be able to easily access the site and intervene in the area of the building.

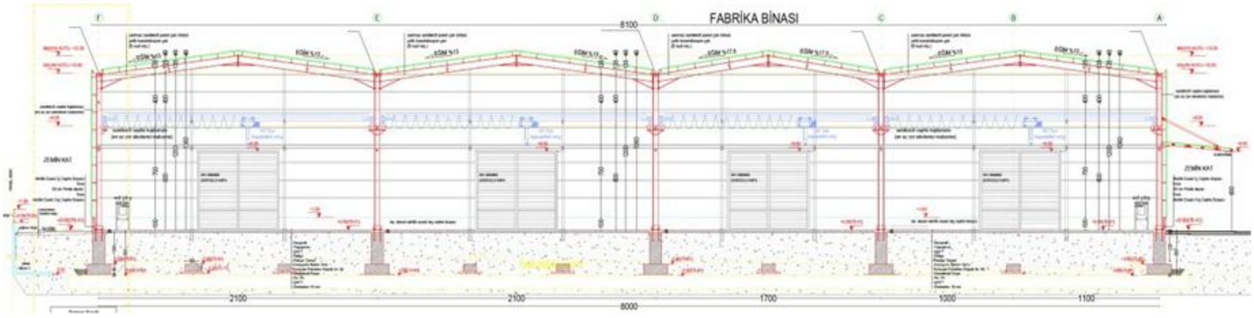


Fig. 2. Factory Building Section

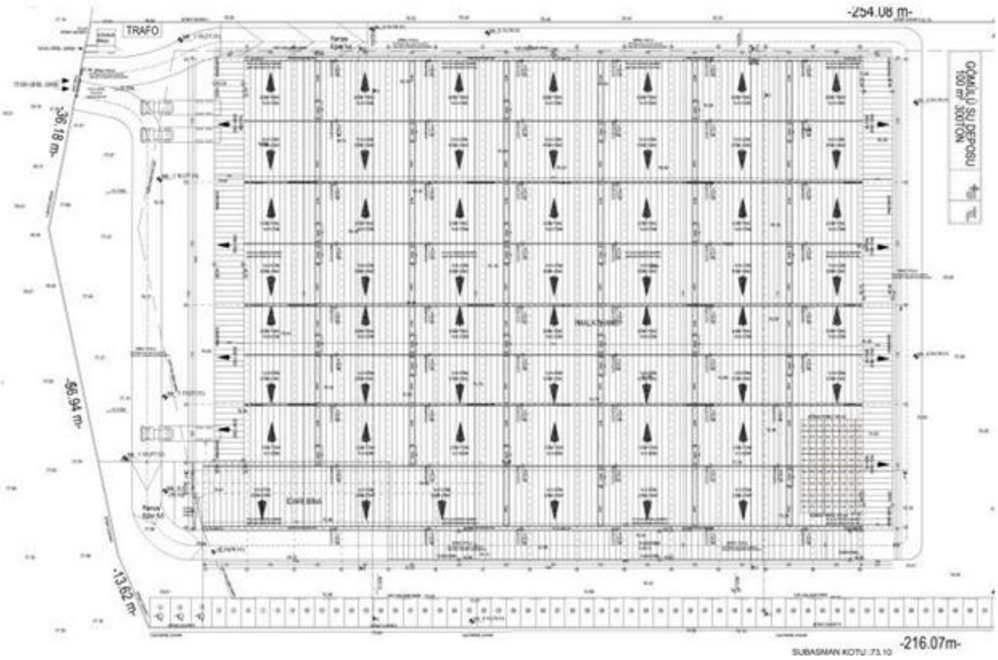


Fig. 3. Building Site Plan

### 2.3. Material Selection

Steel structures were chosen as the building framework. Both wide openings were provided as part of the design decisions, and fire resistant materials were selected. All steel structures that are not in danger of spreading fire to the environment, and whose combustible materials will not cause a temperature increase of more than 540 °C in the steel elements during a fire, are considered fire resistant. Except for single-storey structures with an area of less than 5,000 m$^2$ the steel in other structures must be properly insulated from heat. Insulation can be done by plastering with fire-resistant spray plaster, painting with fire-resistant paint, wrapping with fire-resistant materials, boxing, and mass insulation. Sandwich panel facade cladding, which is the least flammable material, was used on a 1 meter reinforced concrete curtain wall (120 min fire resistant material). The least flammable sandwich panel (B roof material) was used as roof covering. Fire resistant materials were selected.

### 2.4. Escape Routes, Escape Stairs

Fire safety halls are built to prevent smoke from entering escape stairs, to be used by extinguishing and rescue personnel, and to keep the disabled and injured waiting when necessary. The halls must be designed so that they do not hinder the movement of users in the escape route.

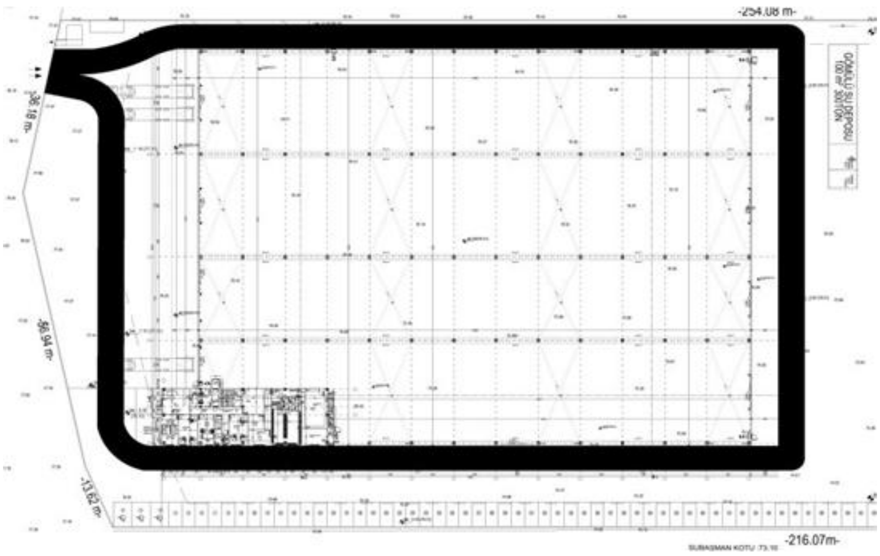


Fig. 4. Fire Brigade Ring Line in the Layout Plane

No flammable material can be used on the walls, ceiling, and floor of fire safety halls, and these halls must be separated from other sections by walls resistant to fire for at least 120 minutes and smoke-tight doors resistant to fire for at least 90 minutes. The floor area of fire safety halls cannot be less than 3 $m^2$, more than 6 $m^2$, and the size in the direction of escape cannot be less than 1.8 m. Unless otherwise specified, escape stairs are accessed through a fire safety hall or through a hall, corridor, or lobby separated from the areas of use by a door.

Escape stairs, Figure 5, are part of the escape routes used in fire and other emergency evacuations and cannot be designed independently of other escape route elements. No flammable material can be used on the walls, ceiling, and floor of escape stairs. These stairs are separated from other sections by a wall resistant to fire for at least 120 minutes and a smoke-tight door resistant to fire for at least 90 minutes.

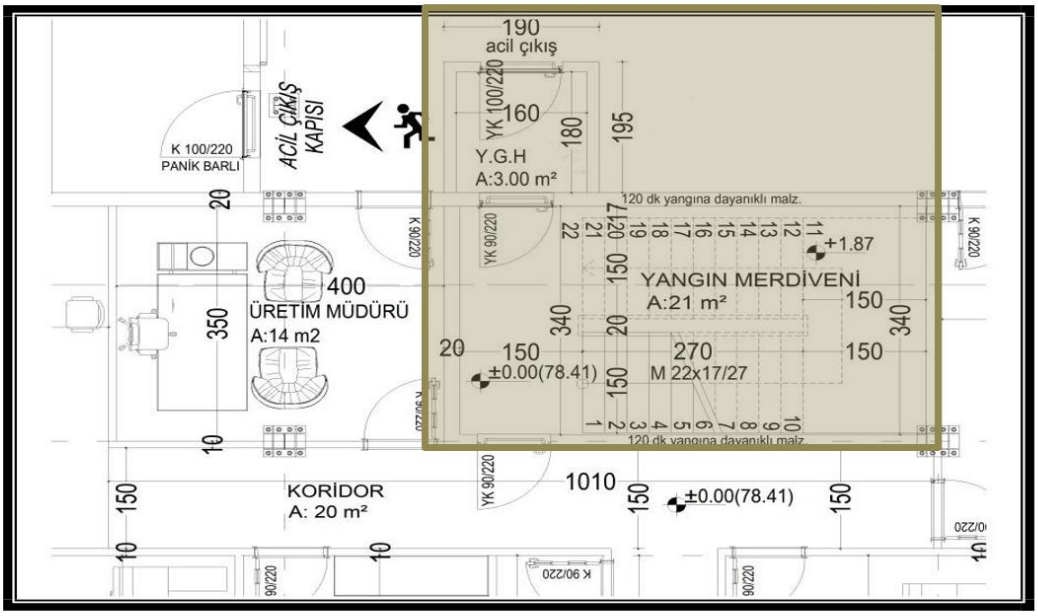


Fig. 5. Fire Safety Hall and Fire Staircase Detail

If the escape staircase descends to a circulation area such as a hall, corridor, foyer, or lobby, where the exit at ground level is visible and unobstructed, the distance between its descent and the external open space cannot exceed 10 m if the escape staircase serves more than one floor. In buildings with sprinkler systems, this distance can be a maximum of 15 m. The outdoor area must be clearly visible from the point where the escape staircase descends, and must be directly accessible in a safe manner. An exterior door of sufficient width, to meet the user load discharged from internal escape stairs, is required.

A fire escape staircase reaching all floors has been included. 120-minute fire resistant material was selected for the walls of the staircase. All doors are designed as fire doors. A fire safety hall is arranged at the transition from one area to the fire staircase. A hatch was left on the staircase for ventilation purposes.

In the building, a sprinkler system is used since escape distances during a fire are insufficient for safe escape without it. Escape distances in one direction are a maximum of 25 m and escape distances in two directions are a maximum of 60 m, Figure 6. Escape doors are equipped with panic bars.

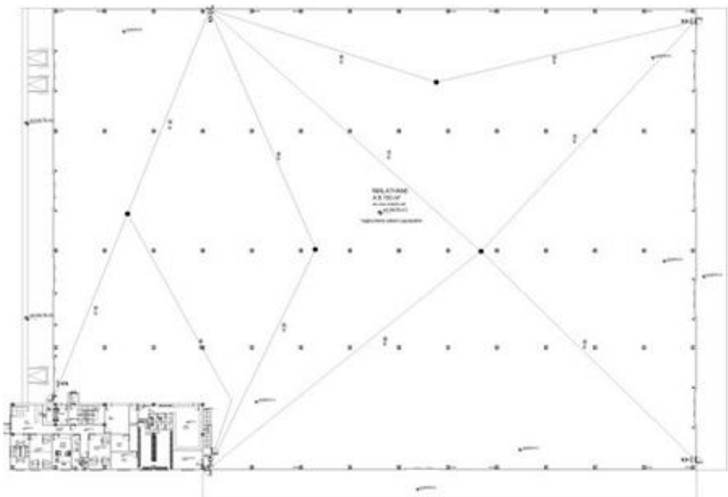

Fig. 6. Fire Escape Plan

### 2.5. Precautions Taken on the Building Roof

Flammable, combustible and explosive materials cannot be kept in attics. The least flammable sandwich panel roof covering (B roof material) was used as roof covering. Since the Building Hazard Class of the building is Medium Hazard 3, a 1%, ventilation hatch area should be created. Roof area: 8.217 $m^2$, Figure 7. A minimum of 1% ventilation requires an area of 82.17 $m^2$. A total of 84 $m^2$ of ventilation cover area was created from twenty-eight sections, each measuring 3 $m^2$.

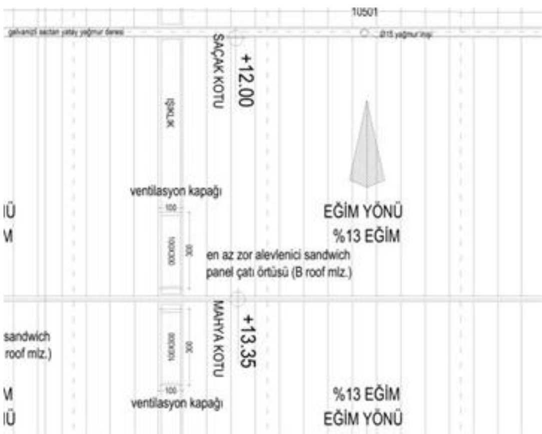


Fig. 7. Roof Partial Plan

### 2.6. Installation and Systems

Due to the dimensions of the building, it is necessary to install a sprinkler system since the escape distances do not meet safety standards. In this way, the escape distances to the doors were increased. For this system, a water storage area was created in addition to the existing water storage. In the plan shown in Figure 8, the areas affected by the system are indicated.

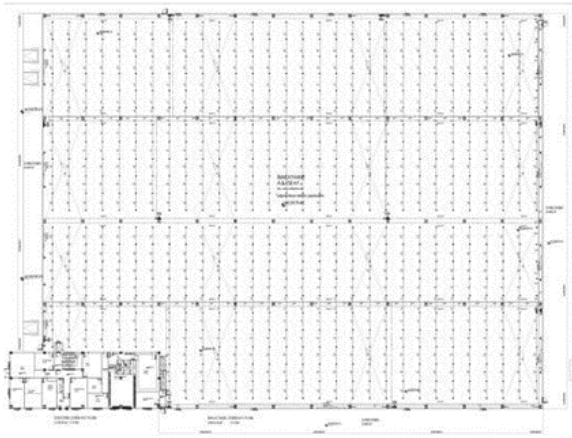

Fig. 8. Sprinkler System Plan

Electrical installations, escape route lighting and fire detection and warning systems installed in buildings systems must be designed, installed and kept in operation in case of fire or any emergency, so as not to harm those in the building, prevent panic, ensure the safe evacuation of the building and create a safe environment. All kinds of electrical installation, escape routes lighting, emergency lighting and guidance and fire detection and warning systems (Figure 9) are designed in accordance with the relevant installation regulations and standards.

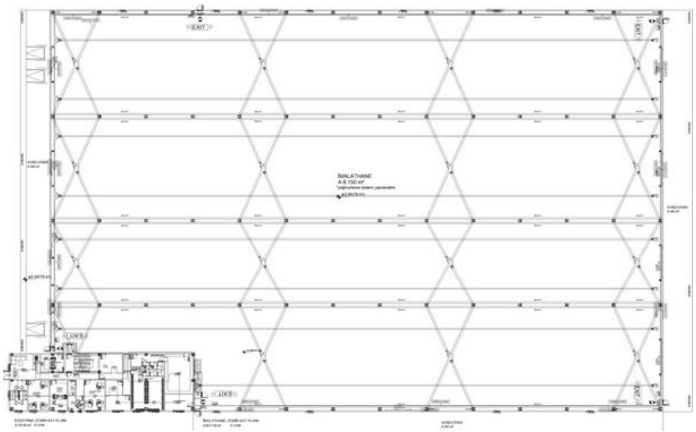

Fig. 9. Fire Detection and Warning Installation

## 3. Conclusion

This study, which aims to examine fire safety standards through spatial design, seeks an answer to the question "What kind of design approach should be adopted in terms of fire safety in new buildings?" Accordingly, based on the Regulation on Fire Protection of Buildings in force in Türkiye, the precautions taken in a metal factory in Kocaeli are analyzed. The study aims to reveal the impact of standards on design decisions by demonstrating how the provisions of the regulation are reflected in architectural projects. The findings show that design in accordance with the regulations plays a critical role in fire safety, especially in buildings in high-risk categories, such as industrial buildings, and provides significant contributions that direct new projects in this field. Fire safety in industrial buildings is a multifaceted process that is not limited to the structural design of a building.

Measures taken against fire should be evaluated in a wide scope, from building design to the materials used, and from fire extinguishing systems to emergency escape routes. In this study, critical design criteria for fire safety based on the Regulation on Fire Protection of Buildings, are discussed through the analysis of a metalworking workshop. Industrial buildings pose a great danger in terms of fire risk, especially in areas where flammable materials, high-heat-generating equipment, and chemicals are concentrated, such as metal processing. In this context, the building hazard class being determined as medium hazard 3 reveals the scope of the safety measures to be taken. The selection of fire-resistant materials, the use of steel as a load-bearing system, and special coatings that increase resistance to smoke and heat during fire stand out as important design elements in ensuring fire safety. Escape routes are of vital importance for fire safety. In line with the arrangements made, fire escapes reaching all floors are protected with walls that are resistant to fire for at least 120 minutes and escape doors are equipped with fire-resistant panic bar systems. In addition, as long as the escape distances within the building do not exceed the specified limits, the evacuation process is intended to be safe. However, since some escape distances were not adequate, sprinkler systems were integrated and activated during a fire. Fire safety cannot be ensured by structural measures alone; electrical installations and ventilation systems within the building must also be designed to be resistant to fire. In this context, electrical panels were isolated from flammable materials, and emergency lighting and directional signs were placed in accordance with the regulations. In addition, regular maintenance of electrical installations within the building is an important step towards minimizing the risk of fire due to short circuits or overheating. This study reveals the necessity of a holistic approach to fire safety in industrial buildings. The use of fire-resistant materials, proper planning of escape routes, integration of sprinkler and detection systems, designs that facilitate fire brigade access, and safety of electrical installations are essential factors in terms of fire safety.

However, such measures should not be considered merely a static structure, but should be supported by regular maintenance, drills and fire awareness training for employees. Fire safety is a process that requires continuity and should not be limited to measures taken at the initial stage. Fire safety strategies should be updated in line with technological developments, and the systems used in the building should be periodically checked to ensure their effectiveness.

In conclusion, the relationship between architecture and fire safety is not only a structural and aesthetic concern, but also a discipline with the responsibility to protect human life. In industrial buildings such as metalworking workshops, ensuring this safety is not only a necessity but also a critical investment that ensures business continuity and prevents large-scale losses. The relationship between architecture and fire safety is complex and involves many different elements. The use of fire-resistant materials, the design of safe escape routes, the integration of technological fire prevention systems, and proper urban planning make both individual buildings and cities in general safer against fire. Modern architecture has a responsibility to protect human life by combining aesthetics and functionality with fire safety. Industrial buildings are structures that contain hazards, and where many people work at the same time. One of these dangers is undoubtedly a fire hazard. The measures to be taken for fire should be considered at the very beginning of the design process. These measures directly affect the design.

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