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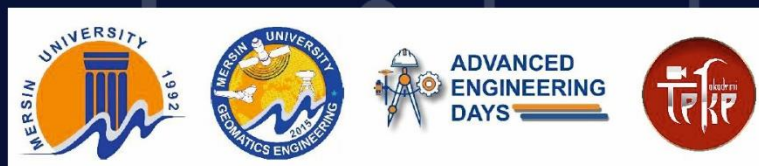
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# 5th Advanced Engineering Symposium

I would like to thank all of the contributing authors and reviewers to the 5th Advanced Engineering Days (AED) Symposium, 3 December 2022. In this international symposium there are 57 presentations. We would like to see you in the 6th AED which will be held on 4-5 March 2023.

Best regards

Prof. Dr. Murat YAKAR

# The proceedings of the
# 5th Advanced Engineering Days

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# Mardin historical Eski Demirciler (Old Blacksmiths) and Kunduracılar (Shoemakers') Bazaar architectural features

**Lale Karataş**[*1] , **Aydın Alptekin** [2] , **Murat Yakar** [3]

*1Mardin Artuklu University, Department of Architecture and Urban Planning, Mardin, Türkiye, lalekaratas@artuklu.edu.tr*
*2Mersin University, Department of Geological Engineering, Mersin, Türkiye, aydinalptekin@mersin.edu.tr*
*3Mersin University, Geomatics Engineering Department, Mersin, Türkiye, myakar@mersin.edu.tr*

**Keywords**
Cultural heritage
Bazaar
Historic fabric
Sustainability
Mardin

**Abstract**
The bazaar is an important formation in the Islamic city, and the architectural features and location of the bazaar determine the effect of the bazaar on urban life. However, today, rapid developments in modern society, population growth rate and size and urban development, the development pattern of new streets depending on the bazaar, the distance of the modern area to the bazaar areas and the accessibility of the bazaar areas to public transportation, rapid urban growth and socioeconomic development processes are the factors affecting the general position of the bazaar have changed the level of influence on the city. Today, as a result of the fact that traditional bazaars cannot continue to function as much as they used to, it is seen that the process of extinction has begun in Mardin Bazaars, as in many historical cities in the world. However, Mardin bazaars have been the subject of a very limited number of studies and have not been adequately studied collectively. In this context, the architectural features of the Eski Demirciler and Kunduracılar Bazaars, which are among the historical bazaars in the center of Mardin, together with their understanding of plan and space, and their current state of preservation have been the subject of research. In the study, it is aimed to determine the architectural setups, regional characteristics and places of the Eski Demirciler and Kunduracılar Bazaars, which have survived to the present day with historical continuity, in the city of Mardin.

## Introduction

Urban history studies reveal that various factors affect the development of ancient cities, and bazaars have always been one of the most important factors in urban growth [1]. In the past, the bazaar was not established in a fixed place, but in special neighborhoods on certain days [2]. Gradually, the increasing amount of trade on the one hand and the development of the city structure on the other hand made some places for trade and barter needs [3]. The layout of the spaces in the bazaar has led to the creation of spaces suitable for different needs in the bazaar [4]. The bazaars, which are formed in certain regions according to their various functions, have always hosted a large part of commercial activities in city life and have become an integral part of every city [5]. The importance of economic and commercial relations has caused the development of the bazaar to be side by side in many cities, directly affecting each other's physical and social formation and configuration, and the formation of its architecture [3]. In this context, in our study, together with the plan and space understanding of the Eski Demirciler and Kunduracılar Bazaars, which are among the historical bazaars in the center of Mardin, the architectural features and the current state of preservation have been the subject of research. In the study, it is aimed to determine the architectural setups, regional characteristics and places of the Eski Demirciler and Kunduracılar Bazaars, which have survived to the present day with historical continuity, in the city of Mardin.

**Material and Method**

Literature review and archive research method was used in the study. Documents taken from Mardin Metropolitan Municipality KUDEB unit were compiled and information about the location, previous period features, formation forms, architectural setups and regional characteristics of Demirciler and Shoemaker Bazaars were presented.

**Results**

The Eski Demirciler and Kunduracılar Bazaar, which is registered to the address of Mardin Province, Artuklu district Sar Mahallesi, 75th street, is in the title deed; Island 67, Plot:-1-2-3-4-5-6-7-8-9 10 11 12 13 38 14 15 16 17 18-19-21-22-23-24-25:27-28- 29-30-31-32-33-34-35-36; Island:69, parcel: 1-2-3-4-6-7-71-70-69- 68-67-66-65-64-63-62-61-60-59-74-73-72- 58-57-78-77-76-75 - 56 - 55 - 54 - 53 - 52 - 51 - 50-49-48- 47-46; Island 97 is registered on parcels 18-19-20-21 and is located on the street south of 1st Street (Figure 1).
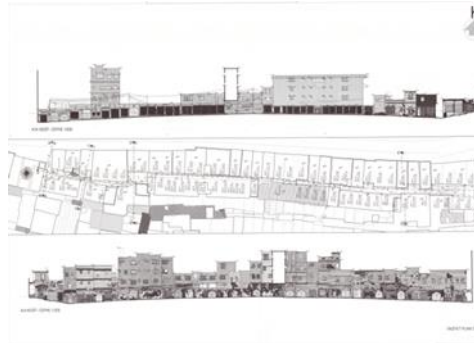


**Figure 1.** Location map of Eski Demirciler and Kunduracılar Bazaar

The Eski Demirciler Bazaar is accessed by a small staircase with an abbara at the western end of the Kasaplar Bazaar and the Eski Kuyumcular Bazaar. No inscriptions or archive records regarding the construction date of the bazaar were found. The bazaar, which is referred to as the Demirciler Bazaar in historical sources, is known as the workshop of iron-produced materials. It is thought that this bazaar, which is known as the Kılıççılar Bazaar in history, is here. Today, the bazaar is known as the Eski Demirciler bazaar and has lost its blacksmithing function to a large extent. Most of the shops are closed and a significant part of the open ones are used as offal shops. The bazaar is still active today.

Kunduracılar Bazaar starts at the eastern end of Eski Demirciler Bazaar and continues until the small staircase leading to 1st Street in the west. In the bazaar, which is referred to as the Kunduracılar Bazaar in historical sources, two shops that produce and sell shoes are left alone. Today, the bazaar is known as the Kunduracılar Bazaar, and shoemaking has lost its function to a large extent. Many of the shops are closed. We can say that the bazaar creates the street texture by positioning the shops adjacent to it over time. However, the south wing of the bazaar was completely demolished before 1950 and instead a five-storey reinforced concrete apartment building was built on the same plots. Even though the northern wing of the bazaar has traditional architectural details, multi-storey residences have been built above the shops.

Based on the traces from the building and similar period features, written and visual sources, two periods are seen in the building, the original and the current situation. In the first period when the bazaar carried its original texture, its shops were built as a single storey made of smooth cut and coarsely cut limestone, and on the north and south wings of the bazaar, they have pointed and semi-circular arch entrances facing each other, and the entrances have wooden door wings. It had a rectangular plan and a cross or barrel-vaulted plan from the inside and a flat roofed plan from the outside, and it continued to function in this order. Having the typical characteristics of Mardin Bazaars, which forms the starting point of a new bazaar after the end point of each bazaar, the Eski Demirciler Bazaar also turns into the Kunduracılar Bazaar at the west end, and the Eski Kuyumcular and Kasaplar Bazaar by making a fork at the east end; Kunduracılar Bazaar opens to 1st Street at the eastern end of the Eski Demirciler's west end. In this period, which constitutes the current state of the bazaar, the bazaar shops lost their original function in the process and started to have different commercial functions, and over time, changes in the bazaar shops and deterioration in the original texture began. For this reason, the bazaar has recently undergone restoration intervention.

The building was built in the masonry construction system as in the traditional Mardin architecture. The main construction material is limestone, which is processed from the quarries in the region. The main construction material of the elements such as the walls, cover and flooring of the building is the same stone. The sections between the inner and outer faces of the walls and the interior of the vaults are rubble fill. The outer walls are

made of rubble masonry and thick joints. However, the wall of the interior and the walls of the sections where the vaults are located are thin. Wooden materials are used in the door, window joinery and wings.

Contrary to the traditional Mardin housing structure, a simpler orientation is observed in the buildings where the economic activities of the city are located. The architectural features of the bazaar are simple and generally consist of multi-storey houses built over the shops. The apartments built on the north and south wings of the bazaar were built so close to each other that they could close the street crossing distance. The inner filling stones of the original shops of the bazaar, located just south of the 1st Street, are made of coarsely cut limestone, and the outer walls are made of locally cut and finely cut limestone. The shop entrances of the bazaar are designed as pointed and semicircular arches with wide openings. Due to the topographic structure of the bazaar, it slopes from north to south and extends in the east-west direction, forming a small area by breaking in the west of the street bazaar. At the end of this area, the street narrows again and opens to the 1st Street in a sloping way. Near the western end of the street, it passes to the Yemeniciler and Kaçakçılar Bazaar with a small street. The street floor is paved with masculine basalt stone pavements. The shops of the open-top bazaar are next to each other, facing each other on the north and south sides of the street. The original shops have a rectangular plan with pointed or semi-circular arches, cross and barrel vaults from the inside, and flat roofs from the outside, and they face the street. Today, however, a significant part of the south-facing shops has been converted to reinforced concrete (Figure 2).
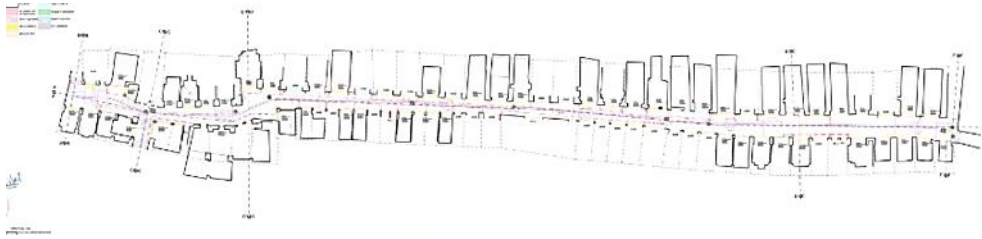


**Figure 2.** Floor Plan of Eski Demirciler and Kunduracılar Bazaar

It is seen that the shops in the north wing of the bazaar generally preserve the original texture. The construction of multi-storey houses on the shops along the north wing destroys the original texture and adversely affects the static condition of the shops due to the load on them. Many of the north wing shops are closed (Figure 3).
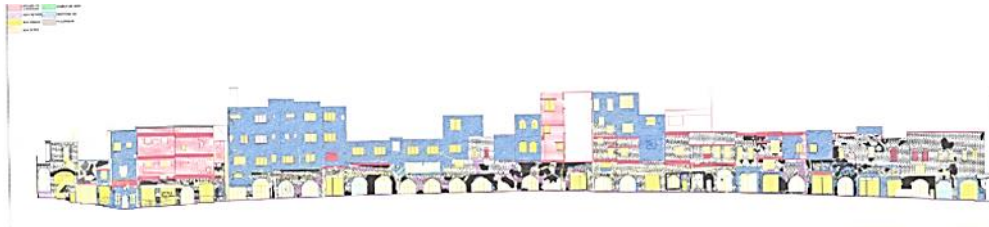


**Figure 3.** Eski Demirciler and Kunduracılar Bazaar North Wing View

The arcaded shop entrances in the south wing of the bazaar have been converted into reinforced concrete lintels and are single storey. While the street façade of the south wing preserves its structural originality, interventions contrary to the original texture are observed on the façade surface. The fact that the facade surfaces were plastered in places, the original entrances were damaged, and the original wooden doors were replaced by iron doors or shed shutters caused significant changes in the authenticity of the street facade of the bazaar. The southern wing of the Ayakkabıcılar Bazaar was completely demolished before 1950, and instead, reinforced concrete shops and a three-storey reinforced concrete apartment building were built on the same plots. In the west direction of the south wing, there are shops with the original texture but whose entrances have been converted into reinforced concrete lintels (Figure 4).



**Figure 4.** Eski Demirciler and Kunduracılar Bazaar South Wing View

**Discussion**

Documenting cultural heritage and transferring it to future generations is an important scientific study. In addition to the classical method, these are documented by using modern methods such as unmanned aerial vehicles, laser scanning and photogrammetric methods. Especially, 3D measurement techniques make very important contributions to the documentation of cultural heritage [6-12].

**Conclusion**

The phenomenon of globalization and modernity has affected the architecture of traditional markets and urban planning systems [13]. Mardin, the oldest city on the historical Silk Road, has faced many changes in its culture. Mardin Bazaars is an objective symbol combining traditional and semi-traditional architecture. Although retail activity has declined with the emergence of new markets, it is still a traditional local market for essential goods. Traffic problems and lack of access points to the city center significantly affect the number of visits. Some modern shopping centers have completely replaced traditional bazaars, while others have coexisted in the same conditions and atmosphere. In this period, which constitutes the current situation of the bazaar, the bazaar shops lost their original function in the process and started to have different commercial functions, and over time, changes in the bazaar shops and deterioration in the original texture began. Although the bazaar has recently undergone restoration, it is seen that the bazaar still has not regained its former density.

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# Mardin historical Kasaplar (Butchers) Bazaar restoration evaluation

**Lale Karataş**\*1 , **Aydın Alptekin** 2 , **Murat Yakar** 3

¹Mardin Artuklu University, Department of Architecture and Urban Planning, Mardin, Türkiye, lalekaratas@artuklu.edu.tr
²Mersin University, Department of Geological Engineering, Mersin, Türkiye, aydinalptekin@mersin.edu.tr
³Mersin University, Geomatics Engineering Department, Mersin, Türkiye, myakar@mersin.edu.tr

**Keywords**
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Bazaar
Historic fabric
Sustainability
Mardin

**Abstract**
The bazaar is a characteristic element of cities in different historical periods, which makes the social and economic life of a city a sign of progress or backwardness. Since the first days of civilization and urbanization in Mardin, bazaars have existed in cities and have become a factor in cultural exchange between civilizations. However, as in many countries in the world, in the city of Mardin, various architectural, material and structure losses have occurred in traditional bazaars over time, and restoration interventions have been needed in the bazaars. In this context, recent restoration interventions in Mardin Kasaplar Bazaar, one of the historical bazaars in the center of Mardin, and the current state of preservation have been the subject of research. As a result of the study, it was concluded that due to the effect of modernism on traditional architecture, the modern form and standard content of the Bazaar should not be changed in terms of physical, symbolic and atmosphere.

## Introduction

The concept of life and survival in today's bazaar architecture is remarkable with its development from traditional to modern times in traditional markets in big cities, especially in Mardin. With the new consumption habits, traditional bazaars have lost their "productive" structure, and the consumerism of the urban society has begun to fundamentally change the architecture of the urban bazaar [1]. In addition, various material and structural losses occurred in traditional bazaars over time and restoration interventions were needed in the bazaars. In this context, the recent restoration interventions in Mardin Kasaplar Bazaar, which is one of the historical bazaars in the center of Mardin, and the current state of preservation have been the subject of research.

In documentation of cultural heritage, modern methods such as unmanned aerial vehicles, laser scanning and photogrammetric methods have been used frequently in the last decade [2-8].

## Material and Method

In the study, literature review, archive research and field research method were used. First, a literature review was conducted for Mardin Kasaplar Bazaar. Afterwards, the photographs of the bazaar before and after the restoration taken from the Mardin Metropolitan Municipality KUDEB unit were compiled and compared. In addition, observations about the restoration of the bazaar were included in the study by examining the bazaar site with field research.

**Results**

Kasaplar Çarşısı is registered in Mardin Province, Artuklu District Teker Neighborhood, 81st Street, Island: 617, Plot: 12-13-14-15-16-17-18-19-20-21-22; Island: 132, Plot: 11-12-13-14-15-16-17-18-19-20-1-21; Island:347, parcel: 2-3-4-5-6-44-18-19-20-21-22-23-24-25-26-27-28-31-32-33- 34-35. It is registered on parcels 36-37-38-39-40-41-42-43 and Ada67, 37, and located in the street south of 1st Street (Figure 1).
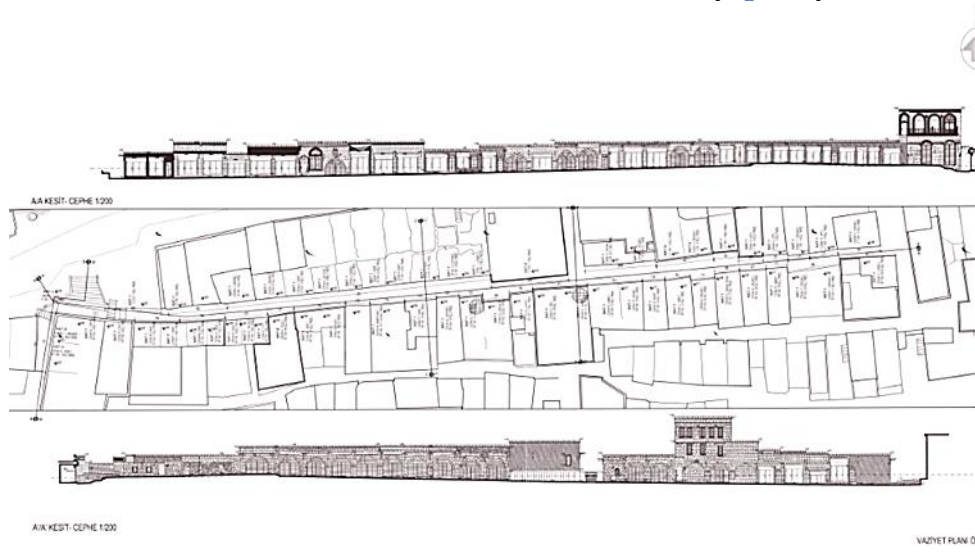


**Figure 1.** Location of Kasaplar Bazaar

No inscriptions or archive records regarding the construction date of the bazaar were found. The fact that it is named as Kasaplar Bazaar in historical sources shows that this name has not changed. The bazaar is still active today.

Based on the traces from the building and similar period features, written and visual sources, two periods are seen in the building, the original and the current situation. In the first period when the bazaar carried its original texture, its shops were built as a single storey made of smooth cut and coarsely cut limestone, and on the north and south wings of the bazaar, they have pointed and semi-circular arch entrances facing each other, and the entrances have wooden door wings. It had a rectangular plan and a cross or barrel vaulted plan from the inside and a flat roofed plan from the outside, and it continued to function in this order. The western end of the Butchers Bazaar, which is typical of Mardin Bazaars, which forms the starting point of a new bazaar after the end point of each bazaar, opens to the old blacksmiths' bazaar and 1st street, while the eastern end opens to the carpenters' bazaar and 1st Street (Figure 2).
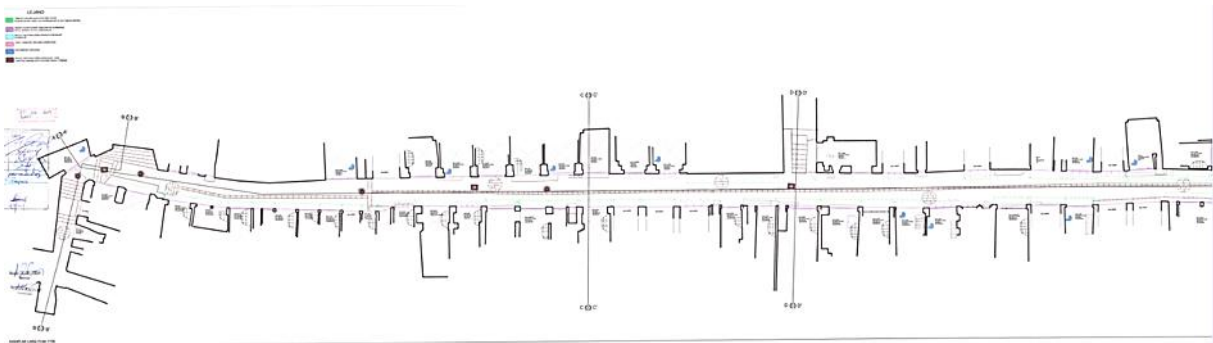


**Figure 2.** Kasaplar Bazaar Floor Plan

The shops (foundation shops) that have been identified have been preserved together with their annexes with historical and functional value, and interventions have been made to the worn and changing parts of the buildings and their annexes within the framework of street improvement principles. Buildings built with systems other than traditional construction techniques (reinforced concrete, etc.) were intervened according to their relations with the traditional architectural texture, and the building was made to be compatible with the original texture by applying plaster of denial. In the buildings considered within the framework of the street improvement project, roofs whose slope and form do not comply with the original architectural texture, whose roofs were raised, were arranged as terraces or deformed so that they could not be used were completely removed. In traditional and registered buildings, the application was carried out within the framework of the restoration project without changing the original forms and gauges. The awnings on the facades of shops and commercial houses and the top

covers made of various materials were removed, and the joinery and awning with wooden construction, the details of which are specified in the project, were made in the structures suitable for their places. The metal shutters on the facades of the shops and commercial establishments within the registered and traditional buildings were removed and replaced with automatic metal shutters according to the details of the project. Among the shop and commercial joinery found in traditional and new buildings, metal and unusable ones have been replaced with wooden joinery to be manufactured in harmony with the original architecture. Additions such as electricity, telephone cables, antennas, advertisement-billboards, signboards, solar energy systems, mailboxes, etc., on the roofs and facades of all buildings will be removed. The elements, which must be used due to their function, have been applied in a way that does not spoil the original façade setup and appearance and within the framework of the principles specified in the project. Along the street, the parts of the buildings that disrupt the original architectural texture and are dysfunctional have been removed. Electricity and telephone networks will be placed underground in all streets and streets within the street improvement area, and carrier poles have been removed. The uncontrolled growth of plants and trees on the facades of traditional bazaar buildings within the scope of the street improvement project were pruned and rehabilitated, and the facade was cleaned by removing the unqualified plants that grew spontaneously. In new buildings built with systems other than traditional construction techniques (reinforced concrete, etc.), the facade walls, which are considered within the framework of street improvement, are made with wood or pure materials (PVC, aluminum, iron, etc.) that are not compatible with the original texture. Window and door joinery were removed and replaced with wooden (oak) window and door joinery that would harmonize with the original architecture. In the existing demolished rubble stone wall, the demolished rubble and excavation were cleaned, and the original wall was rebuilt with the original size and material in line with the existing traces from the building. The entrance door of the shops, in accordance with the material and construction technique, new door shutter joinery, which will be made of wooden timber to fit into the existing space, has been installed.

**Conclusion**

When we look at the restoration interventions examined in the research, it is seen that the architectural elements changed with modernization in the traditional bazaar are intense. As a result of the study, it was concluded that due to the effect of modernism on traditional architecture, the modern form and standard content of the Bazaar should not be changed in terms of physical, symbolic, range and atmosphere. Secondly, the traditional form and modern content should be such that the market preserves the historical appearance of the traditional bazaar. In this study, it is important to investigate the effect of modernization on the commercial typology of the Mardin Kasaplar Bazaar with an analytical method through architecture and to examine the restoration interventions [9].

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# Mardin historical Kazancılar Bazaar architectural features

**Lale Karataş**[*1] , **Aydın Alptekin** [2] , **Murat Yakar** [3]

[1]*Mardin Artuklu University, Department of Architecture and Urban Planning, Mardin, Türkiye, lalekaratas@artuklu.edu.tr*
[2]*Mersin University, Department of Geological Engineering, Mersin, Türkiye, aydinalptekin@mersin.edu.tr*
[3]*Mersin University, Geomatics Engineering Department, Mersin, Türkiye, myakar@mersin.edu.tr*

**Keywords**
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**Abstract**
Mardin Kazancılar Bazaar is a formation surrounded by historical structures such as mosques, madrasahs, tombs and commercial inns, which have always had a very important place in the history of the city. It is a bazaar in which an operating cycle runs where boilers are made and sold. For this reason, in the past, the bazaar has been a shopping place where people deliberately preferred to go, at the same time they belong and adhere to. Also, as a part of daily city life in the past, the bazaar was a welcome point in Mardin. However, it is seen that most of the bazaar shops are closed today and only four shops are open, but they also do different jobs. Unfortunately, these problems cause the city's relationship with its historical heritage to be cut off. It is necessary to increase the urban life quality of the area by realizing the physical, social, economic, cultural and architectural values of Kazancılar Bazaar. Therefore, this study aims to investigate the history and architectural features of Mardin Historical Kazancılar Bazaar and to understand its place in the urban context. A deep understanding of the functions of the bazaar will contribute significantly to the reconstruction of cultural, social and economic value systems.

## Introduction

Since the past, the bazaar has always been the heart of a city, one of the most important urban elements in developing and uniting cities. It also provides spaces for people to interact and spend their free time. However, the economic and social development of the society has changed the status of the bazaar in the modern era. But unfortunately, this culture cannot be preserved and applied in the modern age. This leads to a decrease in human interaction in cities [1]. The emphasis and work on understanding the urban fabric and architecture of traditional bazaars can guide the creation of new plans to ensure sustainability and the development of new decisions according to the necessary economic and social needs. A deep understanding of the functions of the bazaar will contribute significantly to the reconstruction of cultural, social and economic value systems [2]. In this context, it aims to investigate the history and architectural features of the Mardin Historical Gains Bazaar and to understand its place in the urban context.

Documenting cultural heritage and transferring it to future generations is an important scientific study. Three-dimensional measurement techniques, such as unmanned aerial vehicle and laser scanner make very important contributions to the documentation of cultural heritage [3-9].

**Material and Method**

In the study, literature review, archive research and field research method were used. First, a literature review was conducted for Mardin Kazancılar Bazaar. Later, information about the bazaar received from the Mardin Metropolitan Municipality KUDEB unit was compiled and presented in the study.

**Results**

The bazaar registered at the address of Mardin province, Artuklu District, Teker Mahallesi, 77th Street, 377 Ada; 1- 29,28,27,24,23 parcels, Ada376; and it is located in parcels 15,16,28,29.

No inscriptions or archive records regarding the construction date of the bazaar were found. As the name suggests, it is a bazaar where boilers are made and sold in an operating cycle. It is seen that most of the bazaar shops are closed today and only four shops are open, but they also do different jobs. While three shops are tailoring, another shop is used as a scrap warehouse.

The building was built in the masonry construction system as in the traditional Mardin architecture. The main construction material is limestone, which is processed from the quarries in the region. The main construction material of the elements such as the walls, cover and flooring of the building is the same stone. The sections between the inner and outer faces of the walls and the interior of the vaults are rubble fill. The outer walls are made of rubble masonry and thick joints. However, the wall of the interior and the walls of the sections where the vaults are located are thin. Wooden materials are used in the door, window joinery and wings.

Contrary to the traditional Mardin housing structure, a simpler orientation is observed in the buildings where the economic activities of the city are located. The architectural features of the bazaar are plain and generally consist of a single floor. The inner filling stones of the building are made of coarsely cut limestone, and the outer walls are made of locally cut and finely cut limestone. However, as a result of the interventions made in the late period, repairs made of coarse limestone shaped stones are observed in places. Shop entrances are designed as pointed and semicircular arches with wide openings. However, here, as a result of the interventions made in the late period, the arches of some of the shops were demolished and turned into reinforced concrete lintels. The bazaar shows a slope from north to south due to its topographic structure. The street floor is now paved with masculine basalt stone pavements in terraces due to the slope. The shops of the open-top bazaar are next to each other, facing each other on the east and west sides of the street. The original shops have architectural features with pointed arches, rectangular plans, cross and barrel vaults from the inside, and flat roofs from the outside, and they face the street. However, today, most of the shops have been completely converted to reinforced concrete. One end of the bazaar opens to Tellalar Bazaar, and the other end opens to the intersection of the Marangozlar and the Eski Kuyumcular Bazaar with a ladder. The original texture of the bazaar shops has lost significantly and there are only three shops that carry the original texture, other shops have been converted to reinforced concrete and enlarged. Information about the shops in the bazaar is given in Figure 1.

**D1:** It is located in the north of the bazaar as the first shop of the east wing. The shop, which was built from cut limestone, has a lintel entrance and is closed with an iron winged door. There is damage to the door.

**D2:** It is located on the north side of the bazaar as the second shop on the east wing. There is a reinforced concrete floor addition on the shop, which is completely reinforced concrete. Shop is closed.

**D3:** It is located on the north side of the bazaar as the second to last shop on the east wing. There is a reinforced concrete floor addition on the shop, which is completely reinforced concrete. Shop is closed.

**D4:** It is located on the east wing of the south entrance of the bazaar as the second shop. The shop, which preserves the original texture, was built of neatly cut and rough cut stone, and the low arch entrance was converted into a reinforced concrete lintel. A metal door has been added to the cross-vaulted shop entrance. Shop is closed. There is a reinforced concrete add-on on the shop.

**D5:** It is located on the east wing of the south entrance of the bazaar as the second shop. The shop, which preserves its original texture, was built of smooth cut and rough cut stone, and the low arch entrance was transformed into a reinforced concrete lintel. Shop is closed.

**D6:** It is located on the east wing of the south entrance of the bazaar as the first shop. The shop, which preserves its original texture, was built of smooth cut and rough cut stone, with a low arch entrance and cross vaults. The flat roofed shop is used as a tailor shop.

**D7:** It is located on the west wing of the south entrance of the bazaar as the first shop. The shop, which preserves its original texture, was built of neatly cut and rough cut stone, with a pointed arch entrance and cross vaults. The flat roof shop is closed.

**D8:** It is located on the west wing of the south entrance of the bazaar as the second shop. The shop, which preserves its original texture, was built of neatly cut and rough cut stone, with a low arch entrance and cross vaults. The flat roofed shop is used as a tailor shop.

**D9:** It is located on the west wing of the south entrance of the bazaar as the third shop. The shop, which preserves its original texture, was built with neatly cut and rough cut stone, and its arched entrance was transformed into a reinforced concrete linteled entrance.

**D10:** It is located on the west wing of the south entrance of the bazaar. There is a reinforced concrete floor addition on the shop, which is completely reinforced concrete.

**D11:** It is located in the west wing of the bazaar. There is a reinforced concrete floor addition on the shop, which is completely reinforced concrete.

**D12:** It is located in the north direction of the west wing of the bazaar. There is a reinforced concrete floor addition on the shop, which is completely reinforced concrete. There is rust on the shutter of the baraka shuttered shop. The shop, which has a depth of three digits from the street code, is used as a tailor shop.

**D13:** It is located as the last shop in the west wing of the bazaar. There are two floors of reinforced concrete additions on the shop, which is completely reinforced concrete.
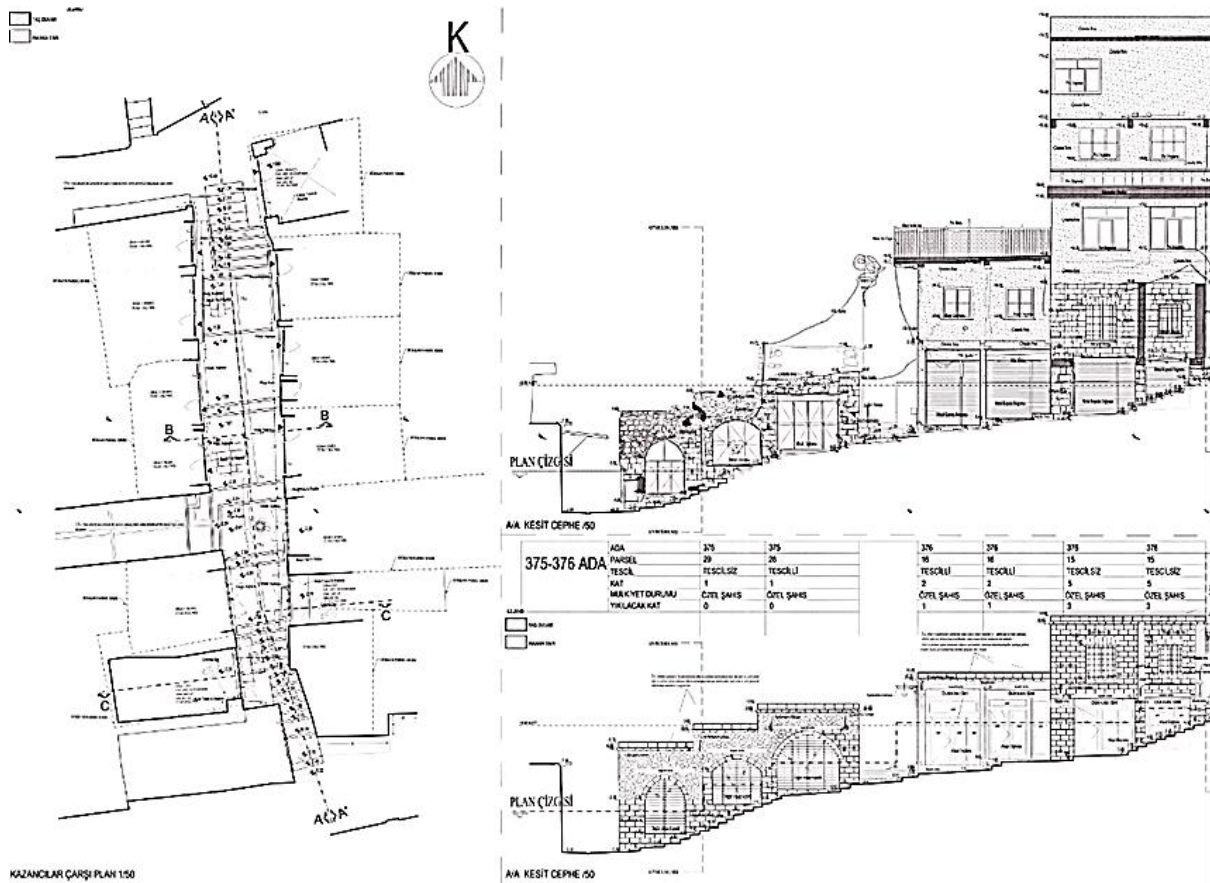


**Figure 1.** Kazancılar Bazaar Floor Plan

**Conclusion**

In the study, as a result of the examination of the current situation of the bazaar, it has been revealed that the bazaar has lost its importance in recent years and that many shops are closed or idle, and this situation has various effects on its architecture and creates changes. In this context, it is suggested that this problem should be overcome

by taking precautions, and that studies should be carried out for the formation and revitalization of the collective memory of the field. In future studies, necessary studies can be done to recognize the effective factors affecting collective memories of the bazaar [10-11].

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# Mardin historical Marangozlar (Neccarlar) Bazaar architectural features

**Lale Karataş**\*1 , **Aydın Alptekin** 2 , **Murat Yakar** 3

¹*Mardin Artuklu University, Department of Architecture and Urban Planning, Mardin, Türkiye, lalekaratas@artuklu.edu.tr*
²*Mersin University, Department of Geological Engineering, Mersin, Türkiye, aydinalptekin@mersin.edu.tr*
³*Mersin University, Geomatics Engineering Department, Mersin, Türkiye, myakar@mersin.edu.tr*

**Keywords**
Cultural heritage
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**Abstract**
Although Mardin bazaars have lost their importance in the past due to the new commercial centers that emerged in the regions where new residential areas were formed over time, traditional retail trade activities are still carried out in the area. Today, the presence of the new settlement oriented towards the industrial facilities in the near vicinity and the traditional city as a whole, far from contemporary conditions, ensure that it is preserved in many aspects. Traditional Marangozlar (Carpenters) Bazaar is one of them. Therefore, this study aims to investigate the history and architectural features of Mardin Historical Kazancılar Bazaar and to understand its place in the urban context. As a result of the study, it has been determined that if a study cannot be carried out to revive the carpentry profession in the field, it is possible to lose the collective memory of the field in the near future.

## Introduction

The concept of life and survival in today's bazaar architecture is remarkable with its development from traditional to modern times. Since the past, the bazaar has always been the heart of a city, one of the most important urban elements in developing and uniting cities. Urban history studies reveal that various factors affect the development of ancient cities. Bazaar buildings are not only decorations of the urban fabric, but also living organisms.

## Material and Method

Mardin Province, Artuklu District Teker Mahallesi, Carpenters Bazaar registered at 76. Alma Street, Adaz377, Plot:1—2—3—4-5-6-30-31—32-33-34; Island:37S, Parcel: 43-42-41-40-39-38-37—36-35-34-33-32-31—30-29—28—27—26—25—23-22—21- 20-19-18-17-16 Block:348, Plot: 1-2-3-4—5-6-7-8-9-10—11-12—13—14—15-36—38; and 618 Island, parcels no.3. It is located in the lower street of the Kasaplar Bazaar, south of the 1st Avenue [1].

No inscriptions or archive records regarding the construction date of the bazaar were found. In historical sources, its name is mentioned as Neccarlar Bazaar. Today, the bazaar is known as the Marangozlar or Neccarlar' Bazaar, and the bazaar is active. A significant part of the bazaar shops are closed, while most of the open ones continue their carpentry functions. The earliest shop units can be dated to the 14th century when we consider its development together with the rows of shops around the bazaar and the pattern of the bazaar. It can be said that the architectural features and analyzes of the bazaar developed in different periods, not in a single period, and gained the texture of the bazaar. Bazaar was registered by Diyarbakır Cultural Heritage Preservation Regional Board with the decision dated 21.09.1979 and numbered A—1933. The western entrance of the bazaar is connected to the Old Jewelers bazaar, and the eastern entrance is connected to the Kasaplar Bazaar and 1st Street.

In the study, literature review, archive research and field research method were used. First, a literature review was conducted for Mardin Butchers Bazaar. Then, information about the architectural information of the bazaar, which was obtained from the Mardin Metropolitan Municipality KUDEB unit, was compiled. In addition, observations about the bazaar were included in the study by examining the bazaar site with field research.

**Results**

Contrary to the traditional Mardin housing structure, a simpler orientation is observed in the buildings where the economic activities of the city are located. The architectural features of the bazaar are plain and generally consist of a single floor. Located on the south street of the 1st Street, just below the Kasaplar Bazaar, the bazaar's interior filling stones are made of coarsely cut limestone, and the outer walls are made of locally cut and finely cut limestone. The shop entrances of the bazaar extending in the east-west direction are designed as pointed and semicircular arches with wide openings. As a result of the interventions made in the late period, the arches of some of the shops were demolished and turned into reinforced concrete lintels. The bazaar shows a slope from north to south due to its topographic structure and extends in the east-west direction. In the middle of the bazaar, the street continues with a small zigzag. The street floor is paved with masculine basalt stone pavements. The shops of the open-top bazaar are adjacent to each other, facing each other on the north and south sides of the street. The original shops have architectural features with pointed or semi-circular arches, rectangular plans, cross and barrel vaults from the inside, and flat roofs from the outside, and they face the street. However, today, some of the shops have been converted to reinforced concrete and there are reinforced concrete additions on the bazaar shops. The western entrance of the bazaar is connected to the Old Jewelers bazaar, and the eastern entrance is connected to the Kasaplar Bazaar and 1st Street (Figure 1).



**Figure 1.** Marangozlar Bazaar floor plan and views

**Discussion**

Documenting cultural heritage is an important scientific study. In addition to the classical method, these are documented by using modern methods such as unmanned aerial vehicles, laser scanning and photogrammetric methods. Especially, 3D measurement techniques make very important contributions to the documentation of cultural heritage [2-8].

**Conclusion**

Bazaars are places where people experience social interactions, feel space and perceive the environment. The formation and keeping of collective memories of the city is the result of the activities and behaviors that occur in these areas. Mardin Marangozlar (Neccarlar) Bazaar is one of the most important areas where the collective memory of the city is formed. However, in the research conducted, it is seen that although the bazaar has recently undergone restoration, interventions were made only to improve the physical conditions of the bazaar, but most of the shops in the bazaar are still closed and idle and the shops used have undergone a change in function. If a study cannot be carried out to revive the carpentry profession in the field, it seems possible that the collective memory of the field will be lost in the near future [9-10].

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# Mardin historical Kuyumcular (Jewelers) Bazaar restoration evaluation

**Lale Karataş**\*1 , **Aydın Alptekin** 2 , **Murat Yakar** 3

*1Mardin Artuklu University, Department of Architecture and Urban Planning, Mardin, Türkiye, lalekaratas@artuklu.edu.tr*
*2Mersin University, Department of Geological Engineering, Mersin, Türkiye, aydinalptekin@mersin.edu.tr*
*3Mersin University, Geomatics Engineering Department, Mersin, Türkiye, myakar@mersin.edu.tr*

**Keywords**
Cultural heritage
Bazaar
Historic fabric
Sustainability
Mardin

**Abstract**
Cultural sustainability is also under threat due to reasons such as the neglect of historical bazaars, inability to meet the demands of modern life, unconsciousness and lack of a conservation plan. In order to ensure the sustainability of the bazaars, it is necessary to understand the meanings of historical buildings and the social and cultural periods in which they are located. For this reason, while these areas are made reusable, the function of the building, its location, and its social and physical integrity should be in order for the building to contribute to social life. The Kuyumcular Bazaar, which is the subject of the study, is surrounded by a touristic and historical area with many mosques, madrasas and tombs. In addition, the bazaar is a great example of historical sustainability with its functional continuity. In the light of these reasons, it is aimed to reveal the future threats at the point of ensuring the sustainability of the bazaar by examining the architectural features and current situation of the Kuyumcular Bazaar.

## Introduction

Bazaar buildings are not only decorations of the urban fabric, but also living organisms. It not only promotes social communication, but also ensures the continuity of social interaction. The bazaars of a city do not only belong to the city with their physical appearance, but also have a decisive role in the creation of daily cultural life. Kuyumucular Bazaar is one of the most important bazaars of Mardin, which maintains its functional continuity. Jewelers' Bazaar is the most important bazaar in Mardin city that maintains its functionality. The reason for this situation is thought to be that it is located on the main alter of the city, which is called 1st Street, and it is a frequent destination for tourists and souvenirs are popular with tourists. However, the bazaar has faced certain threats over time. In this context, it is aimed to reveal the future threats at the point of ensuring the sustainability of the bazaar by examining the architectural features and current situation of the Kuyumcular Bazaar.

Documenting cultural heritage and transferring it to future generations is an important scientific study. In addition to the classical method, these are documented by using modern methods such as unmanned aerial vehicles, laser scanning and photogrammetric methods. Especially, 3D measurement techniques make very important contributions to the documentation of cultural heritage [1-7].

## Material and Method

Jewellers' Bazaar, registered to Mardin Province, Artuklu district Teker Mahallesi, Sakın, 75. and 129. Ayışığı Street address, is in the title deed, Island: 375, parcel: 7-8-10-11-12-13-14-15; Island:69, plot 1:43- 44-45; Island: 376, parcel: 10-1k12-13-14-15 [1].

No inscriptions and archive records regarding the construction date of the bazaar were found. In the oral source research conducted with the tradesmen, it is mentioned that there is an operating cycle in which mostly silver and gold, mostly silver, operated by Armenian and Assyrian families, are processed and sold in these shops.

In the study, literature review, archive research and field research method were used. First, a literature review was conducted for Mardin Kuyumcular Bazaar. Afterwards, the photographs of the bazaar before and after the restoration taken from the Mardin Metropolitan Municipality KUDEB unit were compiled and compared. In addition, the observations about the restoration of the bazaar by examining the bazaar site with field research are included in the study.

**Results**

Contrary to the traditional Mardin housing structure, a simpler orientation is observed in the buildings where the economic activities of the city are located. The architectural features of the bazaar are simple and generally consist of more than one floor above the shop. Located on the south street of the 1st Street, just below the Kasaplar Bazaar, the bazaar's interior filling stones are made of coarsely cut limestone, and the outer walls are made of locally cut and finely cut limestone. The shop entrances of the bazaar extending in the east-west direction are designed as pointed and semicircular arches with wide openings. As a result of the interventions made in the late period, a significant part of the shops, especially in the south wing, were converted to reinforced concrete. The bazaar shows a slope from north to south due to its topographic structure and extends in the east-west direction. The street floor is paved with masculine basalt stone pavements. The shops of the open-top bazaar are adjacent to each other, facing each other on the north and south sides of the street. The original shops have architectural features with pointed or semi-circular arches, rectangular plans, cross and barrel vaults from the inside, and flat roofs from the outside, and they face the street. However, today, some of the shops have been converted to reinforced concrete and there are reinforced concrete additions on the bazaar shops. The west side of the bazaar forks and south street 129 Moonlight; North street is divided into two as 75th Street. 75th street, which is a semi-circular arched cross-vaulted abbara, goes to the Old Blacksmiths' bazaar, and 129. Moonlight south street is to the hatmakers' bazaar; the eastern entrance leads to the Carpenters' Bazaar (Figure 1).
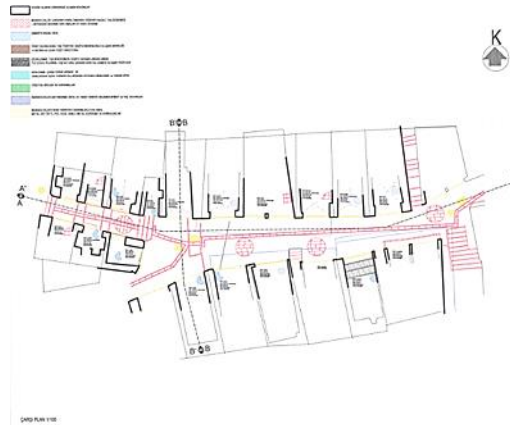


**Figure 1.** Kuyumcular Jewelers Bazaar floor plan [8]

Giving importance only to the economic use value of the Jewelers Bazaar and aiming to increase the economic benefits with the use of the bazaar caused the historical identity of the bazaar to remain in the background. The bazaar has recently undergone restoration intervention. In this context, in the silhouette of the bazaar, it is seen that the front facades of the bazaar are completely covered with additional glass construction and are equipped with identical signboards. It is seen that this situation weakens the relationship of the bazaar with the nearby buildings and causes the shops to be seen as a whole. In addition, the fact that all the shops are like copies of each other prevents the architectural features of the bazaar from being noticed. In this context, in order to keep the bazaar alive as a historical heritage, it is necessary to accept the bazaar as a physical, economic, cultural and cultural asset and to draw attention to the socializing aspects of the bazaar (Figure 2).



**Figure 2.** Post-Restoration Situation of the Kuyumcular Bazaar

**Conclusion**

Within the scope of the study, it is seen that the Kuyumcular Bazaar has not been able to preserve its original design and general architectural features on its facades until today. On the other hand, considering the spatial characteristics of the building, it is seen that the renovation or repair plans of the proposed functions are suitable for the features of the existing structure and the proposed function type in the building, but not for the historical context. This is related to the fact that the building is about to lose its original function today and showcases have been placed in stores to display some other functions. In this respect, efforts to renovate the Kuyumcular Bazaar and ensure its sustainability should be handled with greater depth and care. The contradictions between the attitude that sees tourism only as a source of income and the view that the historical heritage should be protected are also seen in the example of the Kuyumcular Bazaar. Although some efforts have been made for the renovation of the building recently, the restoration works are only aimed at improving the physical conditions of the building. However, the cultural and social sustainability of the building should also be considered with restoration projects. Another issue that should be handled carefully is the importance and value of the building in daily life and the preparation of plans for the sustainability of the bazaar. It is only possible for the Jewelers Bazaar not to turn into an ordinary shopping place with a management that emphasizes that it is the oldest and only jewelers' bazaar in Mardin. Before suggesting ways to make the structures reusable in the restoration projects of the bazaar, care should be taken not to change the original structure and features and not to change the exterior too much during the renovation/repair works of these structures. It is generally recommended that the original structural system of the building be preserved intact so that it reflects the characteristics of the period in which the building was built. For these reasons, it is expected that the repairs will be in accordance with the original structure and form of the structures and that the structures will continue their original functions as much as possible. For example, if repairs or restorations require the preservation of the original plan, profile and appearance of the building, important features, and the use of the building with additional units, it is highly recommended that only the structural system be preserved and the structure preserved [9-10].

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# Measuring PM level in summer season and preparing dispersion modelling for Hacikaymak Region in Selcuklu, Konya, Türkiye

## Sukru Dursun *1 ⓘ, Mehmet Buğrahan Çelik 1 ⓘ

1Konya Technical University, Environmental Engineering Department, Türkiye, sdursun@ktun.edu.tr; mhmtbugrahan@hotmail.com

**Keywords**
Air Quality
Outdoor
Measurement
Modelling
Particulate Matter
Konya

**Abstract**
Global rapid urbanization, the emergence of industry growth and the resulting increased energy demand, the deterioration of air quality in urban and surrounding cities, and ambient air pollution are faced with serious health problems. Different emissions from fossil fuels used in energy production in different environments and processes are emitted to the environment. Some of these emissions are toxic and have acute toxicity, some of them can accumulate in the body and cause chronic effects, and some have a physical mechanism of negative action. In addition to their physical effects of emissions called as particulate matter can affect some of the toxic substances, they carry itself or absorb from the environment they are carrying them to reach to thinnest parts of the lungs. While only 10 micron and below PM values were measured in the previous periods, the measurement importance of PM below 2.5 micrometres has emerged in recent years due to its importance. It is thought that $PM_{2.5}$ is mostly caused by combustion products or exhaust gases of traffic vehicles. At significant levels, prolonged contact with polluted air encounters various human health problems. Specifically, it is a major driver of the rapid development of urban facilities and services to respond to the daily work and life patterns of middle- and high-income residents in the centre of modern metropolises. Therefore, it is necessary to establish air quality control strategies and identify aerosol sources. In this study, distribution modelling was made by measuring PM values in summer month in Hacıkaymak neighbourhood located in Konya city centre (Turkey).

## Introduction

It is known that most environmental pollutants are emitted through large-scale human activities such as industrial machinery, power generation stations, combustion engines and traffic vehicles. Because these activities are carried out on a very large scale, it is estimated that vehicles are responsible for about 80% of today's air pollution [1]. Several other human activities such as plant growing techniques, gas stations, fuel tank heaters and cleaning procedures, as well as various natural resources such as volcanic eruptions and forest fires, also affect our environment [2]. Major sources include emissions of pollutants from power plants, refineries and petrochemical, chemical and fertilizer industries, metallurgy and other industrial plants, and finally municipal combustion plants. Indoor resources include household cleaning activities, dry cleaners, printing houses and gas stations. Mobile resources include cars, vehicles, railroads, airlines, and other types of vehicles. Finally, natural resources include physical disasters such as forest fire, volcanic erosion, dust storms and agricultural burning, as previously noted [3].

In many developing countries, the problem becomes more serious due to rapid industrialization, overpopulation, and irregular urbanization [4]. Negative air quality occurs especially in countries with social inequality and a lack of knowledge in the sustainable management of the environment. The use of wood or poor-

quality fossil fuels for domestic needs exposes people to poor quality and polluted air indoors. It is important that more than three billion people worldwide use poor quality energy sources for their daily heating and other domestic energy needs [5].

Human activities have many negative effects on the environment by polluting the atmospheric air and therefore water resources and soil. Although it was of great importance in terms of providing services for the society with industrialization, it also brought with it the production of huge amounts of pollutants that spread into the atmosphere and are harmful to human health. Global environmental pollution is also recognized as a multifaceted international public health problem. Social, economic and lifestyles are associated with this major environmental pollution problem. Industrialization and urbanization are reaching sad dimensions in the world today. Human-induced air pollution is considered one of the biggest public health hazards in the world, given that it causes about 10 million deaths annually [6].

Long-term effects associated with air pollution are cardiovascular disease, heart failure, chronic asthma, and mortality. In a Swedish study, diabetes is triggered after long-term exposure to air pollution [7]. Moreover, air pollution appears to have various adverse health effects on human life, such as respiratory, cardiovascular, mental disorders [8], and cause adult and infant mortality or chronic diseases [6].

Air pollution is mainly effective in large urban areas, where road emissions contribute the most to the deterioration of air quality. There is also the danger of industrial accidents where toxic fog emission can be fatal to surrounding people. The distribution of pollutants is determined by many parameters, especially atmospheric stability, and wind [6]. The accumulation of air pollution, particularly sulphur dioxide and smog, reached 1,500 mg/m3, resulting in an increase in the number of deaths in London in December 1952 (4,000 deaths) and New York City in 1963 (400 deaths) [9]. Based on monitoring of outdoor pollution in many metropolitan cities of the USA, a relationship between pollution and mortality has been reported [10].

In this study, it is aimed to prepare the spatial distribution modelling in the city centre by making measurements of $PM_{10}$ and $PM_{2.5}$ in summer. It is aimed to prepare a PM pollution map with the data obtained from the modelling and to make comments on emission skies.

**Material and Method**

The variation of air pollutant concentrations in cities between regions has been observed. This variation depends on the characteristics of the regions. This study was initiated for the measurement of emission inventory based on open air areas in the Hacıkaymak region of Selcuklu district of Konya city. The circumference of this chosen region is 6301 m, and its area is 2.25 $km^2$ (Fig. 1). Thirteen different locations were selected for measurement points. These locations were chosen with due consideration to the spread and sources of existing air pollution. It was decided that the most suitable regions for data analysis.

The measurement methods of dust and particles in the air vary according to the volume of the particles and the desired results in the study. The "particle counter PCE-PCO1" is a laser particle counter and dust measuring device configured to determine the concentration of airborne particles by means of electronic recording.

Measurements were made in August month in summer season. During this month, particulate matter measurement data were collected by making weekday and weekend measurements, daily measurements, day and night measurements and hourly measurements (08:00, 12:00, 15:00, 18:00, 22:00 in each day).
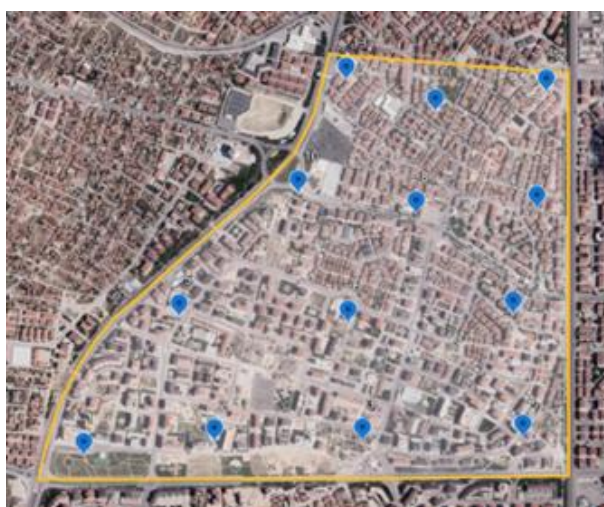


**Figure 1.** Hacıkaymak region Konya, Selcuk district and determined study area measurement points

Surfer 19 software, produced by Golden software company, consists of a 3D graphics system. It is used for gridding scattered data recorded in different environments, creating contour maps and obtaining 3D images. Articles prepared in accordance with the principles of writing and approved by the review board are published.

After taking the coordinates of the measurement points, the data collected at the end of each season were listed in the Excel program as daily, weekly and hourly averages. In addition to the X and Y coordinates, the Z coordinate also represents the measured $PM_{2.5}$ or $PM_{10}$. A worksheet was created by transferring the XYZ coordinates to the Surfer-16 program.

## Results

This study aimed at measuring particulate matter, evaluating air quality and reducing air pollution in Konya, Selcuklu region. The measurement of $PM_{10}$ and $PM_{2.5}$ values in this region was made and the degree of pollution was evaluated by modelling it with the Surfer-19 modelling program. Based on these values, it is aimed to contribute to reducing these values to the lowest levels by determining the regions where $PM_{10}$ and $PM_{2.5}$ pollution are intense and their sources, the factors causing pollution. As a result of research, measurements, and analyses, it was concluded that there are many factors affecting $PM_{10}$ and $PM_{2.5}$ pollution. Considering seasonal and months, $PM_{10}$ and $PM_{2.5}$ pollutant values were determined to be lower in summer months.

$PM_{10}$ and $PM_{2.5}$ pollutant values considering the days of the week; were found to be lower on weekdays and higher on weekends. The traffic density on the weekend is higher than during the week. For this reason, the measured values are higher at weekends and lower during weekdays.

$PM_{10}$ and $PM_{2.5}$ pollutant values considering hours; At certain times of the day, the measurement results were above the average. These hours are the starting and ending hours. Due to heavy traffic, the measurements we made at 08:00 and 18:00 were very high. Average values of seasonal measurements were found as $PM_{2.5}$ value 749 $\mu g/m^3$ and $PM_{10}$ value 31 $\mu g/m^3$ in August (Table 1).

**Table 1.** $PM_{2,5}$ and $PM_{10}$ weekly average measurement values

| Seasonal Average Measurement Values | $PM_{2,5}$ | $PM_{10}$ |
|---|---|---|
| Average of Measurement Values for August | 749 | 31 |

## Discussion

$PM_{10}$ and $PM_{2.5}$ pollutant values considering seasonal and months; It was determined that the weather was higher in the winter months and lower in the summer months. When we investigate the reason for this, it is primarily the pollution that occurs due to the fuels burned for heating purposes. In addition, due to the low air temperature values, people prefer to use public transport, walk, or bike, etc. The use of special vehicles instead of using them also increases the pollutant values. In EU countries and Turkey, the limit value of $PM_{10}$ (Particulate Matter) has been determined as 50 $\mu g/m^3$ as a result of 24-hour measurement. As a result of the annual measurement, the limit value has been determined as 40 $\mu g/m3$.

Considering the weather conditions, $PM_{10}$ and $PM_{2.5}$ pollutant values; It was determined that it was lower in rainy weather and higher in windy weather. When the weather is rainy, some of the particulate matter in the air goes down with the precipitation and the measurement values are lower. The opposite happens in windy weather. It was observed that particulate matter increased in conditions such as wind, breeze, and storm.

## Conclusion

It was determined that $PM_{10}$ and $PM_{2.5}$ 0 concentration were not as important as the relationship with wind speed as it was with precipitation. Despite this, it was observed that $PM_{2.5-10}$ concentration was positively correlated with wind speed in summer. In another study conducted during the summer season, it was noted that there was a positive correlation between coarse particles and wind speed. As a solution proposal because of research and analysis; Attention should be paid to the fuels used during industrial activities and the flue filters in the facilities. To reduce the exhaust and gases from motor vehicles, we can ensure less pollution by using public transportation, at least in an environmentally friendly way such as cycling or walking.

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# Evaluation of water management processes in terms of planning

**Aziz Cumhur Kocalar** *1 iD

*1Niğde Ömer Halisdemir University, City and Regional Planning Department, Türkiye, azizcumhurkocalar@gmail.com*

**Abstract**
The climate crisis has increased the importance of the water footprint. The imbalances in the current water cycle of the planet are obvious. In addition to the settlement pressure caused by rapid urbanization, increasing population and migration to cities, environmental pollution and distorted changes created by excessive water use also cause ecological damage. The study reveals the striking dimensions of the change in water consumption in recent years with field examples from the Central Anatolia Region. The administrative traces of the research show us that it would be appropriate to critically re-evaluate the apparent results and correct the causes without delay.

## Introduction

The climate crisis has increased the importance of the water footprint. The imbalances in the current water cycle of the planet are obvious. In addition to the settlement pressure caused by rapid urbanization, increasing population and migration to cities, environmental pollution and distorted changes created by excessive water use also cause ecological damage.

## Material and Method

The study explores applications in urban and rural areas within the scope of water using. It also evaluates technological developments in other smart solutions related to agricultural perspective.

## Results

The most important reason for the environmental problems increasing with the effect of urbanization is the planning and design approaches where the human-nature relationship and interaction are not analyzed and evaluated, and landscape ecology is not considered [1]. In establishing the nature-human relationship, natural landscape features should be evaluated as a holistic rather than fragmented [2]. A study in which the sustainability indicators of cities [3] are given in tabular form clearly show the problems in artificial areas.

Like urban areas, problems persist in rural areas. In fact, field observations are sometimes encountered, which can be the scene of even more brutal agricultural water uses. However, rural life should set an example for the city with its non-destructive aspects that develop intertwined with nature and have an emphasis on sustainability, and its processes should be preserved in that way.

Ecological restoration: It is the process of helping an ecosystem that has lost its property, been damaged, or destroyed, to recover. Often, an ecosystem in need of restoration has been degraded, damaged, transformed or destroyed as a direct or indirect result of human activities [4].

Previously, studies were carried out on dams and ponds and irrigation canals with a focus on planning on the water resources that come to life in Sivas and the visible effects of climate change [5]. The study could be carried out in Niğde with similar approaches, but for now on geography and field observations with field trips.

The study reveals the striking dimensions of the change experienced in recent years with field examples from the Central Anatolia Region.

As the dam ponds in Niğde were increased in number, the underground water level decreased considerably. Despite this, the number of boreholes and wells was further increased, and the vineyards and gardens were left to dry. Due to the westward expansion strategy of the city, the pressure of construction has reached the dimensions that threaten the town of Fertek*.

The decrease in water in Mersin-Silifke Göksu Delta stands out as another obvious planning calculation error.

**Discussion**

The administrative traces of the research show us that it would be appropriate to critically re-evaluate the apparent results and correct the causes without delay. For this purpose, the results and recommendations of the study are summarized.



**Figure 1.** Akkaya Dam Pond

**Conclusion**

In this way, national dynamics adapted to global market conditions have become product and profit oriented. It has been observed that due to the uncontrolled cultivation of the farmers in the agricultural basins, the products that consume excessive water are given weight.

First, national dynamics adapted to global market conditions, as can be seen from the field examples above, have been turned into products and profit-oriented services, in short, they have been commodified. It has been observed that the farmers in the agricultural basins are given weight to the products that consume excessive water in the plantings that are left unsupervised.

In the example of Sivas, the area where the city was established is both farther from the Kızılırmak shore and wider than Niğde. As Niğde remained in a narrow corridor and blocked the water's path and kept it with dams, it expanded the city towards the plain under the dams.

Negative factors affecting the water cycle are not limited to these. The importance of agricultural areas has been forgotten, as energy production has taken precedence over agricultural production. While the underground waters are extremely valuable, the ecological balances based on the water cycle have been upset with the dams built on the ground (For example, The dam ponds in Niğde).

In addition, air, water, and soil pollution created by the deterioration of environmental conditions caused by industrial activities also caused a decrease in the quality of life (For example, leaving the Niğde Akkaya Dam Pond to dry).

The decrease in the water of Göksu, which spills from Silifke into the sea by making a delta, has reached a level that will destroy the delta in recent years. This is a striking result of the transfer of the resources that feed Göksu to other places.

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# Reducing casting defects in ductile iron castings by optimized pouring system

**Mustafa Murat Zor** *1 , **Serdar Kesim** 1 , **Ferhat Tülüce** 1 , **Alper Yoloğlu** 1

*1ÇİMSATAŞ Çukurova Construction Machinery IND. TRADE. A.S. Mersin, Türkiye, foundry@cimsatas.com*

**Keywords**
Ductile iron casting
Kalpur direct pouring system
Modelling and simulation
Casting defects
Filtration
Greensand casting

**Abstract**
In the study, various version pouring systems have been designed for ductile iron castings in the industrial conditions and a computer-aided design solid modeling program was used in the design of pouring systems for ductile iron castings. Pouring system for ductile iron castings and the gating system ratio of the casting part was selected as 1:3,5: 2,5. The flow and solidification of the casting part was simulated by using magma flow and solidification program. The study clearly shows that the kalpur direct pouring system has revealed that it plays a significant role in preventing non-metallic casting defects in ductile iron castings. In addition, it has been observed in the study that clean parts can be obtained in ductile iron castings with an effective and well-designed pouring system design.

## Introduction

Casting process plays a very important role in manufacturing industry. Modern foundry engineering is a well-developed and sophisticated industry utilizing cutting-edge technologies and tools including 3D printing, robost and automated manufacturing. Despite this, the most important poruduction technology remains the use of greensand molds poured with cast iron or steel. Major applications and uses of castings are in automobile industry, agricultural industry, construction machinery etc. [1-3].

Oxide, sand, and slag iclusions are casting defects that are troublesome and damaging to casting performance. In carbon and low alloy steel castings, reaction between oxygen in the atmosphere and most reactive elements in deoxidized steel results in reoxidation inclusions. In ductile iron castings, the reaction of magnesium oxide and silica during magnesium treatment and further during mold filling is responsible for the formation dross inclusions [3-6].

Pouring system is one of the important design terms of ductile iron casting. And it refers to those channels through which the metal flows from the ladle to mold cavity. High casting quality depends on a reasonable pouring system design. An improper pouring system could result in turbulance, air entrapment and inclusions in the filling process [7-9].

The benefit of filters, especially reticulated foam filters, besides their turbulence-reducing effect, is to prevent non-metallic inclusions such as sand and slag from entering the casting part during pouring the molten metal into the sand mold [11-12].

## Kalpur Direct Pouring System

The kalpur direct pouring system developed by FOSECO for foundries is used in greensand molding lines and resin molding lines to obtain high part efficiency and clean casting parts. The kalpur direct pouring system includes many critical components within its own structure; exothermic feeder, ceramic foam filter, and collapsible breaker core etc. The main purpose of the kalpur direct pouring system is; reduced fettling cost, reduced non-metallic

inclusions, lower turbulence related defects, improved directional solidification, good surface finish optimized yield, and increased space on the pattern plate. Parts molded with the kalpur direct pouring system can be poured with lip pouring ladle or bottom pouring ladle [11-15].

**Material and Method**

In this study, the pouring systems designs of connecting casting part are based on the modulus and geometry of the casting part. In the study, the material of the part is determined according to the DIN EN 1563 standard and material of the casting part has been selected as GGG50. The chemical composition of the casting part is shown in Table 1 and the image of the connecting casting part is shown in Figure 1.

**Table 1.** Chemical composition of the connecting casting part

| Contents | % C | % Mn | % S | %P | % Si | % V | % Cu | % Mg | %Pb |
|----------|------|------|------|-----|------|------|------|------|------|
| **Min.** | 3,6 | 0,18 | 0 | 0 | 2,4 | 0 | 0,29 | 0,03 | 0 |
| **Max.** | 3,75 | 0,22 | 0.01 | 0,1 | 3 | 0,02 | 0,31 | 0,06 | 0,02 |
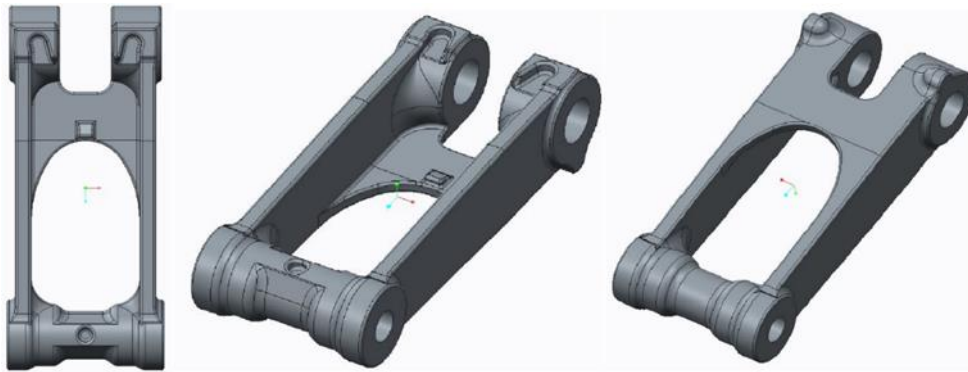


**Figure 1.** Schematic representation of the connecting casting part

In the first pouring system study, pouring system design of the connecting casting part is based on total gross weight of the part (total gross weight including gating system and feeders) and effective casting height. Total gross weight of the casting part is 105 kg and effective casting height is 32 cm. The gating system ratio of the casting part has been chosen as 1:3,5:2,5. Flow and solidification of the part has been simulated at 1350 °C by choosing lip pouring ladle. The designed pouring system ratio and dimensions of the casting part are shown in Table 2 and the images of the simulation results of the casting part are shown in Figure 2.

**Table 2.** Designed pouring system ratio and dimensions.

| Gating system ratio | Vertical runner | Horizontal runner | Ingate |
|---------------------|-----------------|-------------------|--------|
| **1:3,5:2,5** | 1 | 3,5 | 2,5 |
| | 12,56 cm² | 43,96 cm² | 17,5 cm² |
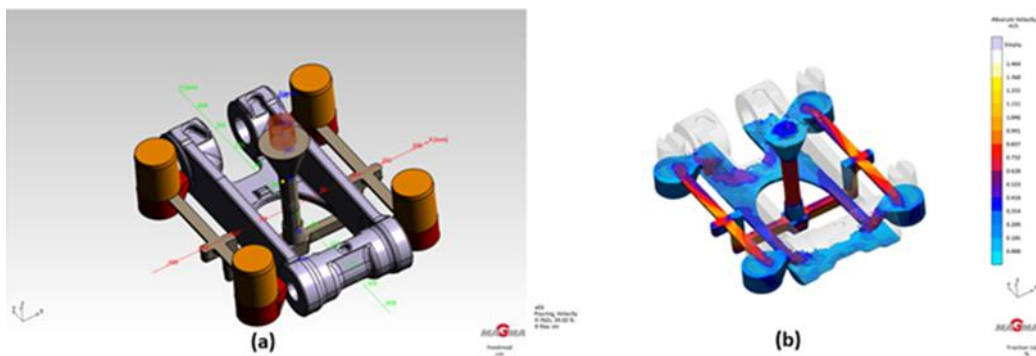


**Figure 2. (a);** The image of the casting part geometry, **(b);** The image of the metal flow and filling simulation of the casting part

After simulation results, one part was molded in the greensand molding system in ÇİMSATAŞ foundry and the casting has been carried out with a lip pouring ladle at 1350 °C and in 20 seconds. Total gross weight of the casting part has been detected as 105 kg. Image of the designed pouring system mounted in the part model and image of the poured part with designed pouring system is shown in Figure 3.
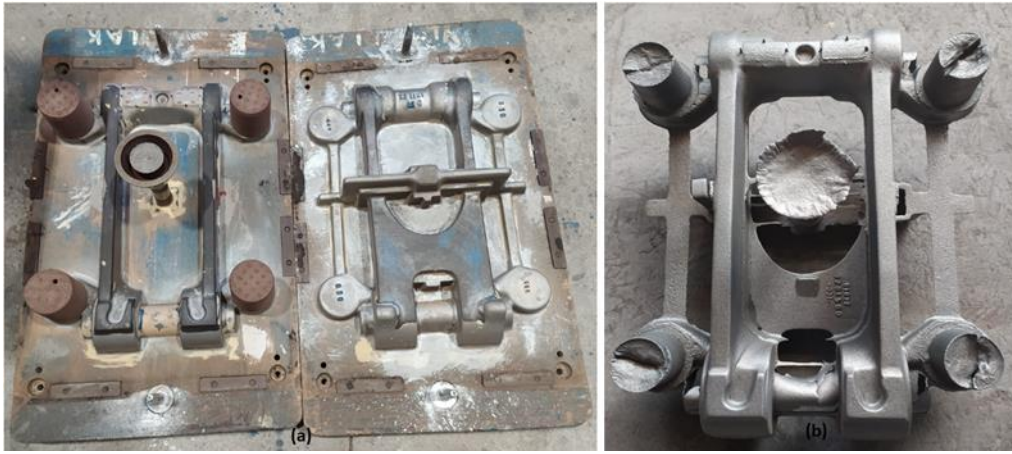
**Figure 3. (a)**; The Image of the designed pouring system mounted to the part model, **(b);** The image of the poured part with designed pouring system

The part poured with the designed pouring system was examined and then a design change was made in the part solid data. The kalpur direct pouring system was placed at the cope side in the casting part solid data and flow and solidification of the part was simulated at 1350 °C by choosing lip pouring ladle. Images of the simulation results of the casting part are shown in Figure 4.
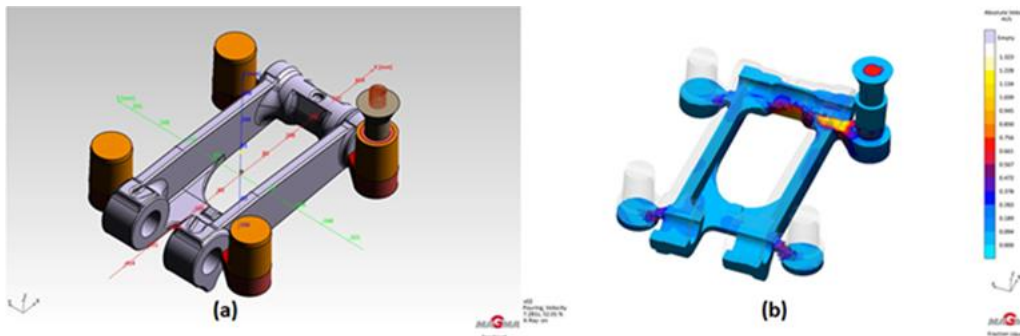


**Figure 4. (a);** The image of the casting part geometry, **(b);** The image of the metal flow and filling simulation of the casting part

After simulation results, one part was molded in the greensand molding system in ÇİMSATAŞ foundry and the casting was carried out with a lip pouring ladle at 1350 °C and in 15 seconds. Total gross weight of the casting part has been detected as 96 kg. Image of the kalpur direct pouring system mounted in the part model and image of the poured part with the kalpur direct pouring system is shown in Figure 5.
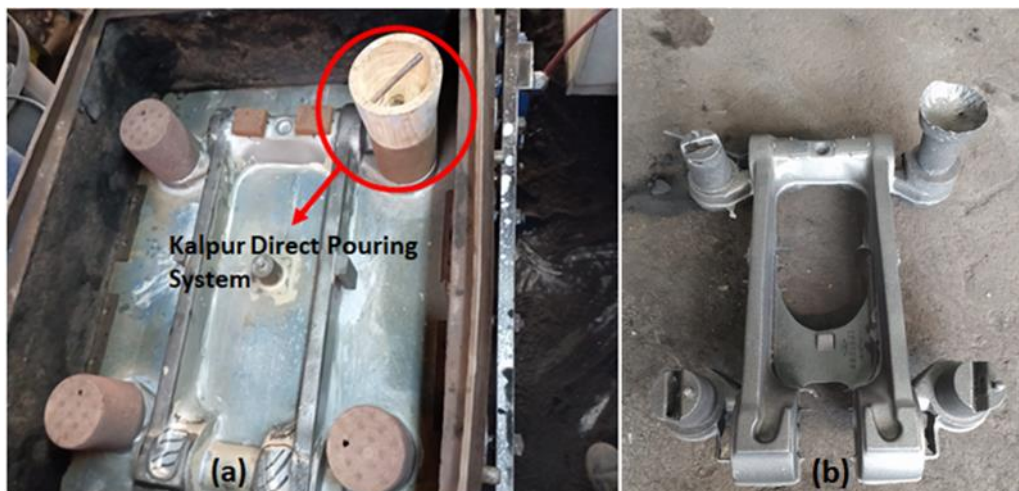


**Figure 5. (a);** The image of the kalpur direct pouring system mounted in the part model, **(b);** The image of the poured part with the kalpur direct pouring system

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**Results**

- It was found that the simulation results represented nearly the actual casting results.
- The total gross weight of casting part poured with kalpur direct pouring system has decreased from 105 kg to 96 kg. In addition,
- While 4 cores were used in the first designed pouring system, only 2 cores were used in the kalpur direct pouring system. 2 cores has been eliminated in the molding of the casting part by the kalpur direct pouring system.
- It has been observed that clean part can be poured with the gating system ratio of 1:3,5:2,5.
- While the filling time of the poured part with the designed pouring system was 20 seconds, the filling time of the poured part with kalpur direct pouring system was decreased to15 seconds.
- It has been observed that the surface qualities of the poured parts are close to each other in both pouring systems.

**Conclusion**

It has been observed that designed pouring system with ratio of 1:3,5:2,5 for GGG50 ductile iron castings minimizes the escape of the non-metallic inclusions from ladle into the casting part during filling of the molten metal to the mold cavity. In addition, it has been increased the importance of the use of ceramic foam filters in foundries in recent years.

By using the design of the different version of the pouring systems in the ÇİMSATAŞ foundry, the surface quality of the casting part has improved by design of both pouring systems. It has been seen that ceramic foam filters are cost-effective and efficient way to reduce casting defects.

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# Determination of the optimum deoxidant addition in steelmaking process and the investigation of an alternative deoxidant material

**Ferhat Tuluce** *[1] , **Buğra Erbakan** [1] , **Alper Yoloğlu** [1] , **Mustafa Murat Zor**[1] , **Serdar Kesim**[1] , **Vedat Uz**[1]

[1]ÇİMSATAŞ Çukurova Construction Machinery IND. TRADE. AS Mersin, Turkey, foundry@cimsatas.com

**Keywords**
Steelmaking
Steel casting
Deoxidation of steel
Alternative deoxidant material

**Abstract**
It is known that the oxygen in the liquid steel causes problems in the process and quality of steel. Nowadays, the addition of aluminum to molten metal is the most common application for deoxidation of liquid steel. In this study, the optimum aluminum addition levels have been determined and an alternative material that can be used as a deoxidant has been evaluated. The optimum addition amount and the optimum alternative deoxidant were determined by optical emission spectrometry, active oxygen measurement in liquid steel, microstructure investigations, and destructive/nondestructive testing methods.

## Introduction

The active oxygen level in the liquid steel is an important factor for the quality of the steel casting. For this reason, the deoxidation process should be done in liquid steel after the melting process. Today, the usage of metallic aluminum alloys for this purpose is the most common practice in steelworks and steel foundries. However, metallic aluminum costs are quite high. In this study, the optimum aluminum addition amount and more economical alternatives will be determined.

According to the results of our research and feasibility studies, the most suitable alternative deoxidant material was chosen as aluminum dross.

## Material and Method

Within the scope of this study, Al dross was obtained from an aluminum casting company (Döktaş Dökümcülük) and an active oxygen measuring device (Celox-Lab E) from an international technology supplier (Heraeus) (Fig.1).



**Figure 1.** a- Aluminum dross b-Celox-Lab E

During the studies, firstly, the efficiency of our standard deoxidation process was examined and the success of the current process was determined by using an active oxygen level measuring device. After the optimization studies, the amount of aluminum and aluminum dross addition rate will be determined.

There is no chemical process that accelerates the melting process (oxygen blowing etc.) in our foundry, which melts with an induction furnace. Active oxygen level and temperature controls were performed on a regular basis without changing the process in order to identify the trend of the current melting process's oxygen levels (Fig. 2).



**Figure 2.** Temperature and oxygen levels measurements in induction furnaces

As expected, it was observed that the dissolved oxygen in the liquid steel increased during the process (Fig. 3).
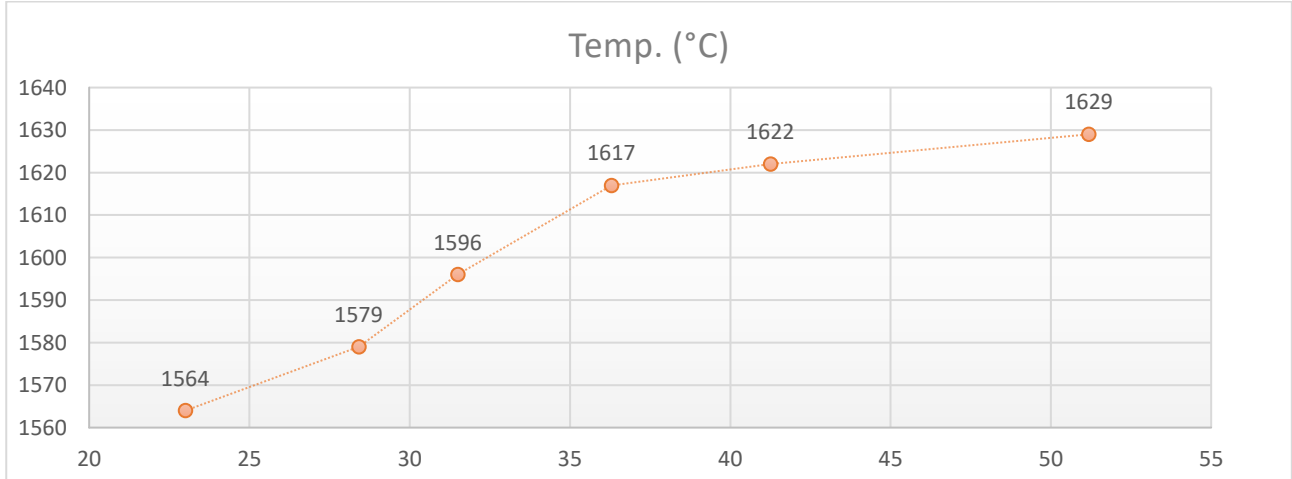


**Figure 3.** Active oxygen level measurement results during the melting process

After determining the active oxygen level change throughout the process, 3 different deoxidant applications were made in the same melting process in the same furnace. Since the deoxidant application is made while the liquid metal is being transferred to the ladle at the last stage of melting, all studies were performed in the same melting process, ensuring that all other steps are exactly the same except for deoxidation.

In the literature, it is stated that deoxidation occurs more slowly below the oxygen level of 20 ppm. In these measurements made immediately after the addition of Al, if the oxygen level is measured below 20 ppm, the deoxidation will be considered successful [1-5].

Oxygen levels were determined before and after deoxidation in the current process (600 ppm Al) with an active oxygen measuring device and the results were recorded for theoretical calculations. The findings obtained from the experiments show that the currently applied deoxidation process is sufficient and even the amount of Al used may be more than necessary (Fig. 4).

As a result of the theoretical calculations, it was decided to add 500 ppm Al to the second ladle and the oxygen level was measured again.
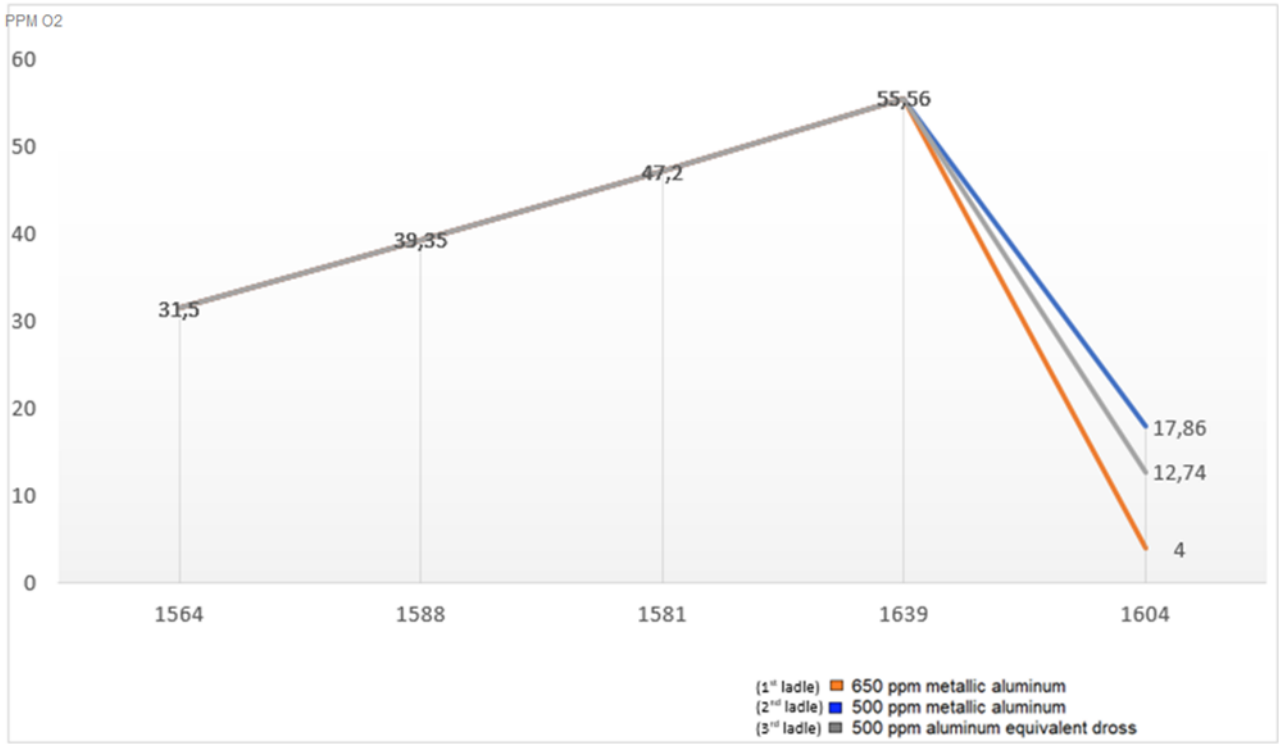
**Figure 4.** Oxygen level decrease in the ladle after the addition of aluminum deoxidant

2nd laddle contains less residual aluminum according to the optical emission spectrometer. Residual aluminum is bad for mechanical properties. For this reason, the addition of 500 ppm Al was found to be more reliable.

In order to evaluate the deoxidation success of aluminum dross according to the equation found, studies were carried out by using aluminum dross instead of metallic aluminum (Fig. 4).

In the last experiment, 500 ppm aluminum equivalent dross was added and it was observed that the oxygen level decreased to 12.74. After the studies, destructive non-destructive inspections and metallographic examinations were made on all samples, and no adverse events were encountered in the tested samples.

**Results**

As a result of the measurements, it is seen that the oxygen in the liquid metal increases as the process progresses. This confirms the information in the literature that oxygen solubility increases with increasing temperature and that dissolved oxygen will increase over time [6,7]. There are many sources for the deoxidation of liquid steel in the literature, but the recommended additional amounts and/or relations in these sources depend on the type of deoxidant used, grade, furnace type, how the deoxidation is done, climate, etc. It depends on many variables within the foundry/meltshop. Therefore, there may be changes according to the operating conditions. In this study, which we aim to start with a theoretical approach and find the optimum amount of addition experimentally, the best results were obtained with the addition of 500 ppm aluminum for 1 ton of 25CrMo4 material melted with an induction furnace.

As a result of the studies, successful deoxidation was achieved with aluminum dross. While the oxygen level decreased to 17.86 in the experiment with 500 ppm metallic aluminum, the oxygen level decreased to 12,74 in the experiment with the equivalent amount of aluminum dross. From this point of view, it can be said that aluminum dross is more successful in terms of deoxidation than metallic aluminum used in equivalent amounts. This observation is the result of the large surface area of metallic aluminum in the aluminum dross [8]. As a result of the metallographic, destructive and non-destructive investigations, it was observed that the trace amounts of inclusions (strontium, titanium, silicon, magnesium, and their oxides) in the aluminum dross did not have any negative effect on the casting part properties.

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# Usability of cyber security with artificial intelligence

## Hüseyin Fırat Kayıran *1 , Aybüke Ergül 2

*1University, ARDSI, Mersin Provincial Coordination Unit, Mersin, Türkiye, huseyinfiratkayiran@tkdk.gov.tr*
*2Cloud Native Engineer, Istanbul, Türkiye, aybukergul12@gmail.com*

| **Keywords** | **Abstract** |
| --- | --- |
| Artificial intelligence<br>Cybercrime<br>Nano technology<br>Mechanic | Nowadays, the Internet has become widespread in every field. With the spread of the Internet, cybersecurity has emerged as an issue per se. Artificial intelligence is used quite often today. The field of use of artificial intelligence is proportional to technology. Cybercrime is all criminal activity that targets or uses a device connected to a computer. Most cybercrime is carried out by cybercriminals or hackers who want to make money. The word cyber is used to describe concepts involving computer networks. Recently, the concept of cybersecurity has entered the literature due to the innovations brought by technology. With this study, a literature review of the use of artificial intelligence in the fight against cybercrime was conducted. The results obtained were compared with each other in this study. |

## Introduction

Cyber security; protecting data, networks, programs and other information from unauthorized access. Today, security should be considered on its own. Different software can be developed for data protection. Countries create their own projects in catching national security and world technology in information systems [1]. Nowadays, internet access is available everywhere and social media can be used at any time thanks to mobile phones. In this context, artificial intelligence plays an important role. Cybercrime can be carried out by individuals or groups. Artificial intelligence is the use of the human brain as a computer, Cyberspace; It is a global networked, computer-managed multidimensional artificial or virtual reality [2]. cyber environment; It consists of software, hardware and communication infrastructure. To give an example of equipment; servers, processors, laptops, satellite systems [3]. Technological developments and the widespread use of the Internet have begun to change people's social behavior. Along with cyber developments, the concept of crime has also been transformed. It has found itself right in human life [4].

## Material and Method

Although artificial intelligence usually refers to the intelligence displayed by machines, it has become an innovative technology that takes place in many aspects of our lives, from semi-autonomous cars on the road to robotic vacuum cleaners in our homes [5].

Artificial intelligence with a different definition; is to ensure that machine equipment has the intelligence and ability of humans through artificial methods. There is no precise definition of artificial intelligence in the scientific community, as scientists continue to have doubts about intelligence [6]. Artificial Intelligence and its subsets are given in Figure 1.

Machine learning, defined as algorithms that parse datasets and then learn to apply what is learned to make informed decisions, is a subcomponent of artificial intelligence. Machine Learning is a branch of artificial intelligence that uses computer science. Machine learning is all algorithms that mimic human intelligence. In the machine learning model, learning takes the form of teaching-teaching (training) and testing (testing). In the learning phase, a learning model is created by learning algorithms and features into the system using the examples

in the data set. In the experiment phase, predictions are made for the trial data with the learning model application Engine [8-9-10]. The machine learning model is given in Figure 2.
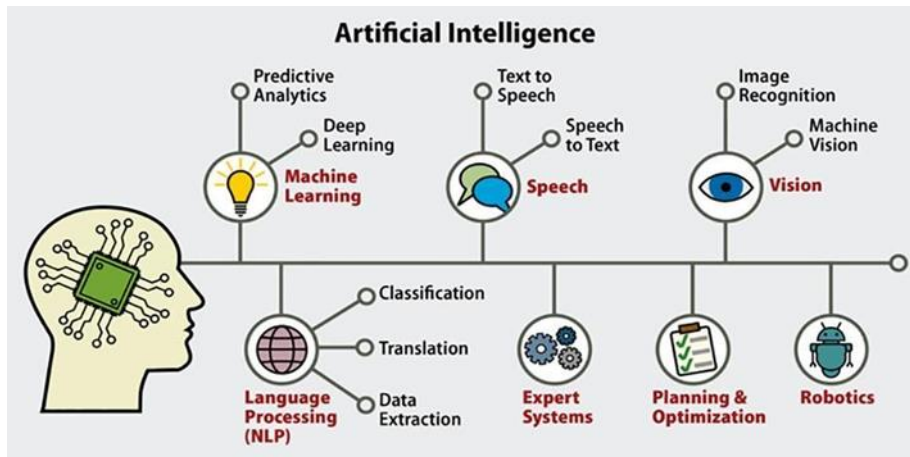


**Figure 1.** Artificial Intelligence and its subsets [7]
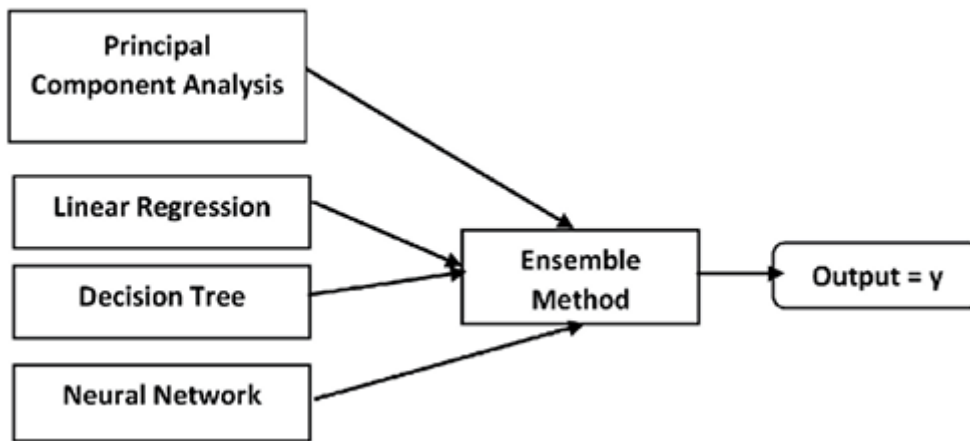


**Figure 2.** Machine Learning Model [11]

Artificial intelligence and cyber security are closely related. Literature studies of the studies in this field are shared in order. With the use of artificial intelligence, financial services can occur in everyday scenarios such as fraud detection, retail purchase forecasting and online customer support interactions. Fraud detection can be made through artificial intelligence. Initial scoring of loan applications in the financial services industry uses artificial intelligence to understand creditworthiness. More advanced artificial intelligence extensions are used to monitor and detect fraudulent payment card transactions in real time. Also, Virtual customer support (VCA). Call centers use VCA to anticipate and respond to customer inquiries other than human interaction. Voice recognition combined with simulated human dialog is the first point of interaction in a customer service inquiry. High-level questions are directed to a person. Banks can be contacted via the chat robot on the web page. Advances in artificial intelligence for applications such as natural language processing (NLP) and computer vision (CV) help industries such as financial services, healthcare and automotive to accelerate innovation, improve customer experience and reduce costs [12]. The changing understanding of security in international relations and Turkey's cyber security strategies have been researched. In another study; The effect of cyber security training on the awareness, knowledge and behavior levels of pre-service teachers was investigated. At the end of the study; As a matter of fact, qualitative findings also support quantitative results. According to the qualitative findings, the students in both the experimental and control groups revealed that they were informed about the cyber security issue, gained awareness and acted towards providing cyber security in daily life thanks to the education. Study of the cyber security measures: Comparative work of the United States and Turkey [13-14]. For example, in a study; It is possible to come across studies on usage in different fields of artificial intelligence in the literature. In general, in different studies; The applicability of artificial intelligence in the field of food has been investigated [15]. In order in different studies; A literature search on the applicability of machine learning, which is a sub-branch of artificial intelligence, in the field of mechanical engineering was conducted. By creating mathematical programming, the stresses occurring in rotating cylinders and thermoplastic discs, discs with B4C (Boron carbide) material, Sic/6061 Al Alloy Composite discs and discs with different materials were investigated. A literature search on the

applicability of artificial intelligence in mechanical engineering was conducted. In a different study; Development of individualized education system with artificial intelligence fuzzy logic method has been investigated. In another study, the legal dimension of artificial intelligence was investigated by literature review [16-26].

Fundamental principles of cyber security: The concepts of confidentiality, accessibility and integrity can be called the "CIA triad" [27].
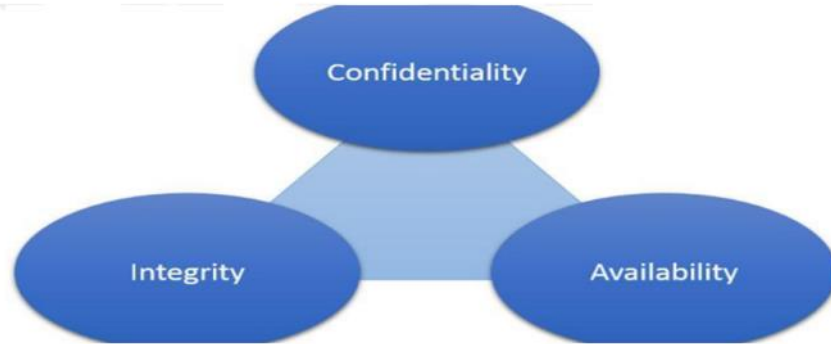


**Figure 3.** CIA Trio

**Results**

In this study, literature studies on the applicability of Artificial Intelligence in the field of cyber security were investigated. Cyber attackers can use a lot of software and code in cyberspace to commit cybercrime. It is thought that sub-branches of artificial intelligence can be used to analyze this software and codes. In the study, the definition of artificial intelligence was made and the applicability of academic studies in the field of cyber security was investigated. In the results of working; It is thought that cyber threats can be combated with programming created using artificial intelligence.

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# Analysis of stresses in rotating cylinders of silicon nitride (Si₃N₄) materials by mathematical modeling

**Hüseyin Fırat Kayıran** *1

¹ARDSI, Mersin Provincial Coordination Unit, Mersin, Türkiye, huseyinfiratkayiran@tkdk.gov.tr

**Keywords**
Rotating cylinder
Mathematical modeling
Silicon nitride

**Abstract**
Today, there are different studies on the study of the strength values of rotating cylindrical materials. It is known that materials show different properties according to temperatures. The behavior of disc and hollow cylinders, such as shafts, under different temperature conditions is being investigated by other academics. In this study, a rotating cylindrical material with Silicon nitride (Si3N4) material was modeled. The inner and outer semi-diameters of the cylinder are modeled as 40 mm and 120 mm, respectively. The angular velocity of the cylinder is w=100 rad/sec. The stresses obtained are shown with graphs.

## Introduction

Rotating cylinders can be used in all areas of machine parts. The behavior of rotating cylinders against different temperatures can vary according to temperature and ambient conditions. It is possible that you will come across different studies on this subject in the literature about disks. When the literature review was carried out on this subject; Radial stresses occurring in a disk rotating at a speed of 75 narrow / sec with Grade G4000 material were examined [1]. In different studies, however; Stress analyses were performed on disks with steel wire reinforced thermoplastic composite material, Boron-Carbide (B₄C) material, Sic/6061 Al Alloy Composite material and disks modeled in different sizes under different temperature conditions. The results obtained were compared with similar studies in the literature [2-6]. In a different study, a training data set was created through artificial intelligence fuzzy logic. In different studies, the stresses occurring in thin rotating cylinders under mechanical load were calculated [7-8].

## Material and Method

The material of the cylinder to be analyzed is Silicon nitride (Si₃N₄) selected from the appropriate material. Silicon nitride (Si₃N₄) mechanical properties are given in Table 1. The boundary layer on a rotating cylinder with axial flow is shown in Figure 1.

**Table 1.** Mechanical properties of cylinder material [10]

| Modulus of elasticity | w | Density | Cylinder Inner half diameter | Cylinder Outer semi-diameter |
|---|---|---|---|---|
| 470 GPa | 100 rad/sn | 3170 kg/m³ | 40 mm | 120 mm |
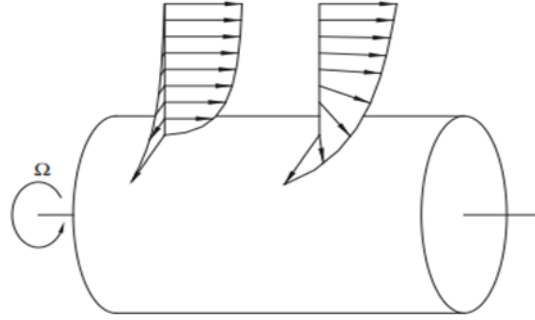
**Figure 1.** Boundary layer on a rotating cylinder with axial flow [11]

Two-dimensional equilibrium equation in cylindrical coordinates [12];

$$\frac{d(\sigma_r)}{dr} - \frac{1}{r}\frac{(d\tau_{r\theta})}{d\theta} + \frac{(\sigma_r - \sigma_\theta)}{r} + R = 0 \tag{1}$$

For the stress analysis equation in rotating cylinders;

$$r^2\frac{d^2F}{dr^2} + r\left[1 - r\frac{E'(r)}{E(r)}\frac{dF}{dr}\right] + \left[v(r)\frac{E'(r)}{E(r)} - 1\right]F = \rho(r)\omega^2 r^3\left[r\frac{E'(r)}{E(r)} - \frac{\rho'(r)}{\rho(r)} - 3 - -\frac{v}{1-v}\right] \tag{2}$$

$$\sigma_r = C_1 r^{(n+k-2)/2} + C_2 r^{(n-k-2)/2} + Ar^{(2+\gamma)} \tag{3}$$

$$\sigma_\theta \text{ (MPa)} = \frac{n+k}{2}C_1 r^{\frac{n+k-2}{2}} + \frac{n-k}{2}C_2 r^{\frac{n-k-2}{2}} + (3+\gamma)Ar^{(2+\gamma)} + \rho(r)\omega^2 r^2 \tag{4}$$

According to the formulas above; r=et transformation is performed, $E_0$, modulus of elasticity, $\rho_0$ density reference value, n and $\gamma$ are optional constants. C1 and C2 are integral constants. For boundary conditions;

**Results**

The radial stress, tangential stress and axial stresses that occur in a cylinder rotating at a speed of w=100 rad/sec with Silicon nitride ($Si^3N^4$) material are given in Figure 2-4.
In the previous study, the stresses occurring in the rotating cylinder with Gray Irons (Grade G4000) material were investigated [1]. Similar results have been obtained with this study. Due to the material change, it has been found that the stresses occurring in the cylinder with Silicon nitride ($Si_3N_4$) material are higher than Gray Irons (Grade G4000) material.
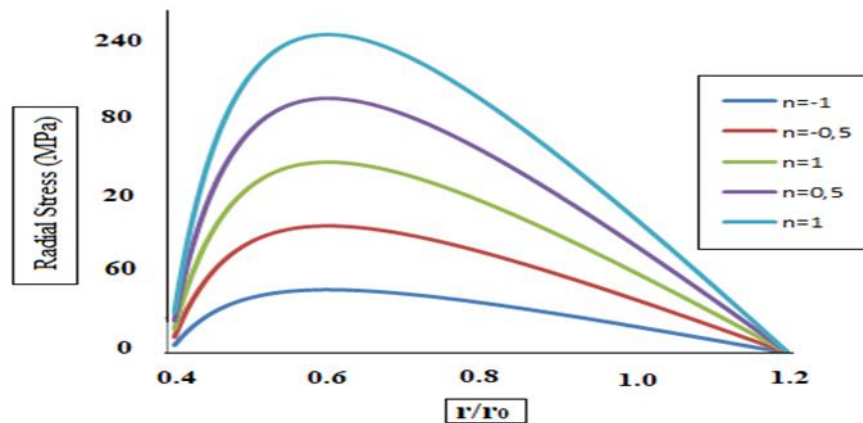


**Figure 2.** Radial stresses occurring in a cylinder rotating at a speed of w=100 rad/sec
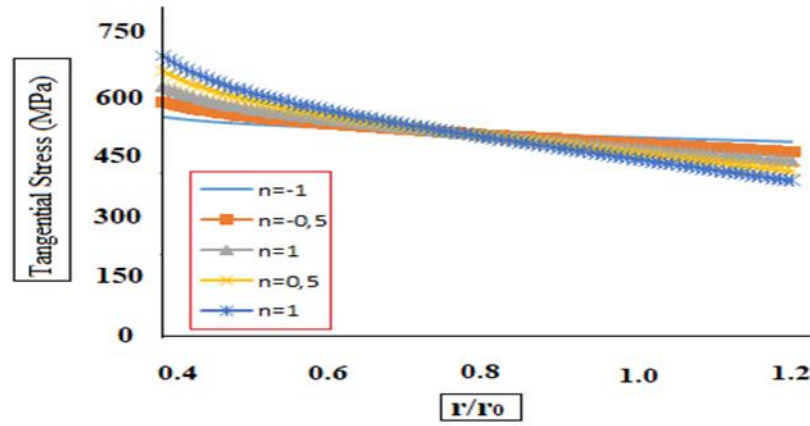
**Figure 3.** Tangential stresses occurring in a cylinder rotating at a speed of w=100 rad/sec
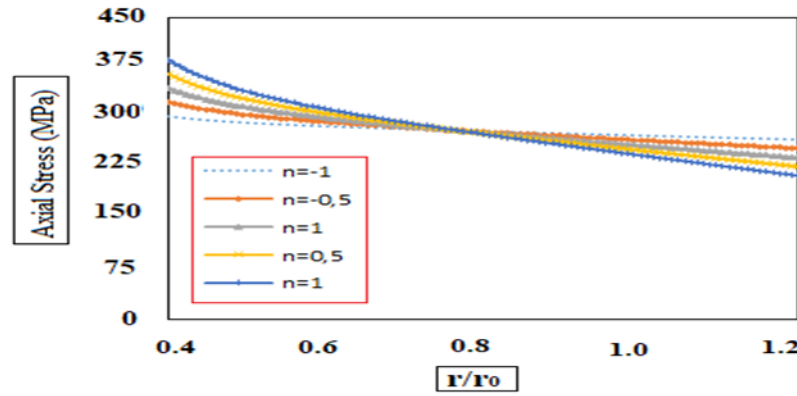


**Figure 4.** Axial stresses occurring in a cylinder rotating at a speed of w=100 rad/sec

## Conclusion

In this study, the stresses occurring in a cylinder with Silicon nitride ($Si_3N_4$) material rotating at a hungry speed of w=100 rad/sec were numerically investigated.

➢ Maximum radial stresses occurred in the central regions closer to the interior of the cylinder. It was observed that the tangential stress occurring in the cylinder is approximately 320% more than the axial stress.
➢ Radial stresses in the outermost and innermost parts of the cylinder are zero.
➢ The effect of stresses is inversely proportional to the increase in the n rating parameter.

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# An overview of solid-state pumps for industrial use

**Mehmet Ali Kurgun** *[1] , **Mehmet Emre Şahin** [1] , **İskender Özkul** [2]

[1]*Koluman Otomotiv Endüstri A.Ş., Mersin, Türkiye*
[2]*Mersin University, Faculty of Engineering, Department of Mechanical Engineering, Mersin, Türkiye, iskender@mersin.edu.tr*

**Keywords**
Solid-State pump
Hydraulic pump
Hydraulic
Piezoelectric

**Abstract**
In this study, research has been made on the production, working principle and materials of a hydraulic pump, which is environmentally friendly, cheaper than other hydraulic pumps, and uses piezoelectric actuators despite increasing environmental pollution. It has been seen that it is well ahead of its competitors in terms of weight, volume and energy.

## Introduction

According to recent research, there is a serious increase in environmental pollution. For this reason, it is extremely important for most companies that directly or indirectly interact with the environment to investigate the impact of the materials they produce on the environment. Studies to reduce carbon emissions are also based on this awareness. This is the main reason why companies adopt the philosophy of doing more with less energy. Due to these considerations, actuators made of solid state electroactive smart materials, which are expected to work even more efficiently, have been intensively studied. These smart material actuators have a positive impact on most industries that use aerospace and hydraulic based materials, starting with the biomedical fields.

Although it has many advantages, it is foreseen that it will be very useful due to its flexibility, strength as well as lightness and also simple working mechanisms. They have the potential to operate without noise and vibration with low power consumption. It is also possible to enlarge or reduce in size. The production methods are quite simple. They are also easily integrated into other devices.

Research on solid state pumps has been conducted in the last 20 years. Solid state pumps produce a pressure of 180 bar with very little energy consumption such as 24 V. Although the output pressure is lower than other pumps, if we compare the efficiency, it makes a serious difference compared to its competitors. In addition, a pump with this efficiency weighs only 0.73 kg. For this reason, if used, it will provide extremely important advantages compared to the vehicle in which it is used. In particular, since the weight will be reduced, it will reduce fuel consumption and significantly reduce the carbon emissions released into the air. For all these reasons, it is possible to say that solid state pumps are extremely environmentally friendly [1]. Said hydraulic pump is shown in Figure 1.



**Figure 1**. Solid State Pump [1]

**Material and Method**

Solid state pumps use piezomotors as energy source. These motors convert electrical energy into mechanical energy with the help of piezoelectric effect. The piezoelectric effect, which we can easily see on these motors, especially on magneto lighters, gives incredibly efficient results, especially in minimal sized mechanisms. Although the principle is the same, in the lighter system, mechanical energy is converted into electrical energy [2]. The mentioned mechanism is clearly seen in Figure 2.
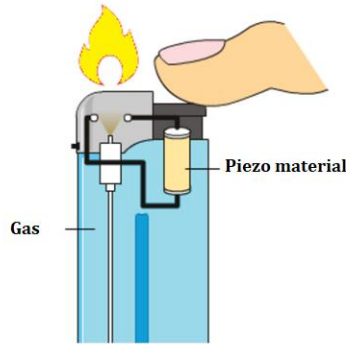


**Figure 2**. Magneto Lighter [2]

During the expansion stroke, the actuator pressurizes the pump chamber using part of its stroke to tolerate fluid mismatches. The actuator expands by pumping fluid through the dispense valve towards the outlet side. Just before it intersects the load line, the actuator only performs about half of the free kick. The actuator then goes into the retracting state, causing the pressure in the pumping chamber to drop. Afterwards, it allows the liquid to enter the pumping chamber through the inlet valve and the desired pressure value is obtained. Finally, unloading of the actuator takes place, which causes the displacement to return to its starting point. Then, the actuator is energized for cycle repetition [3]. During all these events, as a result of the back-and-forth movement of the actuator located in the middle of the system, fluid absorption is realized. The absorbed liquid is pumped at high pressure as a result of the compression of the engine. Therefore, the desired pressure levels are easily reached. The mentioned cycle event is clearly seen in Figure 3.
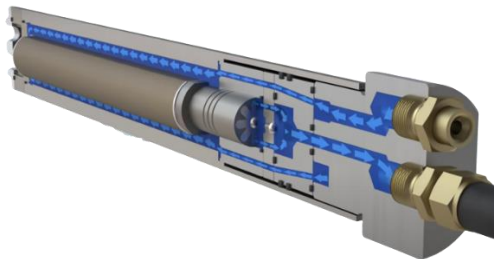


**Figure 3**. Solid State Pump Cycle [1]

Piezomotors, which are used as power sources in solid state pumps, are a device that can be used for various precision applications in many different fields. The main purpose of piezomotors is to produce motion based on small deformations of a material when an electric current is applied [4-5]. Piezomotors convert electrical energy into mechanical energy by using the magnetic movements of the piezolegs. Piezobes need to create a magnetic field against the electric current. Therefore, the materials of the piezolegs are very important. Its main materials are ceramics consisting of Lead Zirconate Titanate, Quartz, Tourmaline Barium Titanate, Zinc Oxide, Polyvinylidene chloride. The most preferred material is Lead Zirconate Titanate. It is possible to process these ceramics, which are in powder form and in certain shapes, to bring them into relevant shapes. The virtual model of piezolegs is shown in Figure 4.
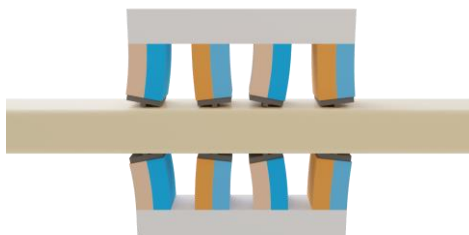


**Figure 4**. Piezolegs [6]

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Actuators to be preferred for using pumps can be composed of composite materials or smart materials. In addition, the material may differ in shape and dimensions. The strain produced by their parties can affect the volumes they pump per revolution and their stress, as well as the pressure heights. The work done on the unit weight of the liquid transferred from the inlet to the outlet on the pump is called pressure. Actuators, which are the main parts of pumps, directly affect the pump performance due to their excitation voltages (U), frequencies (f) and the fluids they operate. The main characterization of pumps is their performance. Solid state pumps, on the other hand, give very good results compared to their competitors when considered in terms of performance/efficiency.

**Smart Materials Actuator Used in Solid State Pumps**

Solid state pumps using smart materials are differentiated according to smart material actuators driving the pumps. To date, unidirectional shape memory alloy (U-SMA), piezoelectric ceramic (PEC), dielectric elastomer (DE), ferroelectric polymer (FEP), ionic polymer metal composite (IPMC) and conductive polymer (CP) based actuators are used.

**U-SMA (Unidirectional Shape Memory Alloy) Actuators**

U-SMA actuators consist of (Ni)-(Ti) alloys. These actuators exhibit unidirectional shrinkage when transitioning from the low-temperature martensitic phase to the high-temperature austenitic phase. U-SMA actuators are adaptable to sheet, wire and springs. These may be biased to induce bidirectional movements.

However, U-SMA unimorphs can also be used, which exhibit bidirectional unidirectional bending without the need for greater prestressing. U-SMAs require voltages around 5 V and their full duty cycle can be limited to low operating frequencies as they require passive restoration to cool from high temperature austenite phases to low temperature martensite phases. However, these times can be reduced by active cooling or by using films that have a large surface-to-volume ratio and can therefore dissipate heat quickly. The latter can operate at frequencies up to 100 Hz [7].

**PEC (Piezoelectric Ceramic) Actuators**

Zinc oxide (ZnO) and lead zirconate titanate (PZT) crystals are common smart materials. Gold (Au), chrome (Cr), platinum (Pt) etc. metal electrodes can be applied to PECs. PECs contain fields with electric dipoles of similar orientation. Due to the piezoelectric effect, in voltage applications, the smart material expands when the direction of the electric field is opposite to the polarity of the retained electric dipoles when the voltages are removed. When it is reversed, it contracts. PEC actuators can be discs, rings, plates, or single crystals with electrodes formed as sheets. Lightweight piezo-composite curved actuators (LIPCAs) are uniform structures produced by bonding a pre-stressed PEC layer electroded on one side to a fiber-reinforced epoxy layer on the other side to generate high forces and displacements [9]. PECs cause voltages greater than 100 MPa and can have extremely high bandwidths of up to 10 MHz. Hard rated PZTs generate extremely small voltages of 0.1% for excitation voltages in the kV range. Soft PZTs exhibit 2-10% strains up to 150 V [8-9].

**DE (Dielectric Elastomer) Actuators**

DE actuators are three layers with electrodes such as PDMS, Silastic or NuSil or acrylic like film. Dielectric membranes are generally prestressed to obtain optimum operating properties; therefore, axial constraints are necessary. Conventional electrodes for DEs are graphite or carbon (C) based. When the electrodes of the DE are positively and negatively charged due to Coulomb forces by applying a voltage difference, the DEs expand unidirectionally in the plane. Smart materials relax to their original state when voltages are removed [10]. DE actuators may consist of a single film or multiple films stacked or wound together [11]. DEs require high voltages for operation in the 100 kV range (close to the dielectric breaking strength of polymers). Bandwidth is high for silicon-based DEs, 1400 Hz and 10 Hz for VHB-based. Working stresses are up to 5 MPa and strains are typically 10-30% [12]. However, DEs can also exhibit large deformation of the order of $\varepsilon$ = 1.692 % due to electromechanical instability or the 'transition' phenomenon [13] that occurs under a combination of electro-mechanical loadings [14]. This was initially reported to be an irreversible process [13], but has recently been shown to be reversible [15,16].

**FEP (Ferroelectric Polymer) Actuators**

The most common types of FEP are polyvinylidene fluoride (PVDF or PVF2) - trifluoroethylene (TrFE) copolymers. Relaxor FEP loses its advanced properties due to defects in its structure. These can be induced by pre-stretching, irradiation with electrons, or combining the two techniques. The applied electrodes are usually metals

such as Al, Cr or Au. Ferroelectric is a type of piezoelectric. P(VDF-TrFE) exhibits bidirectional expansion and contraction when voltage is applied. P(VDF-TrFE) FEPs are generally single layer actuators or membranes that can be used as stacked. They can also be included in unimorphs. P(VDF-TrFE) actuators require high electric fields of 150 MV/mand voltages > 1 kV for voltages of 3.5-7%. They also exhibit high voltages up to 45 MPa and can operate in a wide frequency range up to 100 Hz [7].

**IPMC (Ionic Polymer Metal Composite) Actuators**

IPMC actuators are three layers, mostly consisting of a Nafion ionomer and two Pt electrodes on both sides. IPMCs based on the former produce large forces and fast responses, and those based on the latter produce large deformations and slow responses. IPMCs generally work in water, but they can also work with liquid salts as dehydration can occur and adversely affect their starting properties. When voltage is applied to water-powered Nafion-based IPMCs, the actuators exhibit bidirectional bending upon a change of polarity of the applied voltage due to migration of hydrated ions. IPMCs are typically based on single membranes of Nafion. They are usually consoles, but they can also be fixed perimetrically, bulging when operated [17-21].

**CP (Conductive Polymer) Actuators**

CP actuators consist of a CP called a working electrode, a counter electrode, which is usually also a CP, and an electrolyte, which can be solid or liquid. The most common example of CP is Polypyrrole (PPy). When voltage is applied to these actuators, the CPs exhibit bidirectional activation. CP actuators are generally film-based and uniform actuators are most common. PPy actuators require 2–35% voltage and 1–3 V undervoltage for voltages up to 34 MPa. Also, frequency responses can reach several Hz [20,21].

**Conclusion**

As a result of the researches, solid state pumps that can produce pressure values close to the same levels by using less energy consumed by existing hydraulic pumps have been examined. When the efficiency comparison is made, it is concluded that its use will be more advantageous in terms of both energy consumption and volume. In the tests carried out, certain pressures were reached. It has been observed that even if the pressures reached are not at very high levels, they can be used up to 180 bar. It is clearly seen that it will provide many advantages in terms of energy and weight savings, especially if it is used in hydraulic circuits where there is no need for very high pressure. In addition, due to all these reasons, it will reduce fuel consumption and thus contribute significantly to reducing carbon emissions.

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# Recent CO₂ capture and storage technologies and usage areas

## Ece Kalay *1 ![ORCID], İskender Özkul 2 ![ORCID]

¹Mersin University, Institute of Science and Technology, Mersin, Türkiye, eecekalay@gmail.com
²Mersin University, Engineering Faculty, Mechanical Engineering Department, Mersin, Türkiye, iskender@mersin.edu.tr

**Keywords**
CO₂ capture
Global warming
Greenhouse gases
CO₂ storage

**Abstract**
Due to the increase in energy consumption, the increase in greenhouse gas emissions to the atmosphere day by day leads to global climate change. Global climate change means not only a slow rise in average temperature, but also a change in the way the earth system works. Carbon dioxide has the highest impact on this change with a share of 82%. Even a very small change in the carbon dioxide ratio affects the balance of the atmosphere. Reducing $CO_2$ emissions plays an important role in maintaining the atmosphere balance. In this study, the working principle, current status and use in industry of $CO_2$ capture and storage technologies developed to reduce $CO_2$ emissions are included.

## Introduction

85% of human-produced $CO_2$ is released into the atmosphere as a result of burning fossil fuels such as oil, natural gas and coal. As the greenhouse gases ($CO_2$, $CH_4$, $N_2O$, $O_3$, chlorofluorocarbons, hydrofluorocarbons) in the atmosphere increase, the heat of the Sun is trapped in the atmosphere and causes global warming. For this reason, controlling greenhouse gas emissions has become an important issue in maintaining the atmosphere balance.

Carbon dioxide is the gas that has the biggest impact with a share of 82% among the greenhouse gases. In 2020, a new record was set for atmospheric $CO_2$ at 413 parts per million (ppm). This data shows that there has been an increase of approximately 12% since 2000. 413 parts per million may seem small, but even these levels are large enough to significantly increase global climate change. For this reason, countries are developing technologies to control $CO_2$ emissions with various technologies [1].

Related to the subject, various studies have been carried out on increasing fuel conversions, increasing energy savings, waste management and environmental protection. These studies mostly focused on keeping $CO_2$ at a certain rate. Today, in parallel with the developing technology, studies on the separation of carbon dioxide from the air or its storage in different material forms come to the fore. It is possible to trap the carbon dioxide in a mass and release it underground, or to separate the air by passing it through carbon dioxide-scavenging chemical liquids. These two methods are very effective in reducing the $CO_2$ rate. On the other hand, the use of $CO_2$ in the production of methanol, a biofuel, or its storage by pumping it into underground oil and natural gas deposits, are also effective in reducing carbon dioxide emissions into the atmosphere [2].

## CO₂ capture and storage technologies

Carbon dioxide capture and storage technologies ($CO_2CS$) are a low-carbon technology that prevents carbon dioxide from large point sources, such as industrial plants using fossil fuels or biomass, from entering the atmosphere. It consists of the stages of capture, transportation, use or storage. Carbon dioxide originating from industrial facilities such as iron and steel, electricity production, cement, fertilizer and chemical production is captured by these systems. There are three main ways to capture $CO_2$: pre-combustion, post-combustion and oxy-fuel combustion. More than 93% of carbon dioxide can be captured with these methods. Other technologies include membrane capture and calcium cycling. Commonly used capture technologies are chemical absorption and

adsorption. The most efficient capture technologies are selected depending on many factors such as the composition and concentration of the flue gas, flow rate, operating pressure, temperature and cost. Captured carbon dioxide is compressed at high pressures and transported to the appropriate storage area or facility. Transport is done by pipelines and ships [3].

$CO_2$ is permanently isolated from the Earth's atmospheric carbon cycle, typically by injecting it several thousand meters (0.8-2 km) deep into a carefully selected geological reservoir, such as a depleted oil and gas field or brine aquifer. In addition, carbon dioxide can be used for an industrial purpose. The vast majority of captured $CO_2$ is used by oil companies. It also has many potential uses, such as being used as a raw material for the production of chemicals, building materials and fuels, or in the production of aviation fuel. The technique of converting $CO_2$ into useful chemicals (methane, methanol, ethanol, etc.) with the molecular conversion technique has been given great importance in recent years. In the electrochemical reduction method of $CO_2$, the fact that the studies can also be carried out with completely renewable electrical energy makes this process more advantageous [4].

**Importance of $CO_2$ Capture and Storage Systems in Industry**

In scenarios that limit global warming to 1.5°C, it is estimated that industry-sourced $CO_2$ emissions, which are currently 8 Gt per year, should be approximately 65-80% lower in 2050 compared to 2010. It is aimed to prevent about 60 Gt of $CO_2$ emissions by 2050 from heavy industries such as iron and steel, cement and chemistry, which are responsible for approximately 70% of $CO_2$ emissions, which will be jointly led by Austria and Australia. It does not seem possible to achieve this emission reduction with energy and process efficiency or renewable energy options. This goal can only be achieved through combinations of new and existing technologies, including electrification, hydrogen, sustainable bio-based raw materials, product substitution, carbon reduction, carbon capture and storage [5].

**Conclusion**

One of the main reasons why carbon capture technologies have not yet been widely adopted is the complexity and costs of these operations, which currently cannot be offset by the cost of carbon dioxide emissions. This is a particular problem for industries such as the cement industry, as the cost of carbon capture nearly doubles production costs. It is foreseen that technologies such as Carbon Capture Storage, Bioenergy and Direct Air Capture will be adopted in order to balance the emissions that cannot be eliminated from other sectors. In addition to the storage of $CO_2$ captured with these technologies, it is planned to be used in the production of synthetic fuel for use in aviation [5].

Although carbon capture and carbon sequestration techniques are extremely expensive in current conditions, it is thought that the costs can be reduced over time as a result of the studies. By the middle of this century, it is possible that carbon dioxide will be cleaned in fossil fuel thermal power plants by using new generation carbon dioxide capture and capture technologies and their costs will decrease to appropriate levels. Despite these developments, investments in renewable nature-friendly energy sources are considered to be the best solution and the most appropriate method for reducing global warming.

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# Comparison of frequently used satellite propulsion systems at a quick glance

**Yasin Kızılgün** *[1] , **İskender Özkul** [1]

[1]Mersin University, Mechanical Engineering Department, Türkiye, yasinemre1999@gmail.com, iskender@mersin.edu.tr

**Keywords**
Electrical thrust systems
Ion propulsion
Hall effect propulsion
Motion in space

**Abstract**
In this paper, the motions and positioning of satellite systems in space and orbits, the preferred methods and the comparison of these methods with each other are given. These methods include evacuating a spacecraft or satellite from the Earth's atmosphere and gravity and placing it in the desired orbit, and new generation propulsion systems that have the potential to be used in space travel. Basically, to take an equipment or vehicle out of the atmosphere, an escape velocity must be reached, to reach this velocity a thrust is required. The system and fuel types required to provide this thrust are determined and explained. The systems required for propulsion are classified as chemical propulsion systems, nuclear propulsion systems and electric propulsion systems. Studies and developments related to satellite propulsion systems are given in accordance with the literature.

## Introduction

As humanity, we have always had an interest in space. As a result of the studies carried out with the idea of going out of the atmosphere or traveling in interplanetary space, various successes were recorded and in 1957, the Sputnik spacecraft was the first artificial satellite sent to space. Then, cosmonaut Yuri Gagarin became the first human to go into space. As a result of these developments, it has been seen that going to space is an achievable goal, and studies in this field have begun to be given importance. The 'Moon voyage', the first manned voyage to space, was carried out in 1969 with the Apollo project, with the team of Neil Armstrong, Buzz Aldrin and Michael Collins. Today, studies in this field, which can be diversified by using new generation propulsion systems, aim to reach Mars and farther planets, and to facilitate people's lives with satellites to be placed in Earth orbit. In these studies, from the past to the present, in order for the spacecraft to exit the atmosphere, it must be pushed with a force in the opposite direction to gravity, and it must rise and break its relationship with gravity. If the launch object is an artificial satellite, it must be positioned in orbit to fulfill its mission. This spacecraft must reach an escape velocity of 11.2 kilometers per second to exit Earth. The necessary thrust to reach such a speed is obtained by converting chemical, nuclear and electrical energies into kinetic energy. The propulsion systems are Newton's third law; It works on the principle that when one object exerts a force on another object, the second object exerts an equal and opposite force to the first, forcing the object to move in the opposite direction [1].

In chemical propulsion systems, ignition is made by mixing fuel and oxygen under suitable conditions in a solid propellant rocket. It is formed by the high temperature that occurs during this time. Exhaust gases resulting from combustion are thrown out at high speed and propulsion is provided. Our disadvantage in this method is that fuel and oxygen required for combustion are added on top of the weight of the spacecraft, so the amount of energy required for movement increases [2].

Although nuclear propulsion systems are a system that can produce more energy with less mass, this type of nuclear rockets has the risk of radiation leakage. Its use has been suspended, since the nuclear explosion effect that will be carried out in the atmosphere during take-offs on Earth will be devastating.

Electric propulsion systems offer a newer understanding than other methods, and these system technologies will be examined as electrostatic (grid) ion motors and Hall effect propulsion motors. They were first tested by placing them on SERT-I and SERT-II satellites built in 1964 and 1970, the engines worked for 2011 and 3781 hours, showing much higher fuel efficiency than other propulsion systems in this area and attracted the attention of researchers. The purpose of propulsion systems is to manage the speed and direction of the vehicle as desired. Since long-term thrust is required instead of high thrust in non-orbital journeys, the number of researches involving electric propulsion systems is increasing today [3].

**Propulsion Systems**

The main limiting factor in out-of-orbit travel is the need for propulsion. We have to wait since the planetary alignments used to reduce this need and the Hohmann intervals that facilitate the transitions between orbits are not continuous. Developing technology aims to enable us to use electric propulsion systems and to become suitable for traveling without waiting for these intervals. In electric propulsion systems, according to the way electric motors generate power; It is divided into three basic groups as electrostatic, electrothermal and electromagnetic propellants [4].

**Electrostatic Propulsion Systems**

Electrostatic repellent has emerged by designing the impulse that arises with the force that occurs in the opposite direction when ions are accelerated by electric charge and thrown out over the grids, based on Newton's third law, the principle of conservation of momentum. They use less fuel compared to chemical rockets and solar panels are used as a power source to obtain the required ionization energy. However, this situation is seen as a disadvantage in tasks that cannot benefit from the sun's rays. Mercury was used as a fuel in engines in the first years. However, since the amount of harmful toxic waste is high, the use of xenon, argon, iodine and krypton has become widespread. Xenon, which is one of the fuels, is a type of fuel that can be easily ionized with a high atomic number and high efficiency.

In grid ion propulsion engines, high energy electrons are obtained by heating the cathode with the energy taken from the solar panels. These electrons are given to the mixing chamber, and then the xenon atoms in the fuel tank are sprayed into the mixing chamber for ionization to occur. The heated high-energy electrons collide with the xenons, forming positively charged ions. The positively and negatively charged electrodes inside the tank accelerate the ions by separating them from the plasma. When the ions are ejected at their current velocity, they create a thrust. In such thrusters, the average power is 5 kW, the exhaust output speed is 30 km/h and the thrust force is 120 millinewtons. They work with about 70% efficiency. While the fuel consumption is low and the continuous thrust is an advantage, the low thrust force is a disadvantage for the long journeys to be made with this type of engine. Developments continued after Deep Space 1, Hayabusa and Dawn using this propulsion system. Today, NASA has achieved a working time of 48000 hours with 870 kg of fuel with the Evolutionary Xenon Thruster Project [3].

**Electrothermal Propulsions**

Electrothermal thrusters use plasma to heat the fuel. They direct the energy of the heated fuel to an injector, converting it into kinetic energy and providing thrust. These systems, in which hydrogen, helium and ammonia are used as fuel, are also considered rockets. These systems, which started to be used with Meteor-3 in 1971, are also used in A2100 satellites and Aerojet MR-510 series rockets [5].

**Electromagnetic Propulsions**

Electromagnetic thrusters do not require the use of electrodes, which is an advantage that reduces the number of consumable materials. Plasma formation is provided by electromagnetic fields and the resulting plasma is accelerated and sprayed. They work by a principle called the Hall effect. In 1879, Edwin Hall discovered in his study that when a conductor, in which an electric current is passed, is exposed to a magnetic field perpendicular to it, the electrons carried in the conductor are affected by the magnetic field, creating polarization and creating an electrical potential difference. In Hall effect motors, the potential difference between the negatively charged cathode and the positively charged anode creates an electric field. High-energy electrons are released by heating the cathode. Energetic electrons are exposed to the electric field and move towards the positively charged anode in the plasma chamber [6].

Electrons in the chamber begin to rotate around the cylindrical center, then xenon atoms are sent to the chamber as fuel. After the collision, electrons are ejected from xenons and plasma is formed from positively charged ions. The positively charged ions are ejected by moving outward by being caught in the electric field and

create a thrust. This method is used to provide propulsion for Hayabusa 2 and TURKSAT 6A satellites. There are also different methods such as MPD (Magnetoplasmadynamic) that uses the Lorentz force for high velocities and works with the behavior of charged particles in a magnetic field. However, the use of solar panels as a power source is insufficient to obtain such impulses. Nuclear energy is needed as an alternative, and research on the subject continues [7].

## Results

Sample data and research results of spacecrafts in various satellite propulsion systems are given in Table 1. Magnetoplasma dynamic propellant is considered suitable for manned space travel compared to another spacecraft. For maintenance, research and service missions, grate ion propulsion engines and hall-effect spacecraft come to the fore.

**Table 1.** Effective values in different satellite propulsion systems [1]

| Method | Active Material Output Velocity (km/s) | Thrust (N) | Ignition Delay |
|---|---|---|---|
| Solid-fuel rocket | 1 | $<10^7$ | minute |
| NSTAR motor | 30 | 0,09 | hour |
| Arcjet system | 10 | 10 | minute |
| Hall effect thrust | 30 | 0,08 | month |
| Magnetoplasmadynamics propulsion (MPD) | 60 | 100 | week |

## Conclusion

Traveling to different planets and providing data and communication flow with satellites orbiting the Earth have become an accomplished reality, rather than a dream for humanity. Manned journeys to Mars are planned in the near future with the new generation spacecraft, in which nuclear powered propulsion systems and electric propulsion systems will be used together with scientific studies to approach our goals [8].

Work continues in Turkey for satellite systems. Under the leadership of TUBITAK UZAY, Hale continues its research on the propulsion engine. Since 2014, our country has been strengthening its position in the sector with the TURKSAT 6A satellite, which was developed in the laboratory in the TUBITAK UZAY campus.

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# Comparisons of different deep convolutional neural network and machine learning based methods on gearbox fault diagnosis using small dataset

**Zakaria Miloudi*[1] , Aoul Elias Hadjadj [1]**

[1]Badji Mokhtar University, B.P.12, Annaba, 23000, Algeria; Za_Miloudi@enst.dz

**Keywords**
Gearbox
Deep learning
Convolutions neural network
Feature learning
Vibration signals
Mechanical diagnosis

**Abstract**
Modern industry prioritizes condition monitoring and problem diagnostics due to safety and quality standards. Modern gearboxes, one of the most common components, break under intense operating conditions and require problem detection. Vector assessment and vibration signal analysis have successfully used deep learning to extract representative information and sensitive features from raw data to diagnose gearbox faults. Deep learning for mechanical diagnostics is relatively restricted, and few research have compared feature learning with varied data sources. This study uses vibration signal temporal data to train a convolutional neural network (CNN) using multiple architectures. UoC gearbox data verifies the technique against seven typical intelligent ways. Adaptive learning from temporal data enhances diagnostic accuracy.

## Introduction

In this paper, we used End-to-end stacked CNN with several architectures to learn features using limited time do-main data, raw time and frequency of the data, and identify gearbox health issues. We designed multiple CNN model architectures with different hyper-parameters to find the best model combination. As comparisons, used angle-frequency domain synchronous analysis (AFS) (Huang HB) [1] followed by Support Vector Machine (SVM) classification and six intelligent approaches: SVM with RBF Kernel, Multi-Layer Perceptron (MLP), K-Nearest Neighbors (K-NN), Logistic Regression, and random forest (RF). The selection of several critical CNN parameters is described, and the performance of the proposed approach and CNN detection results with different configurations are compared in experiments.

## Material and Method

This section describes the suggested gear failure diagnosis approach. which may be separated into three parts: first, the raw time-domain vibration data was received from the University of Connecticut gear fault datasets, which were recorded at 20 kHz. The input shaft pinions were examined for nine gear conditions, including healthy, missing tooth, root fracture, spalling, and chipping tip, each with five severity degrees. The vibration signal is directly fed into the enhanced CNN model for back-propagation training. All datasets were divided into nine categories (one health status and eight fault states) to assess performance. Second, our trained CNN extracts representative features from fresh defect raw data. The second comparative method is angle-frequency domain synchronous analysis (AFS) [2] followed by Support Vector Machine (SVM) classification of dense representative feature vectors.

Gearboxes may fail in several ways. Vibration signals from such a system indicate system health. This research uses a 2-stage gearbox with interchangeable gears [3].

Motors control gear speed. A magnetic brake's input voltage controls torque. 32-tooth pinion and 80-tooth gear on the first stage intake shaft. The second stage has a 48-toos pinion and 64-too gear. Gear vibration signaling monitors an accelerometer, while a tachometer measures input shaft speed. dSPACE can sample signals at 20 KHz (DS1006 Processor Board, dSPACE Inc., Wixom

As noted in Section above, each gear situation creates 208 vibration signals. In the input shaft, 9 gear defects—health, missing tooth, root fracture, spalling, and chip tips with five severity degrees are delivered to the pinion. Dynamic responses of a gear-driven angle-periodic system. The transmission system's spinning speed is expected to be constant since it's transient. Due to load disturbances, geometry tolerances, and motor control errors, this assumption is frequently wrong. Vibration signals in the original time domain are converted from time to angle with an equal angular increase in this study.

The University of Connecticut (UoC) [4] Gear one-dimensional original vibration data set was used to assess the one-dimensional-CNN. The dataset has 936 samples, but in our study, 208 signals are generated using the gearbox system for each gear condition. In the period of 4 gear rotations, 1872 angle-even samples are collected for each signal, corresponding to half of the original. To achieve the highest train and test accuracy, the first 208 samples are healthy, 209th - 313th samples are missing, and etc. Therefore, each sample is a tensor of (1872x1x3) dimension and the input tensor for each heal.
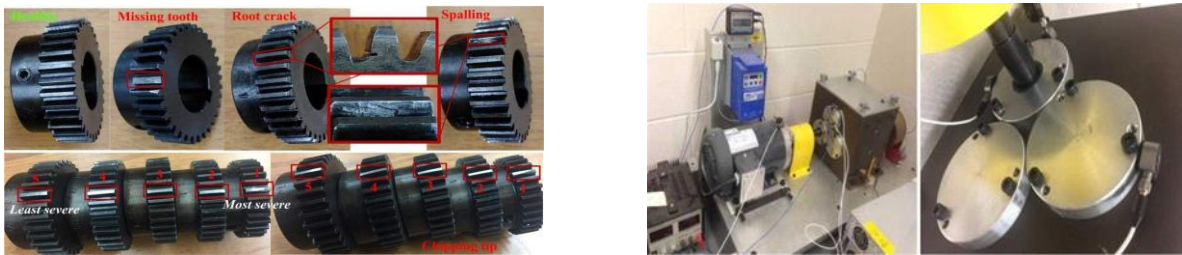


**Figure 1.** Experimental study gearbox

**Results and Discussion**

1. The case study findings in Table 1 demonstrate that the proposed method is successful at diagnosing gearbox problems, with the best testing accuracies of 100 percent and validation of 100 percent in this context. According to the experimental findings of CNN with different configurations, CNN with more layers has higher accuracy and a more stable outcome than CNN with fewer layers. In general, a bigger segment size can supply more specific information to CNN than a smaller one. However, increasing the segment size reduces the amount of data segments, which may have a detrimental impact on CNN training. As a consequence, segment size 1872 yields the best results. Although pooling may result in the loss of local information, in our situation, CNN with two pooling layers outperforms CNN with one pooling layer.
2. In comparison to AFS-SVM, the proposed approach not only outperforms it in terms of performance, but it also requires no pre-processing effort, time domain analysis in this case, making the proposed approach more unbiased in feature extraction and more easily applicable to other fault diagnosis practices. The proposed technique also yields excellent results in terms of robustness.
3. When comparing the performance of feature learning with manual feature extraction, feature learning with CNN produces much better results than manual feature extraction using Machine learning, with an increase in testing accuracy of roughly 10%. This outcome is highly associated with CNN's unique design, which can automatically extract representative information from raw data layer by layer and produce usable features in higher layers for classification. This benefit of CNN not only lowers the requirement for human labor and prior knowledge of signal processing and diagnostic methodologies for feature extraction, but it also adaptively adapts the learnt features to handle various fault diagnosis challenges.
4. While CNN performs better with feature learning, all of the models examined, including AFS-SVM, MLP, SVM, K- NN, LR, RF, and GNB, perform similarly with manual features. Table 4 clearly shows that End-to-end stacked CNN produces higher testing and validation accuracies than other comparison models for the same data type. However, when using manual features, all of the models show identical accuracies, indicating that CNN cannot produce much greater gains in defect identification than traditional approaches without the capacity to learn features.

**Table 1.** Classification results

| Gear fault Diagnosis Method | Training Acc % | Testing Acc % |
|---|---|---|
| End-to-end stacked CNN (our model) | 100 | 100 |
| Learning features + AFS-SVM | 87.48 | 86.57 |
| manual feature + (SVM) with RBF Kernel | 93.12 | 91.47 |
| manual feature + (MLP) | 96.33 | 96.27 |
| manual feature + (K-NN) | 91.52 | 81.60 |
| manual feature + Random Forest | 94.52 | 94.13 |
| manual feature + Logistic Regression | 68.74 | 70.40 |
| manual feature + Gaussian Naive Bayes | 93.79 | 94.40 |

**Conclusion**

This paper develops a One-Dimensional deep Convolutional Neural Network for deep feature extraction and Gear defect Classification. The suggested solution uses less data than AFS-SVM and machine learning and enables free adaptive feature extractions. The proposed End-To-End Convolutional Neural Network architecture has two sections: a pre-trained deep neural network that automatically extracts features from the input, and a fully connected stage for classification that must be trained. The UoC [5] datasets with Raw time data were used to validate the method, which achieved 100% accuracy with a small error rate. Finally, we compared it with AFS-SVM [6] and the most prominent machine learning methods for gear defect classification (Support Vector Machine, Multi-Layer Perceptron, K-Nearest Neighbors, Random Forest, Logistic Regression, and Gaussian Naive Bayes) using frequency domain training and testing data. Statistical feature extraction methods extracted meaningful characteristics from frequency domain data. Training and Testing Accuracy on performance measures of applicable ML algorithms is compared.

MLP (Multi-Layer Perceptron) had the maximum accuracy of 96.27 percent for dataset diagnosis of gear faults. It would be fascinating to identify faults in various gear defects with huge datasets and varied difficulties. Experiments demonstrate that the proposed method can learn characteristics and recognize gearboxes with various faults. Compared to manual feature extraction, the recommended method increases classification accuracy by 10% with less technical expertise and effort. At the same time, our model gets the maximum accuracy with Raw time domain data across all data sources, suggesting that the CNN model is better suited to learn features from vibration data in time domain, as shown in CNN-based vibration analysis. Deep learning for mechanical defect diagnoses is untested. Understanding deep learning generalization is crucial for future research.

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# Industry 4.0: Key features, adoption, and barriers

**Ramesh Rudrapati** *1 , **Perumalla Janaki Ramulu** 2 , **Nikhil Kumar** 3

*1Bule Hora University, Industrial Engineering Department, Ethiopia, rameshrudrapati@gmail.com*
*2Adama Science & Technology University, Mechanical Engineering Department, Ethiopia, perumalla.janaki@astu.edu.et*
*3University of Warwick, Warwick Manufacturing Group, WMG, UK, nikhil.kumar@warwick.ac.uk*

| Keywords | Abstract |
|---|---|
| Industry 4.0<br>Adoption of I4.0<br>Barriers of I4.0<br>Smart Manufacturing<br>Smart products | Industry 4.0 (I4.0), which has captured the attention of many industrialists, governments, and institutions since its publication in 2011 has led to digital transformation. Digitization and integration are central to I4.0, which involves the entire product life cycle. I4.0 focuses mainly on the development of smart manufacturing by utilizing innovative technologies in order to develop smart products. Businesses in the 21st century need I4.0 to survive. In this study, the basic features of I4.0 are presented and the various barriers to implementing it are described. The study concludes with a few observations based on the findings of the research. |

## Introduction

The fourth industrial revolution is the result of innovative technologies being integrated into production environments. The cyber-physical systems and the industrial internet of things are important components of Industry 4.0 (I4.0) that connect types of machinery, devices, workforce, and enterprise platforms [1]. Different enabled technologies are expected to enhance the quality of parts and various services offered by business firms autonomously under dynamic environments [2]. Sustainable performance with the use of available resources is one of the essential features of I4.0. The I4.0 concept is basically invented to create a strong interaction base among human – systems/services in production environments to improve the working atmosphere and thereby increase the quality standards of parts produced [3].

The I4.0 systems may help improve manufacturing firms' agility to produce smart products by integrating various production machines with autonomous decision-making resources. The I4.0 approach make autonomous interest among industrialists around the globe to reach customers with the best possible quality products. This is made possible with the use of information technology, computer, and electronic systems in the production and service sectors. With I4.0 technologies like digitalization and high-level automation, factories become flexible and intelligent in dynamic working environments by equipping sensors and objects. The main goal of the I4.0 methodology is to produce a variety of products flexibly at high production rates with reduced costs and wastage.

The I4.0 initiative is new, and its adoption is not the same in different countries geographically due to a lack of appropriate information. Some developed nations like Germany, the USA, Japan, China, and Europe countries have adopted and implemented the I4.0 approach in their manufacturing firms and progressing to obtain the best possible results from it. Economically and socially backward or developing Nations like India, the Middle East, and African Nations have been negatively affected because of high levels of technologies, cost, and low levels of information. There is an argument that the gap between developed and developing Nations has constantly increased to the adoption and implementation of the I4.0 ideology. From the major research databases, it is understood that investigators are trying to provide information about the adoption and execution of I4.0 principles. The present work is an attempt to discuss the key features and barriers to the understanding of the I4.0 philosophy and implement it effectively and efficiently.

**The main features of I4.0 paradigm**

The term Industry 4.0 can be expressed in several ways and can be explained as the combination of various emerging concepts and main components that compose I4.0 [2], such as artificial intelligence, big data, autonomous robotics, cloud computing, simulation, augmented reality, and Internet of Things. By transforming centralized and analog workflows into decentralized and digital manufacturing operations through the use of advanced technologies found in I4.0, the potential for restructuring all production systems is vastly improved. The main features of I4.0 are described as follows [4-5]:

**i. Industrial internet of things (IoT):** The IoT is a communication network that allows interconnected computer systems to communicate with each other and provide a worldwide service to users by connecting to the Internet and is becoming extraordinarily necessary for a wide variety of modern applications.

**ii. Cloud Computing:** A cloud computing system is a system with a virtual server, which stores the required software applications, programs, and data, and which can be accessed from any computer system. In addition to that, the CC service allows users to store their data online, quickly and conveniently, using the web-based tool that CC provides.

**iii. Big Data:** There will be a large amount of data generated as products are manufactured in any industry due to the interconnected heterogeneous systems and processes that are used to produce them. There are three types of data generated through this method: structured, semi-structured, and unstructured data. Studying and analyzing the three large data sets requires a lot of time and money as the method of analysis requires more time and money.

**iv. Simulation:** In accordance with the I4.0 guidelines, a concept of digital manufacturing has been outlined through the integration of various systems and processes with the internet of things and artificial intelligence to enable digital manufacturing. The complexity of digital manufacturing systems makes it difficult to estimate the performance of these systems through the use of mathematical models conceived as a method of analysis.

**v. Augmented Reality (AR):** Modern human beings face a number of challenges when it comes to living in today's society. Augmented reality (AR) has proven to be a highly innovative way of overcoming these challenges. Using augmented reality technology can be used to enhance the performance of humans by providing the required information for a specific task at the press of a button, so that the efficiency of a task can be increased.

**vi. Additive Manufacturing (AM):** In additive manufacturing, parts are produced by layering data from CAD (computer aided design) files directly from the data input to the machine. A CAD platform is directly connected to an additive manufacturing system so that smart parts can be created by dropping them drop by drop, or layer by layer, as they are manufactured.

**vii. Horizontal and Vertical Systems Integration:** Industry 4.0 is regarded by many as the "new era" of smart manufacturing, as it is the result of combining automation with information sharing and working within a highly collaborative environment between various organizations. I4.0 refers to horizontal and vertical integration of systems as different types of system integration, which are considered distinct from each other.

**viii. Autonomous Robots:** By utilizing robots that can be reconfigured with programming technology, manufacturing sectors are rapidly moving away from mass production and focusing on batch production or personalized production. It is possible to have a wider range of variations when using this feature, enabling products to be more flexible and more customizable.

**ix. Cyber Physical Systems (CPS):** In today's digital age, almost all devices are automatically connected to the internet, creating IoT, virtual environments, and remote access to data that is stored in the cloud. This has a significant impact on all sectors of society, including business. It may lead to a significant risk of vulnerability changes in the connected people and the enterprise information at large, resulting in serious problems for those who are exposed to those vulnerabilities.

**Implementation barriers of the I4.0 ideology**

It is true that the I4.0 concept has numerous advantages, but there may also be some hurdles that prevent it from being adopted and implemented in real practice [6]. There are three types of barriers that can be classified as follows:

i.   **Barriers caused due to governments:** a lack of support and inappropriate policies from the government, uncertainties surrounding the legal system, a scarcity of resources, potential security risks arising from value chains, the inability to integrate value chains efficiently, a lack of suppliers who are specialized and diversified, inadequate legislation and regulations, and inadequate fiscal policies.
ii.  **Barriers caused due to management:** Poor organizational management support, lack of economic resources, lack of research and development activities, absent or low digital infrastructure, inadequate training sessions for the workers, uncertainty about return on investment, poor or no financial infrastructure, insecurity of data, and security of personal information.
iii. **Barriers caused due to employees:** A tendency to resist organizational change, a lack of experience among the employees, the unavailability of funds for self-improvement, misinformation, lack of awareness, an inadequate waste management system, a lack of leadership and responsibility on the part of the organization, and a lack of knowledge that combines a variety of disciplines.

**Conclusion**

Following is a summary of the major conclusions derived from the study:

i.    Industry is a complex, agile process integrated with machine-human activity
ii.   Manufacturing businesses benefit from Industry 4,0's technological innovations.
iii.  I4.0 enables customer-centric solutions
iv.   Improved product quality is ensured by I4.0 tools
v.    I4.0 is reviewed in detail with a focus on its key features
vi.   Industry 4.0 poses several technical, organizational, and management barriers to execute
vii.  The key barriers that must be overcome by the government, management, and employees in order for I4.0 to be implemented are outlined
viii. For enterprises to remain competitive in a global environment, Industry 4.0 must be implemented.

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# A simple mechanism for controlling and reducing malwares at network level, preventing possible cyber incidents

**Vilma Tomco** *1 , **Miranda Harizaj** 2 , **Argena Prendi** 3

*1University of Tirana Faculty of Economy, Albania. vilma.tomco@unitir.edu.al*
*2Polytechnic university of Tirana, Albania. Miranda.harizaj@upt.edu.al*
*3National Authority for Electronic Certification and Cybersecurity, Tirana, Albania, Argena.prendi@cesk.gov.al*

**Keywords**
Malware
Traffic monitoring
Cybersecurity

**Abstract**
Cybersecurity is become the most important issue in the new geopolitical situation, and the consideration about cyberwar as the fifth domain of the war is confirming everyday this definition. The increased rate of public services digitalization, the increased usage of internet access and online services in one side has made easier the life of citizens and businesses but in the other side has become the paradise for cyber criminals, hackers, hacktivism and also for cyberattacks towards countries and regions. Considering that prevention and detection is the most important part of defense capabilities, all national cybersecurity are investing on building cybersecurity capacity (including technical infrastructure and human resources skills as well as on the awareness). Depending on the financial possibilities that also needs quick intervention and a huge budget, there are several mechanisms in order to support cyber experts to deter and prevent in advance the most possible incidents or attacks. We are trying through monitoring and analyzing the internet traffic information collected to identify and report in advance the possible issues with intention to lower the future incidents.

## Introduction

As the work has moved mostly to online environment, also the incidents that previously happened in physical world were transfer towards virtual world. So, the efforts to protect infrastructures and systems in order to detect and prevent possible incidents is become a necessity mostly for the countries that have limited technical capacities. Cybercriminals have intensified their attacks not only towards critical information infrastructures but also towards individuals. The methods of receiving control of their digital equipment's generally are the same: phishing, spoofing, ransomware etc. Through installments of malwares, they gain access to victim information and intent towards main systems or application in order to change information, theft it for selling or asking money or destroy it for creating trouble. Financial sector and other important CII have established their protection systems (intruder's detection systems etc.) and together with implementation of cybersecurity standards at their premises aims to guarantee the protection of system and information. Lots of other companies and individuals are not able to implement such measures and often are target of hackers and becomes a risk for other users on the internet or different networks. Our mechanism aims collection of information from ISP network, analyzing the malwares that are installed at end-users, inform them through communication with ISP in order to reduce the number of infected PC, reducing the possibilities for creating other incidents or attacks.

**Result**

As we have stressed in our previous research, [1] it is needed a longer period for monitoring, analyzing and notifying the proper ISP to clean up malware-infected end-user computers. This process requires specific tools and we choose information delivered from shadowserver.org. In order to see the results of our work, a better and continuous communication with all internet service providers where needed. In this regard, we use a sharing information platform (MISP) for communication to share information and receive the results. Monitoring of the network has begun on May 2021 with only 2 ISP and we saw a considerable reduce of malwares after sending report with notification to them. It is increased the number of ISP and institution in monitoring process and we try to change the behavior notification.
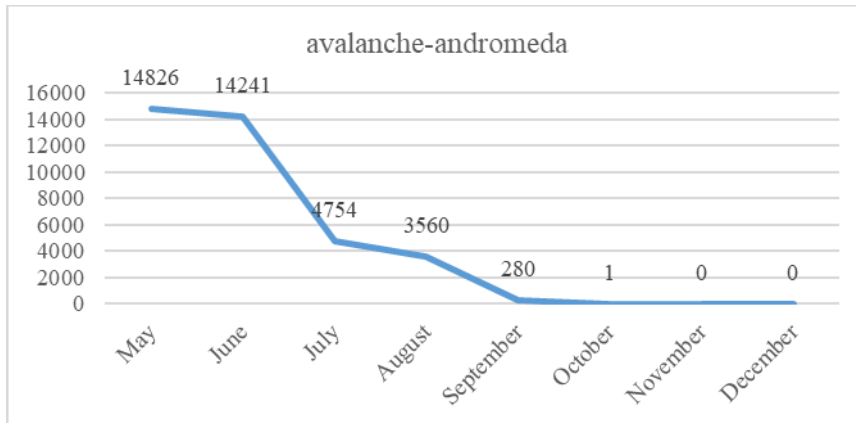


**Figure 1.** Avalanche – Andromeda Malware reduction – 1 ISP

We monitored all infected IP and existed malware circulated through ISP network. Among lots of other malwares, Avalanche - Andromeda was the virus that has infected the majority of IP's. After one year of regular monitoring/notification process, it results a huge decrease of this malware as well as other malwares. In order to support all expert with quick action in cleaning malwares from their network a recommendation material [2] has been prepared and distributed to all ISP and CII. It is a very important fact that when it was stopping the process of notification, a slight and occasional or significant increase of infected IP was noticed. The second fact, it was noticed that the same IP's results again infected.
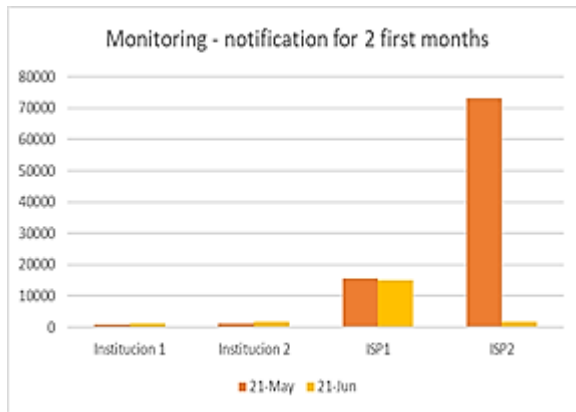


**Figure 2.** Number of IPs, May-June 2021, for 2 Insitution and 2 ISP (3 without notification**)**
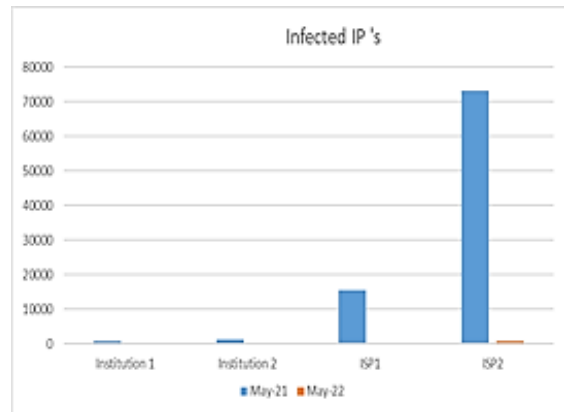


**Figure 3.** Number of Ip's reduction , May 2021 – May 2022

**Discussion and Conclusion**

As the result of all this process of continuing monitoring for one year of the internet traffic for infected IP together with malware types, it was notice:

- A reduction when notifications were sent to ISP's and follow up the process of actions were taken from them

- When notification was stopped, a directly increase of the figure of malwares and infected IP's were noticed.

What we can suggest in actual situation, without any injection on establishing cybersecurity tools (SOC's or other system) which requires considerable budget to them, a well define and continues process *monitoring-notification-responding-analyzation* will reduce the cases.

It is a very important fact that when it was stopping the process of notification, was noticed a slight and occasional or significant increase of infected IP. The second fact, in some cases, the same IP's results again infected. It needs more analyzes and monitoring of client behaviors for understanding and preventing happening this fact again.

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# A proposed power control solution for industrial application in decentralized energy production

**Miranda Harizaj** *1 , **Igli Bisha** 1

*1Polytechnic University of Tirana, Faculty of Electrical Engineering, Albania, miranda.harizaj@fie.edu.al; igli.bisha@fie.edu.al*

**Keywords**
Eco-efficiency
Decentralized energy production
Hybrid solution
IIoT

**Abstract**
Communities and industries across the globe depend on decentralized power generation to ensure the availability and security of supply. As the world moves toward decarbonization, energy generation systems are increasingly turning to small-scale turbines or engines operating on hybrid solutions with renewables as a cleaner, intermediate step toward a truly sustainable future. The infrastructure of the main electricity network in Albania is very problematic and about 90% of the energy is produced by hydropower plants, increasing the dependence on rainfall. Based on this problem, in order to have the independence of the electrical energy of the industry from the main electrical energy network in the country, in this paper is proposed a solution of energy control for decentralized energy production. This automated solution interconnects groups of distributed energy resources and loads at a defined electrical boundary. It can operate in either island/isolated mode or networked mode. In a system consisting of a generator and photovoltaic plant, this automated solution guarantees minimum fuel consumption by maximizing PV penetration without compromising minimum genset load requirements. This decentralized system of energy resources is based on IIoT, helping to develop smart cities. Decentralized control support identifying and control of important challenges for our unstable energy grid. Beyond the technical hurdles, our energy grid also needs a new paradigm for resilience, protecting against natural disasters and cyberattacks.

## Introduction

For decades, power grids have been structured in a hub-and-spoke model, with a few large, centralized power-generating plants providing electricity to a huge consumer base connected via long transmission and distribution lines. The idea was that the larger you build the plant, the more efficient the electricity system. For a long time, that logic held true. But with the urgent need to pursue decarbonization, the large increase in intermittent renewable energy on the grid, the still-expensive nature of energy storage, declining costs of decentralized generation, and the need for greater grid resiliency, decentralized power generation is increasingly recognized as a crucial tool during the energy transition [1-2].

Decentralized energy systems provide promising opportunities for deploying renewable energy sources locally available as well as for expanding access to clean energy services to remote communities.

The paper proposes a power control solution in a decentralized energy production system. The paper proposes a power control solution in a decentralized energy production system. This is given through a concrete application of the industry's need for energy production, creating dependence on the network in the country [3]. In the exciting system that the factory has to produce electricity consisting of a generator and the main energy network, it is proposed to integrate a renewable source such as a photovoltaic plant and also a controller for power management.

The system proposed in the paper offers a reliable, fully integrated and optimizing solution between sustainable power plants and generating power plants. The system is designed for green applications and includes controllers that can interface with PV inverters and other power source controllers. With the usage of an intelligent and flexible generator controller, power generation becomes more efficient without additional climate impact. With a highly configurable electric switchboard, power goes where it needs to go and ensures uninterrupted uptime.
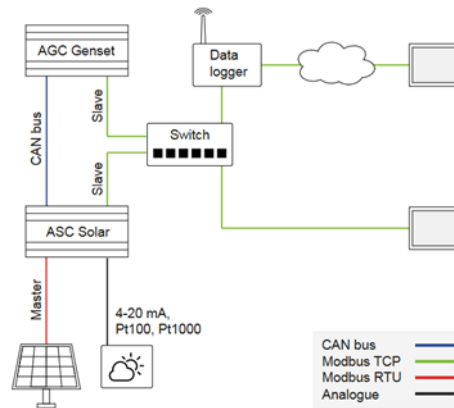


**Figure 1**. Hybrid energy system

**Decentralized energy system**

A decentralized energy system is characterized by locating energy production facilities closer to the site of energy consumption. A decentralized energy system allows for more optimal use of renewable energy, reduces fossil fuel use and increases eco-efficiency [4]. A decentralized energy system is a relatively new approach in the power industry in most countries. Traditionally, the power industry has focused on developing large, central power stations and transmitting generation loads across long transmission and distribution lines to consumers in the region. Decentralized energy systems seek to put power sources closer to the end user. End users are spread across a region, so sourcing energy generation in a similar decentralized manner can reduce the transmission and distribution inefficiencies and related economic and environmental costs.

**Hybrid energy system**

A hybrid energy system combines multiple types of energy generation and storage or uses two or more kinds of fuel to power a generator. A hybrid energy system is a valuable method in the transition away from fossil fuel-based economies [5-6]. Particularly in the short term, while new technologies to better integrate renewable energy sources are still being developed, backing up renewable generation with conventional thermal electric production can actually help expand the use of renewable energy sources [2].

Hybrid energy systems can capitalize on existing energy infrastructure and add components to help reduce costs, environmental impacts, and system disruptions. Planning a hybrid electricity system has a market focus rather than a technology focus: the priority is to choose a mix of energy technologies that is the most efficient and reliable way to meet users' needs. The proposed solution in the paper maximizes renewable energy penetration which can satisfy the energy demand and maximize the system energy efficiency as illustrated in the Figure 1.

In each operating mode, the solar controller automatically maximizes the stable energy penetration, depending on the total load demand on the hybrid plant, without compromising constraints such as the minimum generator load demand. In off-grid operation, the system provides a minimum generator load constraint that lowers steady power penetration if PV production is compromised. This ensures a certain amount of load on the generators, eliminating the risk of reverse power situations and the problems of dirty burning and exhaust.
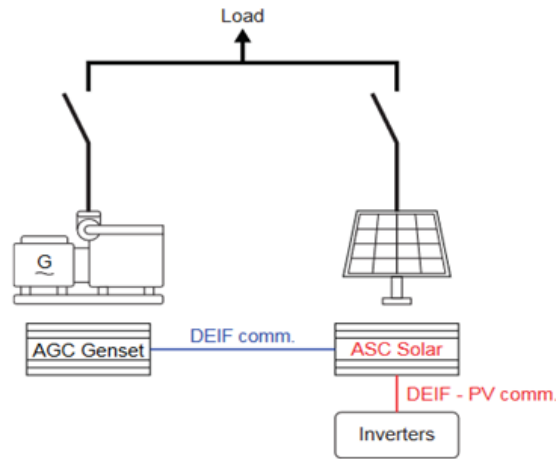
**Figure 2.** Communication between PV, generator and controller

## Results and Discussion

In the proposed solution, consisted of a generator and a PV system, a controller has been integrated for power management based on the consumption of the factory.

Through the controller we manage to realize the following processes for each hybrid resource:

- PV plant: P and Q control, Control PV breaker, Inverter communication.
- G-set: Governor Control, AVR control, Control genset breaker, ECU communication.

Controller communicates with the inverters through a gateway device-data manager as shown in. Controller communication with the PV uses a Modbus RTU protocol. The controller is the master and the inverters are the slave [5]. As it is presented in Figure 2 from the data obtained in real time of the energy flows in the factory, through the controller, energy management was realized based on the consumption of the factory.

In the Figure 3 is presented the case of system operation, when there is no network and the factory's consumption needs are met by PV and the generator according to the algorithm set in the controller. So, by receiving information on the consumption of the factory, energy management is done, making maximum use of the power from the PV plant, while the generator operates with minimum operating conditions as presented in the simulation in Figure 4.
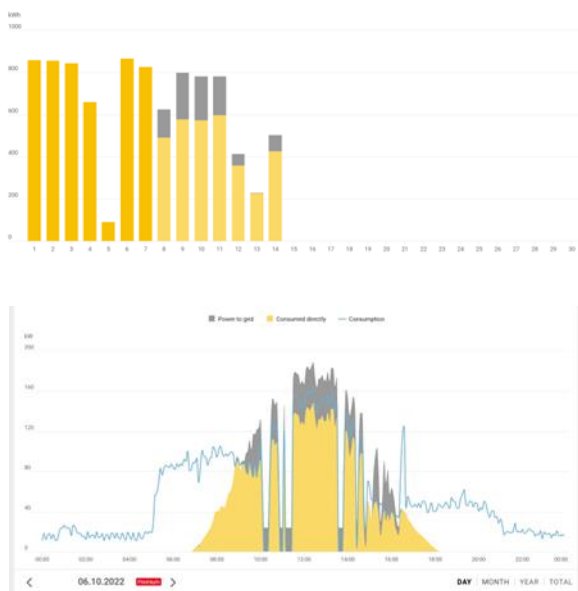


**Figure 3.** Energy data received from PV, generator and grid
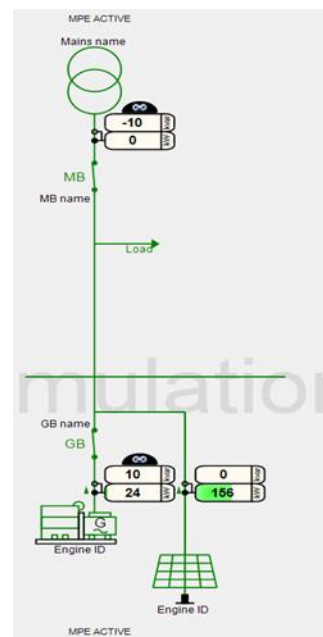


**Figure 4.** Simulation of the system in the controller

**Institutional Challenges**

- State-controlled electricity markets hamper the development of a decentralized energy system because distributed generation encourages myriad actors to become power producers.

**Technical Challenges**

- If not properly planned, large-scale deployment in distributed generation may result in the instability of the voltage profile.
- Emerging technologies, such as smart grid, renewable energy, and energy storage, will require the operation criteria of the whole power system to be redesigned and modified.

**Conclusion**

Our hybrid power solutions combine renewable energy sources, the generator, and the main power grid in a hybrid power plant or microgrid. Intelligent automated solutions for energy management using IIoT enable the development of smart cities. Through this paper and the results obtained in the sections above, we reach the conclusions that such power control systems in decentralized energy production systems have the benefits:

- Rural electrification: Because grid integration of distributed generation and storage requires major technical upgrades, countries in the region can focus on distributed generation for rural electrification – either through off-grid or mini-grid systems.
- Increases in the share of renewable energy: A decentralized energy system is designed to accommodate many energy sources, including renewable sources with intermittent production, such as wind and solar. Distributed generation, demand management and storage can all facilitate increased inflows of renewable generation.

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# Increasing productivity and energy efficiency in cement industry by using VSM

**Aida Spahiu** *1, **Denis Panxhi** 2, **Darjon Dhamo** 3

¹Polytechnic University of Albania, Department of Automation, Albania, aspahiu@upt.al, denis_panxhi@yahoo.com, darjon.dhamo@gmail.com

**Keywords**
Value Stream Mapping
Lean thinking
Packing system
Productivity
Efficiency

**Abstract**
In the conditions of the energy crisis due to the war in Ukraine, the ever-increasing price of the electricity, it is very important to save electricity, through the use of new technologies, products, services and innovative solutions. The cement industry is one of the most important industries with high consumption of thermal and electrical energy in Albania. The aim of the paper is to show that using the Value Stream Mapping and Lean thinking method of the production system in cement industry, will ensure good opportunities to improve the production system and reduce the energy consumption. The cement factory in Fushe Kruje, Albania is taken as a case study in this paper. Recently, as the cement demand rose, the factory has encountered with long-waiting lines at the loading facilities. The plant loading facilities are capable to serve pallet loading, bulk loading, and floor loading trucks. The paper is focused on pallet loading facility, as it is the easiest one to be modified. Thus, the goal of the study is to redesign the loading facility and change the packing process in order to reduce the overall waiting time of the system, electricity consumption and increase the production capacity.

## Introduction

Fushe Kruja cement factory is one of the largest producers of Cement industry in Albania and has an annual capacity of 1.3 million tons of cement and meet global standards for environmental protection. Achieving high process energy efficiency and ensuring high product quality are the main duties of the cost-effective cement production in Fushe Kruja cement factory.

The packing plant is one of the key sectors when cement dispatches to clients on 50 kg and 25 kg paper bags. There are installed two Roto Packers 8 spout, which feed two palletizers with a capacity of 2400 bags/hour with 50 kg each or 2700 bags/hour with 25 kg each. The challenge is to upgrade the existing palletizer system to grow production capacity in order to reduce the waiting time for consumers and energy consumption. The possibilities to fulfill all the market requests for packet cement would be easier and in a short time with lower cost. Much less time of operation for the same production has a great impact on technical aspects and energy consumption. So, the availability of the machinery will be higher and it will be more time for service.

The analysis of existing packing system based on Value Stream Mapping and Lean thinking methods helps to find what can be modified in order increase the production capacity, using line automation flexibility without sacrificing quality, reduced the energy consumption and other costs of the system.

Two main factors are taking in consideration during the study: 1) time of production process, which is converted in increasing palletizing system efficiency, and 2) reducing cost of production. Proposed PLC programming modification will ensure maximum robustness and maximum operational reliability combined with excellent palletizing quality. This will benefit to the company in increasing two times its palletizing system capacity, increasing resource utilization in distribution facility, reducing production costs and gaining customers' satisfaction.

**Material and Method**

Value stream mapping and Lean thinking are methods used in this study. VSM is a systematic method to identify wasted time and actions in a manufacturing process. In more recent times VSM it has been used to re-engineer businesses because it identifies unnecessary effort and resources to permit simplification and streamlining of operations processes [1-2]. VSM is used to investigate processes to identify improvement opportunities lying in their wastefulness and lack of fluidity. In VSM method the process is followed from start to finish monitoring and measuring what happens within, and between, each step of the process. For each step of the process are recorded the variety of resources used in the step, the amount of their usage and the range of times each resource is in use as a block of information specific to that step.

Lean thinking is a highly involved method of managing an organization to improve the productivity, efficiency, and quality of products [2]. Lean Manufacturing is the systematic elimination of waste from all aspects of an organization's operations, where waste is viewed as any use or loss of resources that does not lead directly to creating the product or service a customer wants when they want it. Lean thinking relies on recognizing the "seven wastes" [3]: over-production, over-processing, inventory, motion, scrap, waiting and transportation. Some benefits of lean manufacturing stated by [4-5] are: help to produce business outputs as fast as possible; able to produce work faster, can do more with the same resources as machineries and people. As a result of waste reduction, improvements emerge in reduction of operating cost, productivity, and quality and on-time delivery of products.

It is clear that value stream mapping is a process designed to reduce lead-time to make product flow and to eliminate waste, non-value-added operations or activities. All for purpose of meeting customer demand at the lowest cost and with the highest quality [6].

The goal of study is to reduce the costs by eliminating waste and to produce in time with customer demand and value stream mapping is an essential tool used.

**Analysis of the conditions in palletizing system**

First of all, it is created the value stream map based for the current palletizing system based on procedure stated on [1, 2, 3] as:

a. *The Current State Value Stream Map*: - Select the product family that will be mapped; - Decide what the goal for improvement will be done; - Form a team to collect data and map the selected value stream; Walk the flow and collect data on the value stream; - Value Stream Map terminology; - Value stream map standard symbols; - Draw a map of the value stream; - Analysis the Current conditions; - Identify value added and waste; - Choosing appropriate waste reduction methods and reconfigure process to eliminate waste and maximize value
b. *Take actions and create the Future State Value Stream*

The worth of VSM becomes self-evident during the analysis phase. The first analysis performed is to compute a ratio of total customer-value-adding time to total process time to see how customer effective is the process [7]. Other important factors to identify during the analysis are the variability between good and poor performance in each of the process steps.

Process flow analysis can quickly lead to an understanding of where inefficiencies exist and how to eliminate them [8-9]. After analysis based on VSM created based on the current conditions of packing system and identification of value added and waste, the changes are proposing that need to be done in order to reduce time and costs of the production. First of all, on current palletizer should be made some mechanical modifications and a new pneumatic system or a motorized system to divide the bag path on two paths. So, it will have a bigger capability to position the bags on a layer and can support a bigger capacity of coming bags. Based on VSM created the proposed modifications are shown in Table 1.

**Results**

The future state map is implementation plan that highlights what kind of lean tools are needed to eliminate the waste, and where they are needed in the product value stream. Creating a future state map is done through answering a set of the questions concerning issues related to building of the future state map and technical implementation related to the use of lean tools. After creating the future state map, the last step is to carry it out by trying to implement the different ideas generated by the future state map on the actual value stream [7, 8, 9].

In the new palletizing system are proposed to have two independent feeding paths, which can be made possible through the dividing system of bags. For this reason, two bags are selected to go straight and after bags are moved by the lower layer feeder in front. Three bags after them are turned by $90^0$ and create a layer that is moved in front by upper layer feeder. So, it is created the layer without usage of lower layer feeder because the bags come in the

right positions. Also, this system does not need to rotate the layer since the combination of bag is made on the layer.

All layers except the last one is turned by $180^0$ making a combination of bags in a way that the pallet is more compact and solid one. One pallet has 7 layers (5 bags) and one special layer 4 bags in the top.

All the modifications of the proposed new palletizing systems will be performed in PLC program. The proposed changes in current palletizing system will bring:

1. Arrival time of bags sequence will be done: 30s/39bags = 0.77s/bag
2. Time of completion of 7 layers (a pallet) = 7 x 5 x 0.77 = 27s/layer
3. Time of completion of special layer 4 bags is 4 x 0.77 = 3.08s/layer
4. Production for one hour in new palletizing system is 4800 bags/hour; 4800/39= 120 pallets/hour or 4800bags/hour = 1.33bags/s

**Table 1.** Impact of lean thinking in palletizing system of cement factory in Fushe Kruja

| Proposed modification | Reason | Results |
|---|---|---|
| Bag Divider System | This system will route cement bags on two paths. | Increase the capacity of processing cement bags to create a layer feed from two different paths. |
| Bag selector system (straight/turn $90^0$) for the new path | As on the new system will be two independent paths there are need for two independent bag selectors. | This will make possible to reduce a complex process of turning layers on lift. |
| Mechanical modifications of the belt conveyors | Fill out the conveyors to create two different paths. | Create a new path for bag processing. |
| Create and modify PLC program for the New Bag selector, bag divider, turning layers | As we have changed the logic of palletizing process, we have to interpret this at the automation system | Create a new logic control for the proper devices |
| Modify the control law of frequency converters | It will be needed to change the speed of the motors on the same processes to respond the new system. | The system will work correctly with higher efficiency. |

**Discussion**

The selected improvements are included in the redesigned 'future state map' of the process. Identifying less obvious improvements is helped by simplify the process into function blocks as shown by the variable blocks in Figure 1.
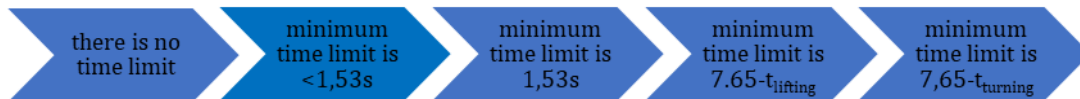


**Figure 1.** Current state functioning block diagram of palletizing system

By taking the process back to its most basic components, it is possible to redesign the process by removing, combining and overlaying its basic functions to arrive at a simplified and higher customer-value-added operation. Figure 2 shows the palletizing process with increased value-added and inventory speed achieved by halving two paths for bags in palletizing system instead of one path for bags as in current one is.



**Figure 2.** Proposed state functioning block diagram of palletizing system based on VSM method

It is clear that after applying the modifications the efficiency of palletizing system will be increase and the cost of production will be decrease. The calculation results for new palletizing system are:

1. Time of completion of a pallet is decrease two times from 53.84 s/layer to 27 s/layer. This will bring the reduction of the production cost.
2. The production time for one hour, which is converted in palletizing system efficiency, is increased two times from 60 pallets/hour to 120 pallets/hour.

In new palletizing system is proposed to replace two complex systems, as the Lower Layer Feeder with two electrical motors, one is synchronous motor with frequency converter and the other is induction motor, with two pneumatic systems. The other system proposed to replace is the $180^0$ rotating system, which has also two similar motors. These complex systems have a very big spare parts cost and need a costly maintenance. The results from calculations have shown clearly that the modified palletizing system can increase the productivity twice and reduce energy consumption average 34%.

## Conclusion

This paper demonstrates that using VSM method in packing system can quantify both the operational and financial benefits during the early planning and assessment stages of lean implementation. Simulation can be considered an integral part of VSM and can be used as a visual tool to convince management to adopt lean from both operational and financial perspectives.

The implementation of proposed modification of current palletizing system will bring potential economic, technical and quality benefits for Cement Company, increasing the production twice per hour and reduction of costs. So, the same personnel are used to produce a higher quantity of pallets. Reduction of some processes will require less electricity too, for the same production quantity.

Totally integrated automation of the palletizing systems makes possible to be very flexible on changing and testing it very easy and with a low cost. The system can be programmed and integrated on the existing project only doing same modifications to the main functions of the programmable logical controller program.

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# PV production forecasting using machine learning and deep learning techniques: Albanian case study

**Darjon Dhamo** *1 , **Xhilda Dhamo** 2 , **Aida Spahiu** 1 , **Denis Panxhi** 1

*1Polytechnic University of Tirana, Automation Department, Albania, darjon.dhamo@gmail.com; aspahiu@upt.al; denis_panxhi@yahoo.com*
*2University of Tirana, Applied Mathematics Department, Albania, xhilda.merkaj@fshn.edu.al*

**Keywords**
Solar power
Photovoltaic plant
Machine Learning
Deep Learning

**Abstract**
The increasing use of solar power as a source of electricity in Albania has led to increased interest in energy production forecasting. In this paper is done the forecast of energy production of 518kW photovoltaic plant installed on the terrace of a factory in Tirana. Using this information, the factory can intelligently plan their energy consumption over the coming hours. So, they can increase the rate of self-consumption and even cut their energy bills through greater independence from the grid. To perform the forecast is used a database which provides historical data of energy production, irradiation, ambient temperature, modules temperature and wind speed every 5 minutes for a year (01/01/2021-31/12/2021). The quantities are measured by some sensors which are installed at PV plant. Different machine learning algorithms, including Multiple Linear Regression, Polynomial Regression, Decision Tree Regression, Random Forest Regression, Support Vector Regression, XGBoost and Neural Network with LSTM layer are considered in the study. Using the proposed models, solar energy production for the following hours can be forecasting. Various comparative performance analysis based on the mean absolute error, mean square error, root mean square error, median absolute error, explained variance score and R2 score, between these techniques are provided in this paper.

## Introduction

Until now in Albania are installed different PV plants, for example Koorporata Elektroenergjetike Shqiptare (KESH) has completed construction of a 5.1 MW PV facility at the Qyrsaq dam in Vau i Dejës, in Shkodër city, northwestern Albania. The solar park is expected to generate 7,000 MWh per year and operate in combination with the hydropower plant. The economic advantages of these systems are the optimization of installation and operating costs by bulk buying and the cost effectiveness of the PV components and balance of systems on a large scale. In addition, the reliability of centralized PV systems can be greater than distributed PV systems because they can have maintenance systems with monitoring equipment, which can be a smaller part of the total system cost. Furthermore, in Albania are installed many rooftops PV system, one of them is the case of the study of this paper. The increase use of solar power as a source of electricity in Albania has led to increased interest in energy production forecasting. Using the information generated from PV Plant sensors, factories can intelligently plan their energy consumption over the coming hours [1-3]. So, they can increase the rate of self-consumption and even cut their energy bills through greater independence from the grid. Different machine learning algorithms including Multiple Linear Regression, Polynomial Regression, Decision Tree Regression, Random Forest Regression, Support Vector Regression, XGBoost and Neural Network with LSTM layer are implemented to forecast energy production

of 518kW photovoltaic plant installed on the terrace of a factory in Tirana [4-7]. Using these algorithms solar energy production for the following hours can be forecasting.

**Material and Method**

To perform the forecast is used a database which provides historical data of energy production, irradiation, ambient temperature, modules temperature and wind speed every 5 minutes for a year (01/01/2021-31/12/2021).

**Table 1.** Parameters taken from photovoltaic plant

| Parameters | Values |
|---|---|
| Ambient Temperature | °C |
| Wind Speed | m/s |
| Irradiation | W/$m^2$ |
| Module Temperature | °C |
| PV Production | Wh |

The forecasting is carried out using Python programming language with various library functions such as scikit-learn, keras, pandas, tensorflow and numpy. Different machine learning algorithms are considered in this study Linear Regression, Polynomial Regression, Decision Tree Regression, Random Forest Regression, Support Vector Regression, XGBoost and Artificial Neural Network with LSTM layer.

**Results**
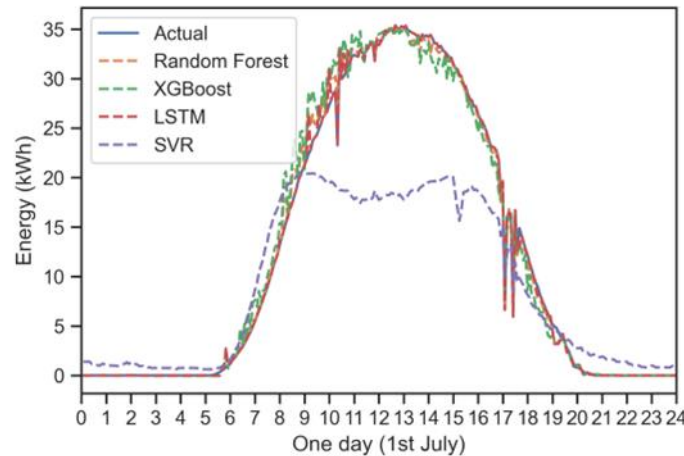


**Figure 1.** Short-term PV production forecasting

Short term PV production forecasting is performed using data from 1st day of July 2021. Forecasting results are shown in Figure 1. Support Vector Machine is seen to be the last accurate method for PV production forecasting compared to other machine learning and deep learning methods. Random forest regression, XGBoost and LSTM are the best machine learning method for predicting PV production in one day.
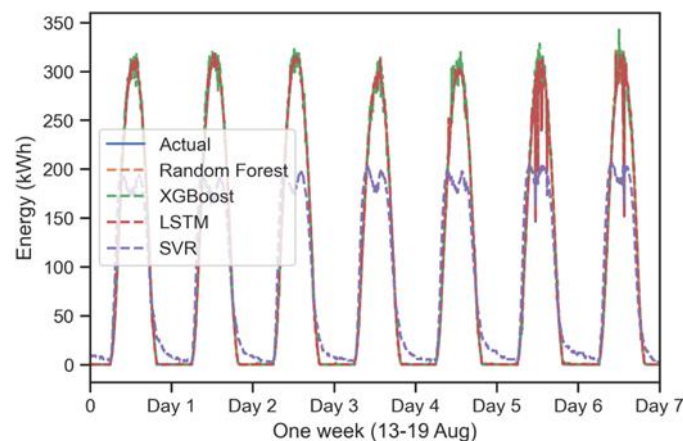


**Figure 2.** Medium-term PV production forecasting.

Medium-term PV production forecasting is performed using data from one week of August (13- 19 August 2021). As shown in figure 2, even in this case support vector machine seems to be the less appropriate method for medium- term forecasting.

**Discussion**

Table 2 gives detailed information about the performance of each of the methods used based on some performance metrics such as mean average error, mean square error, median average error, explained variance score and $R^2$ Score.

**Table 2.** Performance metrics

| | Mean average error | Mean square error | Median average error | Explained variance score | $R^2$ Score |
|---|---|---|---|---|---|
| Decision Tree Regression | 0.1089 | 0.07279 | 0.00737 | 0.92673 | 0.926737 |
| Random Forest Regression | 0.09607 | 0.05667 | 0.00772 | 0.94283 | 0.94283 |
| Linear Regression | 0.16511 | 0.08213 | 0.077 | 0.91734 | 0.91734 |
| Polynomial Regression | 0.14939 | 0.07557 | 0.06238 | 0.92395 | 0.923945 |
| XGBoost | 0.10038 | 0.05702 | 0.01044 | 0.94262 | 0.942614 |
| Support Vector Regression | 0.12765 | 0.07103 | 0.08057 | 0.93056 | 0.930353 |
| Long Short-Term Memory | 0.10664 | 0.05753 | 0.02335 | 0.94194 | 0.94188 |

The smaller the mean average error, mean square error and median average error the more accurate is the method for forecasting PV production. The higher the explained variance score and $R^2$ Score the more suitable is the method to forecast PV production.

**Conclusion**

An analysis of the potential impacts of weather parameters on PV power prediction reveals that the ambient temperature, irradiation and module temperature impact energy output, whereas wind speed appears to be a less significant dominating factor of PV power prediction. For the short-term energy generation forecast, the irradiation condition is the most important parameter. A comparative analysis using various machine learning and deep learning approaches, including Linear Regression, Polynomial Regression, Decision Tree Regression, Support Vector Regression, XGBoost Random Forest regression and Long Short-Term Memory, showed that Random Forest, XGBoost, LSTM performs better than the others in predicting the energy.

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# Assessment of airspace surveillance and control in Albanian territory from the current and historical prospective

**Fatmir Basholli** *1

¹Albanian University, Department of Engineering, Tirana, Albania, fatmir.basholli@albanianuniversity.edu.al

**Keywords**
Airspace
Monitoring
Surveillance
Communication
Detection

**Abstract**
The main goal of this article is to present the background importance of airspace control and surveillance with aim to increase the capacity of detecting potential issues and establish a safety traffic flow management and the optimal allocation of airspace resources. Further on the approach consider the multi-sector airspace scenario established after the second world war, securing the territorial integrity, provision of maritime and airspace monitoring. To that fact immediately after the year 1944 the relevant military structure was organized for aerial surveillance, notification and communication with a reduced force, which was organized in visual posts equipped with optical tools with limited capabilities in detection distances, that alter on was accomplished via radio-electronic means. In an organized manner and with a clearly defined mission, the radio-locator stations have started their work in the unified system. In terms of variety, radar stations of various types of Soviet production were used, and after the seventies, the radar-park was completed with other more powerful Chinese production stations. With further advancements the electronic airspace detection power absolutely guaranteed the air sovereignty of Albania, in the conditions where the closed skies strategy was implemented for over 40 years. The experience accumulated over the years, the studies and experiments carried out have turned this service into an integral part of NATO.

## Introduction

The current developments of different sectors of economy are directly connected with air traffic management with aim to provide safe and effective movement of goods, services and humans. Following [1] ones the flight traffic continues to increase, the traditional air traffic management methods can no longer meet the current practical needs. Further on it is worth to mention that the air traffic situation prediction can help air traffic management departments anticipate the trend of future operation status to identify congested airspace and formulate traffic balancing and management measures in advance [2].

The main goal of this article is to present the background importance of airspace control and surveillance with aim to increase the capacity of detecting potential issues and establish a safety traffic flow management and the optimal allocation of airspace resources. Further on the approach consider the multi-sector airspace scenario established after the second world war, securing the territorial integrity, provision of maritime and airspace monitoring.

With this regards the beginnings of the Albanian Radio-technical service date back to the year 1947, when the airspace compnay was created, based in Tirana, with a workforce of 80 people, which spread to nine Visual Posts with over twenty points of Visual-Optical Surveillance in dominant positions such as Koplik, Shishtavec, Dibër, Korçë, Bilsht, Gjirokastër, Saranda, Vlora, Cape Rodoni, etc. from where the Air Space was continuously monitored and data on the Air situation was transmitted to the Headquarter unite. Within the first year, the department

managed to organize a unique system of observation with optical means, played a decisive role in air defense, laying the foundations of the future military strategy for ensuring the air sovereignty of the country.

Air traffic situation assessment is an objective representation of the airspace operational status, and its results are also the basis for air traffic situation prediction [1]. The national advancement in Alkbania followed similar path with other countries, so the mainstream assessment methods mainly represent the air traffic situation with the help of the concept of air traffic complexity (also called airspace complexity or air traffic control complexity) [3]. Since there is no precise definition of this concept and many factors affect air traffic complexity, researchers can deconstruct air traffic complexity to represent air traffic situations from multiple perspectives [4-6].
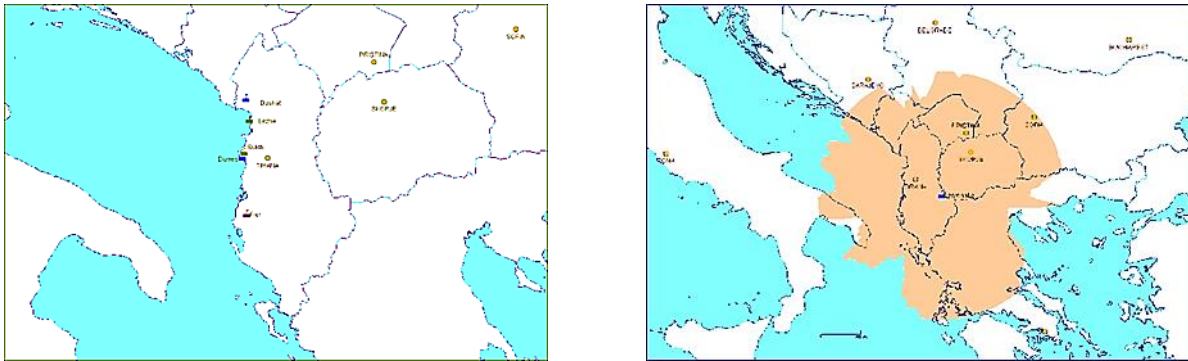


**Figure 1.** (left) The position of our Albania in relation to its neighbors and (right) The surveillance at the altitude of 1000 m a.s.l.

**Material and Method**

The method used in this approach is based on description of background documents and historical developments of the air traffic situation in Albania that can be understood as the operational status in a specific airspace environment. Different scholars have proposed various methods to characterize the airspace operational situation. So, for the national for large-scale airspace, an objective and concise way must be designed to solve the air traffic situation assessment problem. Now the centre of importance for the continuation and advancement of the airspace control continues to go directly through equipment's with radars of different frequency ranges and detection parameters.

**Results and Discussions**

At the current circumstances based on the air force development plan and under the direct supervision of the headquarters, concrete cooperation with similar structures of other countries for the analysis and study of the state of the existing system as well as the design of transformation projects has begun. and modernization at the levels of standards of interaction and integration in the Airspace control system of South-Eastern Europe. In this framework, in implementation of the new strategy and approaches in 2003 was appointed an air surveillance structure under which two main air surveillance headquarter and a temporary one spread in their previous locations, Porto-Romano Durres and Zefjan, Bushat.
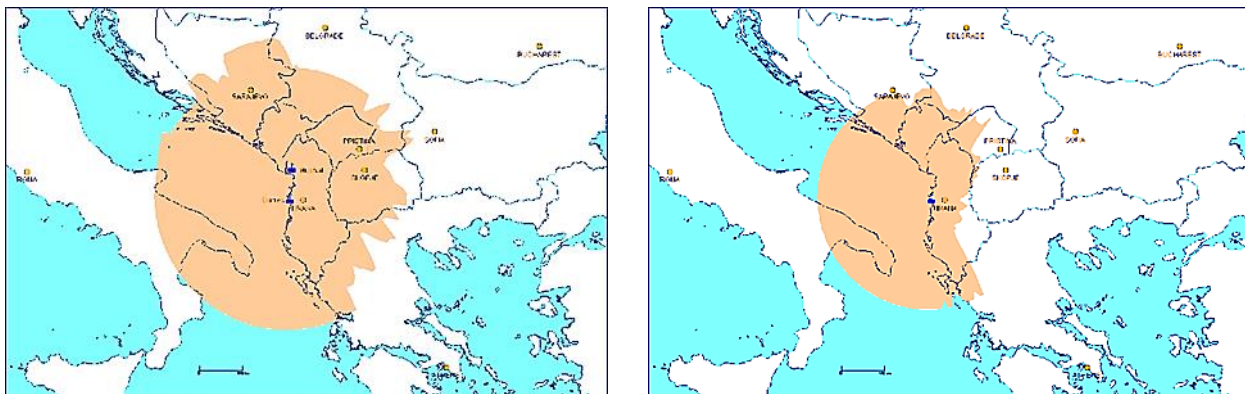


**Figure 2.** (left) Radar detection area for the guidance of combat aviation at an altitude of 10,000 meters a.s.l., and (right) Radar detection area in Durres

Further on the air surveillance for the continuous observation of the Airspace, although with reduced continues to be implemented with the motto: to make maximum use of the existing technique in order not to interrupt the combat task until the introduction of the new technology. Airspace control and management, system modernization is a primary objective of the air force headquarters. This is no longer promising, but a problem that needs to be solved. Thus, the glorious history of this department and its continuous air surveillance will continue to be narrated with the legitimate pride of an effective that is transformed and developed day by day, to achieve modernization and the most contemporary technologies for the continuation of its Mission that has been will remain vital for ensuring the country's air defense and sovereignty.

**Conclusion**

Due it geographical location of the country, the terrain particularly in the northeastern and southeastern areas is mainly hilly and mountainous, which limits radar detection at low altitudes, so further technical advancements are required.

Regardless of radar detection, the value and importance of visual and optical detection in specific directions cannot be neglected, so an integrated approach is also pursued.

The experience accumulated over the years, the studies and experiments carried out served for the dignified integration of this service in the framework of the international structures.

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# Electronic interference and protection from it

**Fatmir Basholli** *1

*1Albanian University, Department of Engineering, Tirana, Albania, e-mail: fatmir.basholli@albanianuniversity.edu.al/ fbasholli@yahoo.com*

**Keywords**
Electronic interference
Systems
Spectrum
Electronic protection
Frequencies

**Abstract**
The main purpose of this article is to present the importance of complex protection from this advanced electronic technology which is an important part to achieve objectives at different levels of a conflict or a military operation. Electronic interference is used to enhance capability and ensure superiority over the adversary. Control of the electromagnetic spectrum has a major impact on the success of military operations. Modern weapons and support systems utilize radio, radar, infrared, optical, laser and ultraviolet technologies. Electronic interference has a major role in ensuring and maintaining the independence of action in an electromagnetic environment, it is vital in the formation, content, dominance, stabilization and capabilities in the various phases of an operation. The level of electronic intervention helps the leaders of the operation to understand the battlefield, to organize, structure and harmonize the actions with the various civil authorities, etc. Electronic interference applications are important to restrain, detect, prevent various threats such as missiles, aircraft, ships, terrorist groups, cyber threats, etc. The experience from the applications of electronic intervention allows to ensure the normal functioning of communication and information systems as well as the independence of the work of different systems, which makes it interesting to study and include different security structures of a country.

## Introduction

*Electronic interference* is the totality of measures and efforts that are carried out for the use of directed electromagnetic energy, ie to control the electromagnetic spectrum. Nowadays, the use of this spectrum for directing weapon systems, for observation and detection, etc. is increasing. The use of the electromagnetic spectrum is an integral part of military and civilian operations [1].

The electromagnetic spectrum is a composite of oscillating electric and magnetic fields that propagate at the speed of light. It includes radio frequencies, infrared rays, light rays, ultraviolet rays, gamma rays and X-rays. Radio frequencies, as part of the electromagnetic spectrum, include the radio wave and microwave band from 3 kHz to 3000 GHz. *Show fig. 1*

The purpose of electronic interference is to provide complete information on the adversary, damage its electromagnetic spectrum during the entire time of the operation and protect our electromagnetic spectrum from the attacks of the adversary [2].

The main purpose of this article is to present the importance of background control and surveillance of this spectrum with the aim of increasing the detection capacity of electronic intrusions and focusing on effective protective measures. The main components of electronic intervention are:

*Electronic attack* that includes actions taken to prevent or reduce the enemy's effective use of the electromagnetic spectrum or of weapons that use electromagnetic energy; Electronic defense includes actions taken to protect personnel, facilities and equipment from the effects of the use of electronic warfare by adversary forces; *Electronic support* that includes actions to capture, identify and locate sources of electromagnetic energy radiated intentionally or not, for immediate hazard determination. It includes actions determined to seek, capture, identify and locate sources of electromagnetic energy radiated intentionally or unintentionally with the aim of immediate recognition of threats, of targets, planning and implementation of future actions; *Electromagnetic*

*interference* encompasses any electromagnetic disturbance that interrupts, impedes or reduces and limits the normal operation of electrical and electronic equipment. Electromagnetic interference is the intentional introduction of electromagnetic energy into transmission paths to cause confusion; *Electromagnetic stability* consists of the actions taken to protect personnel, objects and equipment by means of transmission, attenuation, burial, limitation and protection against the unwanted effects of electromagnetic energy; *Electromagnetic jamming* is the intentional radiation, re-radiation or reflection of electromagnetic energy to prevent or reduce the effective use of electromagnetic energy and damage an adversary's combat power; *The electromagnetic impulse* is a powerful electronic impulse, with a short duration, that with the electric and electronic fields it creates, can completely or temporarily damage the electrical and electronic systems; *Electronic masking* is the controlled radiation of electromagnetic energy at our frequencies ensuring the protection of transmission and electronic systems from supporting measures of electronic interference; *Electronic recording* is intentional radiation, determined to be introduced into the equipment or systems of the adversary, with the aim of learning about the operation and operational capabilities of the equipment and systems; *Electronic reconnaissance* is the detection, location, identification and evaluation of electromagnetic radiation. Electronic discovery is a technical and multifaceted discovery that benefits from external electromagnetic radiation; *Electronic security* is the protection resulting from all the measures established to deny unauthorized persons valuable information that could have benefited from their capture and study of non-communicating electromagnetic radiation; *Emissions control* means the selected and controlled use of electromagnetic energy transmitters to make the best use of command and control capabilities and minimize adversary detection and interception and mutual interference; *Spectrum management* involves the planning, coordination and administration of the use of the electromagnetic spectrum through operational, technical and administrative procedures [3-6].
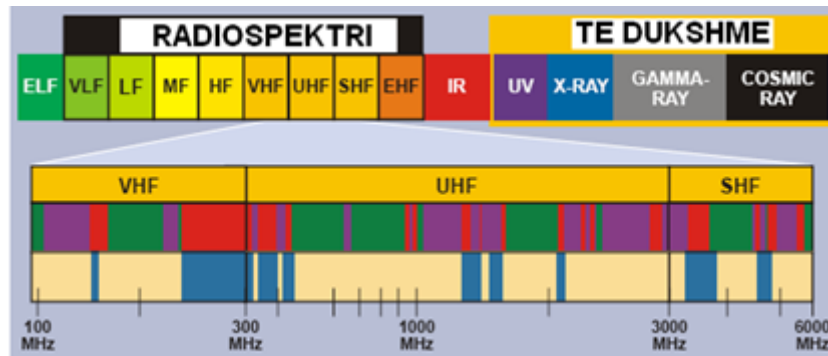


**Figure 1.** View of the breakdown of the electromagnetic spectrum

**Material and Method**

Electronic attack has two main sub-components, jamming and electronic spoofing.

(a) Jamming is the interruption of the signal before it reaches the intended receiver. Blocking radiation by means of blocking includes equipment that radiates: for example, the transmission of electromagnetic energy in order to disrupt radio and radar transmissions.
(b) Re-radiation jamming, uses the collected transceiver signal to receive the adversary's transmissions, alters them in some way, and re-radiates the signal back to him. The two devices used are repeaters and transponders.
(c) Reflection blocking confuses opposing electronic systems, thus degrading their effectiveness. The three effective jammers are exciter, loop and corner reflectors. Examples include government treaty frequencies as well as RADAR frequencies used for missile control and rapid air defense alerting.

Likewise, electronic fraud with the creation of the list of necessary frequencies is of particular importance. This list summarizes all the necessary electromagnetic spectrum within an operation area and is the basis for frequency support during all phases of operation planning. It is vital to prevent tampering and helps optimize the use of limited electronic tampering resources [7,8].

**Results and Discussion**

The implementation of electronic protection, is carried out following several main methods such as: Avoiding the use of transmissions perpendicularly, in contrast to our communication signals. By eliminating perpendicularity, we reduce the chance of an adversary successfully using electronic interference to disrupt our communications. The use of terrain camouflage consists of placing communication antennas in positions that give

advantages in the protection of the apparatus using the features of the terrain and also the buildings and fortified facilities built for this purpose. The use of directional systems such as microwave and satellite, or other systems such as frequency modulation (FM) and encrypted radios, the use of directional antennas oriented parallel to the front. The use of terrain cover and the remote placement of the power emitting antenna system create real impossibility for the adversary to identify the object from which it is being transmitted. The increase in false transmissions and especially the most effective way to protect our communication is to limit the emission to the greatest possible distances and to use radio silence whenever possible [9].

Secondary communication is envisaged and provided as an alternative route and means communications during non-critical moments. This will prevent the adversary from collecting and analyzing information on our primary system beforehand. As a result, the collected information is often useless, due to the greater time required to analyze and process it for decryption, especially in cases of the alphanumeric encoding system.

Primary communication systems use advanced technological equipment and are protected from visual and satellite surveillance. This can be accomplished by careful use of camouflage and by installing antennas on the opposite side of slopes, behind natural obstacles, and by using encrypted electronic systems [10].

Highly directional antennae. These antennas are used to cover a sector where jamming is present, thus nullifying the effects of useless signals. Multi-function antenna. Multi-functionality allows multiple radios to work on the same antenna, making it possible to reduce and physically display multiple antennas without compromising communication quality. Systems of a wide spectrum. These systems spread the transmitted signal over a very wide frequency band, so it becomes difficult to detect and separate the signal in the noise environment. Automatic frequency adjustment. Systems that have this feature reduce the output power to the minimum required to maintain stable communication. This reduces the range at which the signal can be captured and analyzed [11].

## Conclusion

Nowadays, referring also to the Russia-Ukraine war, electronic interference is a reality and an important element of command-and-control operations. In the planning, organization and development of electronic interference, different structures, detection, communication and radio detection are included in an integrated manner. The provision of communication and information systems depends directly on electronic intervention. A successful electronic intervention is dependent on personnel training in the use of electromagnetic energy, and the appropriate amount of frequency band.

Electronic warfare must be evaluated in the complex with all elements of the communication and information system, whether they are communication, non-communication or electro-optical systems.

An important role in the implementation of protection measures against electronic interference is the use of new technologies and the advantages of technology must be recognized when dealing with the electronic interference of the adversary.

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# Monitoring and evaluation of the quality of electricity in a building

## Fatmir Basholli *1 , Adisa Daberdini 2

*1Albanian University, Department of Engineering, Tirana, Albania, fatmir.basholli@albanianuniversity.edu.al/ fbasholli@yahoo.com*
*2Aleksander Xhuvani University, Department of Informatics, Albania, adisa.daberdini@uniel.edu.al*

**Keywords**
Electrical
Monitoring
Quality
Electric current

**Abstract**
The term, "Quality of Electricity" has been applied to a wide variety of many power system phenomena. The increasing application of electronic devices as well as the production and distribution of electricity has increased the interest in energy quality. Today, non-linear loads have increased, mainly with the addition of computer equipment, printers, photocopiers, fans, heaters, air-conditioning systems, refrigerators, elevators, etc. Therefore, it is good to take some measures to reduce the levels of general disturbances, as well as to immunize the sensitive equipment in such a way as to ensure the stability of the electrical installations. To achieve these objectives, it is important to measure and analyze harmonic distortion. For this, the origins and possible consequences of harmonic disturbances in computer equipment and distribution networks of the building or university campus are studied, which is the focus of this study. The paper argues the main precision strategies in an electrical installation applied in a building, in which the biggest loads are computer and laboratory equipment. For this and many other reasons that affect the Quality of Electricity will be argued.

## Introduction

In the preparation of our research, we set as a separate task and analysis, the monitoring of electricity in a part of the building of a consumer environment with computers and information technology equipment. Since usually schools, universities, etc., are users of many computer and ICT devices, there is a need to do a study in these facilities where these devices are installed. In the following, we will get to know the quality of electricity in the devices that are included in this study. In order to make it possible to monitor electricity, we will also look at the electrical installation with computer equipment, which serves as a starting point and basis for laying out the foundation issues in solving problems that may occur during the measurement period or other phenomena. Further along this road, we will see the progress of changing the electrical load with the addition of equipment. Rather, we will focus on problems related to the quality of electricity, how this quality changes depending on the electrical load, etc. [1-3].

## Material and Method

***In terms of the quality of electricity supply,*** I was initially introduced to some generalizations regarding the quality of the electricity supply system to users, the quality of production, and the quality of the system. It is reasonable to know the quality of the above elements, since they provide us with a good quality of electricity, with acceptable parameters [4,5]. Interruption of the user's electricity supply, as well as any deviation from the nominal values of voltage and frequency, reduce the efficiency of devices that operate on electricity. In a more analytical way, the "Quality of Electricity supply" of users is mainly characterized by the following factors: [6-8]

a. Continuous supply of electricity (or degree of security of supply); b. Stability of supply voltage; c. Frequency stability; d. Purity of the shape of the supply voltage curve; e. Tendency to have the three-phase system of symmetrically clean voltages.

Absolute provision of uninterrupted electricity supply to all users, without any interruptions of any kind, is practically impossible. Aiming for such a thing leads to large unwarranted capital and operating expenses. The level of guarantee of uninterrupted supply is evaluated by the "security degree" of this supply. More clearly, the degree of supply is expressed by the possibility of uninterrupted supply [9-13].

*Quality of production, quality of electrical system and electricity.* In today's language, the word quality is very usable and is related to different concepts and colors, it has a high degree of subjectivity, which often takes on personal colors, electricity has its own quality [14]. The quality of electricity is ideal when the dependence of current or voltage on time is a pure sinusoid, that is, when the dependence graph has no deformations, deviations. But this thing is purely theoretical, enough to be familiar with the terms of the quality of electricity. The quality of electricity varies at different times for different electrical loads. In reality, electricity does not have a 100 percent quality. The change in the quality of electricity is directly proportional to the change in electrical loads. In order to use good quality electricity, the three-phase system, which serves as a source of electrical power for consumers, should generally be symmetrical. So, in order to preserve this symmetrical system, it is necessary that the three phases of the same electrical system have the same amplitude, the same voltage magnitude, the same frequency for the three phases, and their phasing in time must necessarily be 1200. However, this is not really possible for many reasons. It is worth mentioning that the increase in linear electrical loads has always affected and is still affecting the quality of electricity [15-18].

**Results and Discussion**

In the paper, the monitoring of electricity in a part of the building of a university environment, namely the central building of the Department of Engineering at the Albanian University, was considered and analyzed separately. Initially, the Power Network Analyzer "Power Sight 250" (Figure 1a) was installed, which serves to measure/monitor and analyze the quality parameters of the power network.

*Results of Monitoring and Their Analysis.* Figure 1a and 1b shows the viewing window of the form of currents and voltage for the monitored three-phase system. Here, two complete cycles of sinusoids with a time of 50 mS are triggered by the process. From the visual inspection, we noticed that the shape of the sinusoids deviates from their ideal shape. This deviation is visually more noticeable for the curves that present the law of current change, and especially with the naked eye it is clear that the curve of the neutral conductor current is much more deformed than those of the phase currents, (Figure 1b) while those of voltages appear in a much more regular form compared to current curves (Figure 1c).



(a) (b) (c)
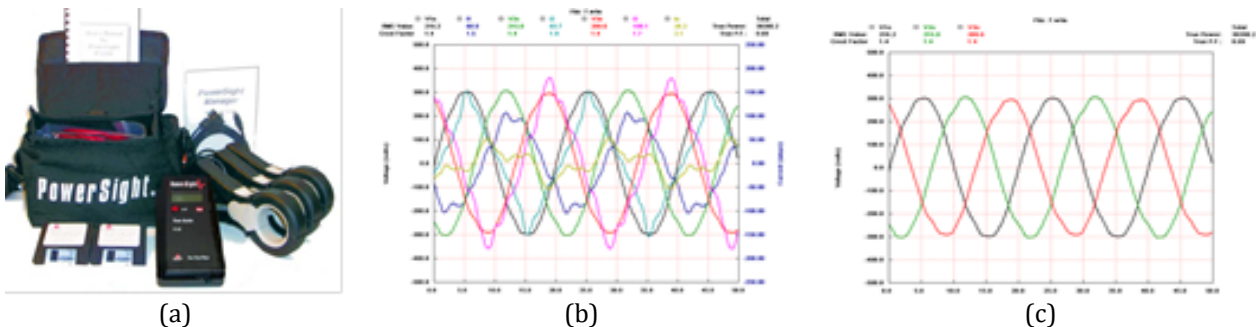
**Figure 1a.** Power Sight apparatus and other measuring devices. **Figure 1b.** Graphic representation of analog voltage / current quantities for the three-phase system. **Figure 1c.** Graphical representation of analog values of the three-phase voltage system at the 0.4 kV level.

The monitoring process started on 26.04.2021 at 10:15 until 03.05.2021 at 15:30. The monitoring was carried out for a period of 5 days, where records with data of average values were taken from the process. The graph below shows the legality of the current change for the monitored period. From the Figure 2a and Figure 2b, it can be seen that this legality changes periodically during the day and night according to the load change, giving us information on its profile.

Monitoring for Voltage Fluctuation based on the standard refers to the difference of the effective value in the magnitude (198 - 242) V with periodic fluctuations in magnitude. From the control of the database, there are no major voltage fluctuations. The variation of the change of the power coefficient results within the allowed norm. During the monitoring process, the change in legality resulted on average for all three phases in the range of 0.91-0.93, i.e., within the standard. The variation of the frequency change results within the standard and allowed norm (49.80 – 50.20) Hz.

|                          (a)                          |                          (b)                          |
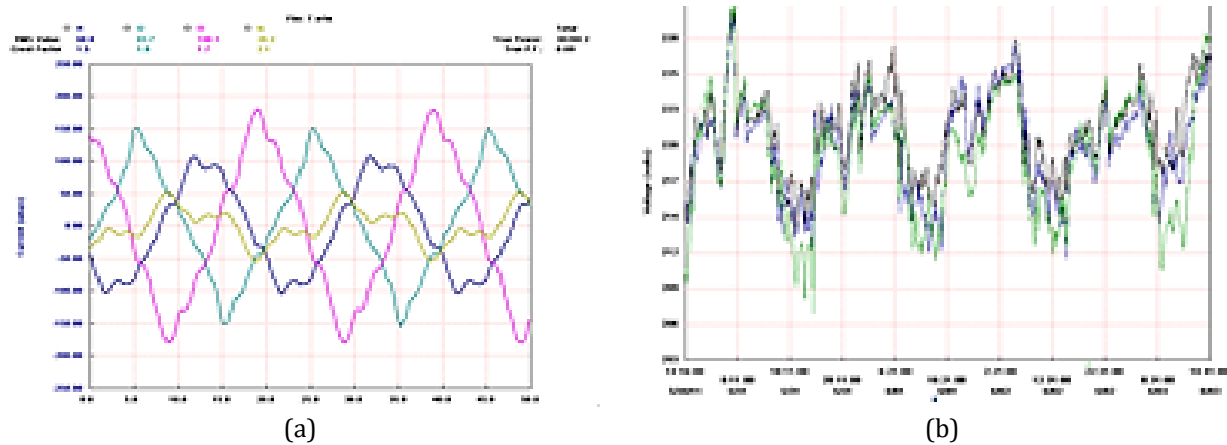
**Figure 2a.** Graphic representation of analog quantities, system of three-phase currents and zero current. **Figure 2b.** The profile of the voltage changes for the monitored period

## Conclusion

Disturbances such as Voltage Reduction, Under-Voltage, Over-Voltage are present only in 3% of the monitoring window and do not constitute concerns for computer and ICT equipment in the building under observation.

In the case of the monitoring carried out by us, the data analysis process was carried out exclusively by the "Power Sight 250" measuring/monitoring instrument.

The sinusoidal waveform of the observed voltage does not consist only of the fundamental harmonics. The data collected during the monitoring period were analyzed and provide the necessary information regarding the performance of the quality of the electricity supply to the building of the Engineering Department.

For minimum load the symmetry is preserved, while for the peak load the symmetry is broken. The voltage profile is affected by the load change. The effective value of voltage and frequency for the minimum load period is within the permissible limits.

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# Cyber security in mail with Fortiweb and Fortinet for companies and institutions

**Adisa Daberdini** *[1] , **Fatmir Basholli** [2] , **Novrus Metaj** [3] , **Elisa Skenderaj**[1]

[1]*University Aleksander Xhuvani, Department of Informatics, Elbasan, Albania, adisa.daberdini@uniel..edu.al, elisa.skenderaj@uniel.edu.al/*
[2]*Albanian University, Department of Engineering, Tirana, Albania, fatmir.basholli@albanianuniversity.edu.al*
[3]*Polytechnic University of Tirana, Department of Physical Engineering, Albania, novimetaj@gmail.com*

**Keywords**
Cybercrime
Cybersecurity
Fortinet
Security
Fortiweb

**Abstract**
In this paper, we will present some studies that we have done on the applications that are used for the cyber protection of email on the client and on the server. It is expected that these can also be applied in companies and also in different institutions. One of the applications that is being used for data protection is Fortinet and for web and email protection on the web is Fortiweb, which can be used in different ways with EMS and FortiGate. Fortinet is installed on a linux server as it is one of the most suitable systems for such programs given the protection they offer against various viruses. The data analysis that was done on this server was done on the basis of the attacks that were recorded mainly on the server. Security management in different companies has started to be separated from the management of IT sectors as it is always and more presenting a high risk and security is normally required in applications and in their most efficient use. Also, they are also very vulnerable, since expanding to every user, then not everything can be controlled and secured by IT. Nowadays, organizations, different companies and different government organizations are moving more and more towards a digital acceleration, which has brought the highest risk of cyber-attacks. We will also consider how we will have the opportunity to increase the protection and integrity of regular email and email used in companies and institutions.

## Introduction

One of the main solutions that can provide the applications that will be used is the increase in security in the company's computer networks. Also, the application of the principle of a secure network with a firewall and all the necessary applications for its protection: "wide. integrated. automated network" [1]. First, a central system must be created that unites the concepts of cyber security in the servers that will be used in the network and then the users of this network, the use of powerful software that provides security and stability in the work they perform and ensures comprehensive protection. cyber security for all; "users, devices and applications" and at all edges of the network [2]. First, the central security equipment that can be used in the company must have an operating system that provides encrypted (encrypted) traffic, stability, high performance, ensures interoperability with systems, security, tools and other hybrid applications that can be integrated into the network. Since in recent years the methods to encrypt traffic and packages have been applied precisely in this field of cyber security and the field of emails is one of the most important for their security. Hackers have continued to work harder and harder to break this aspect of security [3].

E-mails are one of the standard forms of communication that are used more often in today's trade, but also for communications in offices and beyond. Today, they are one of the most convenient, official ways of communication in institutions, offices and private companies to convey work and tasks or various announcements [2]. Email addresses in almost all companies and institutions are public and can be seen by everyone at any point of communication between two users, but they are also exposed on their official websites. Therefore, due to their confidential and transparent nature, we cannot write sensitive information in ordinary and institutional or

company e-mails [2]. We expect high privacy when communicating with regular mail, however regular e-mails are not private and do not offer security, they are exposed to everyone and very easy to fall prey to cybercrime. E-mails are mainly based on point-to-point communication [4].

**Material and Method**

In this study we have done the construction of the security of a system taking into account forclient 7.0 installed on some client computers and also fortinet with fos 7.0, which support forticlient with free licenses and Fortiweb. FortiClient is software that provides remote filtering of the institution's network, providing more security on the web and filtering the content of information that can be accessed from the web [3]. The Web Application Firewall provides botnet protection and granular traffic control of applications used by employees in relevant institutions, including several applications, web-based applications, and also software as a service (SaaS) [3]. FortiClient is a Fabric agent that provides external threat protection, compliance, and secure access in a single, lightweight, modular client [5]. A Fabric Agent is a piece of endpoint software that runs on an endpoint, such as laptop or mobile device, which communicates with the Fortinet Security Fabric to provide information, visibility and control for that device. It also enables secure, remote connection to the Security Factory [6].

**Results and Discussion**

The FortiClient 7.0 that we have installed includes a vulnerability scanning component that the system can display to check the endpoints of the security system and for known vulnerabilities [7]. The possible results of the vulnerability scan may include these elements that we have presented:

- The list of vulnerabilities detected in the system and in the endpoints of the system.
- How many detected vulnerabilities should be evaluated as critical system threats, as high, medium or low system threats.
- If we need more information, we will contact the FortiGuard Center [8].
- One-click connection to install system troubleshooting and resolve as many identified vulnerabilities as possible.
- Some elements of these solutions require manual installation to resolve vulnerabilities.
- FortiClient has the ability to detect and recognize vulnerabilities for many software [9].



**Figure 1.** Vulnerabilities in forticlient.

For the safest protection of the system, perform the following actions by checking the following components:



**Figure 2.** The Component checked in the following data to increase the security of the system [10]

**Conclusion**

At the end of this study, which was also a practical development of an application for the protection of information security [11].

If all security policies are correctly implemented, the application provides protection of security information and safe transfer of information.

We have managed to record some of the logs that have been captured and so far we have not been able to see a breach of its security [12].

To secure e-mail and the network, there are several steps that must be followed: create an identity, set up secure email software, obtain public keys for software, get public keys for recipients, start sending secure messages [6,13].

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# Simulation with the Mirone application for the construction of marine mechanical waves generated by possible seismic events in the territory of the Adriatic and Ionian seas

**Adisa Daberdini** *[1] , **Fatmir Basholli** [2] , **Novrus Metaj** [3]

[1]*University Aleksander Xhuvani, Department of Informatics, Elbasan, Albania, adisa.daberdini@uniel.edu.al*
[2]*Albanian University, Department of Engineering, Tirana, Albania, fatmir.basholli@albanianuniversity.edu.al*
[3]*Polytechnic University of Tirana, Department of Physical Engineering, Albania, novimetaj@gmail.com*

**Keywords**
Seismic Simulation
Wave
Tsunamis
Applications

**Abstract**
In this study, we will present the practical development of some simulations that we have done with the Mirone program for the generation of tsunami waves. These simulations are taken into account for real seismic events that have occurred in the Adriatic and Ionian seas throughout history and the data that have been reported for certain areas. In practical simulations with applications, we have the opportunity to see what is actually expected to happen in such events. We have presented several scenarios and we have also analyzed all the results that we have derived from the calculations and simulations made. We have taken risk assessment scenarios in both our seas and we have also given the effects they will have on the ecology of coastal areas and underwater ecology. In the tectonic origin risk assessment scenario in the Adriatic and Ionian seas, we study the tsunami risk generated by faults. Despite the fact that most of the seismic tsunamis are generated in the oceans as well as in the basins of small seas such as the Adriatic and the Ionian, where these phenomena can occur. A scenario-based method was used to provide a tsunami hazard assessment for the first time in this region.

## Introduction

Real seismic sources with tsunami potential are found to model the expected coseismic deformation, which is directly related to the water surface and is used as an initial condition for tsunami propagation. Seismic results show examined sources and only presents very high threat causing wave amplitude up to 4m, one high, two intermediate and three low waves causing amplitude smaller than 4 m in some of the tourist resorts along the Ionian coast -Adriatic.

The Ionian-Adriatic region has experienced a sudden economic and tourism boom with an increase in the coastal population and the development of large free time zones in recent years and more so in parts of coastal cities that are only a few meters above sea level. sea making them future targets of a large-scale disaster, even if the height of the tsunami wave is moderate.

Large tsunami events require the presence of a thick layer of water that can only be found in oceanic domains, but they can also occur in small basins such as the Ionian and Adriatic seas in which many tsunamis have been reported during historical periods.

Numerical modeling of the tsunami, mainly those made by Bousinesq and Green's models, are the basis for the construction and coding of the programs used for the simulations [1]. These numerical models and the algorithms built from them are integrated into the Mirone, Geowave programs that contain both numerical models. Both of

these programs are Matlab based. We have also presented the data we have collected through the Surfer and Wizmap programs that serve for the visual and three-dimensional construction of the structures and for merging these data with the maps we have. As input parameters of the program, we put the data of our coast longitude and latitude and the depths [2].

Mirone is a matlab-based program that allows the display and manipulation of a large number of grid formats through its interface with the GDAL library. Its main purpose is to provide users with an easier use of graphics compared to the more frequently used programs of the GMT package [3].

In addition, it offers a large number of tools that are focused in particular on the field of geophysics and earth sciences [4]. Among them the user can find tools to do multibeam planning, elastic deformation studies, tsunami propagation modeling, IGRF calculation and Parker magnetic inversion, Euler rotations and Euler pole calculation, plate tectonic reconstructions, seismicity analysis and mechanisms of hearth, advanced image processing tools. Mirone is written using the Matlab programming language a separate version is also provided to run under the Windows operating system [5].

**Material and Method**

For the study and development of the simulations, we have taken into account the bathymetry of the Adriatic and Ionian seas and also the earthquake events that have occurred in these areas. Materials for this study we used different software, while for the construction of simulations one of the software's is Mirone. Below are the bathymetry data and also the profiles that were taken into consideration for the development of the simulations. [6]. The profiles are obtained as follows: the first coordinate is taken on our coast and the second coordinate is taken on the nearest neighboring coast. We will have a very accurate presentation of the profile and the distance of each of the two points. The profiles are almost parallel to each other and have different distances starting from the geometry of the coast and the bathometric data that we had available from the institute. Also, in the construction of bathymetry we have used another program Surfer that we have built the coastal basin using the dates obtained from the depths of the profiles [7].

Each of these profiles we have obtained has a very special structure and what we expect is that an earthquake occurring in different areas of these profiles will affect in different ways [8].
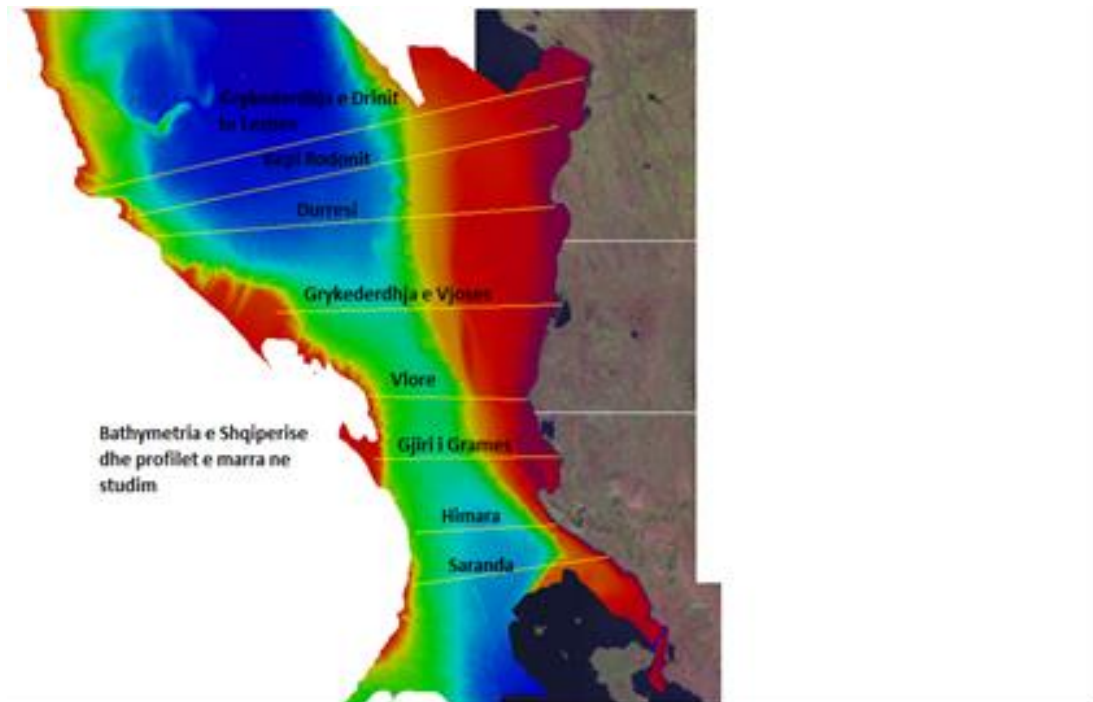


**Figure 1.** Bathymetry of Adriatic and Ionian Seas build with Caris Base Edition 4.1.

This menu has options to display data related to earthquakes and the mechanisms and elastic deformations that generate the earthquake. Below we also have the tool that allows us to simulate the spread of the tsunami. Figure 2 give us the simulations with the data used.
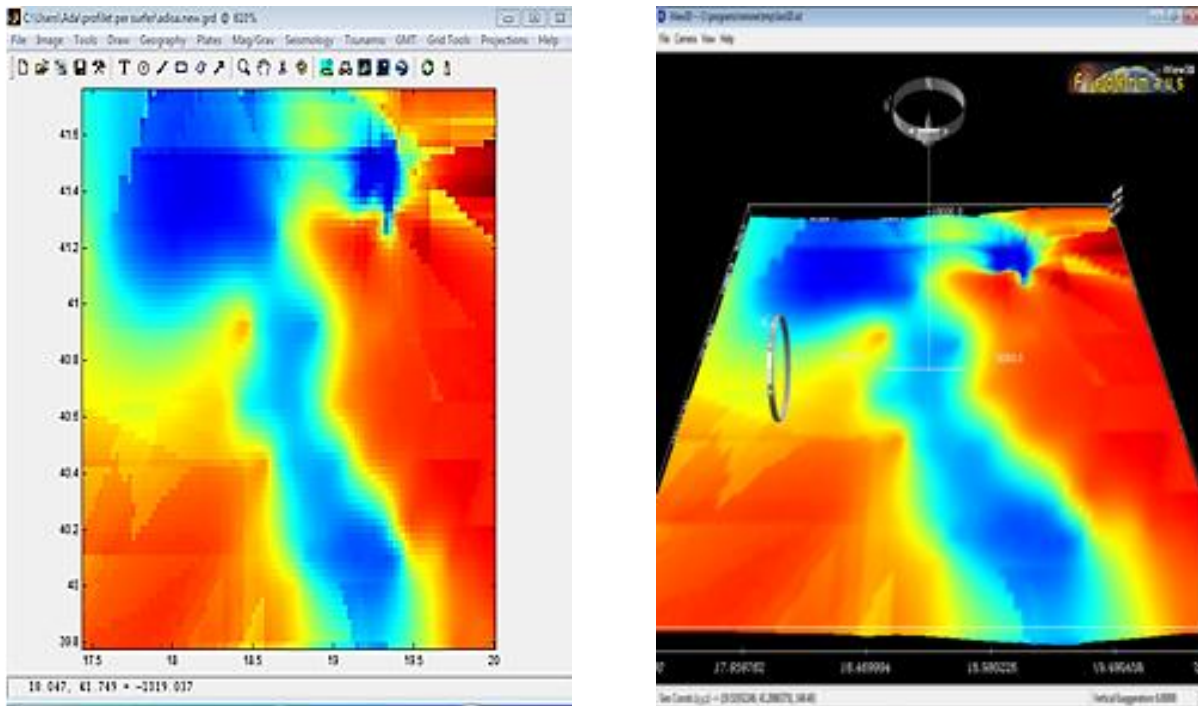
**Figure 2.** Bathymetry of our 3D coasts taken in Mirone

**Results**

First, the results of this study show how to build an approximate model for the structuring of the Adriatic and Ionian seas if the Adriatic and Ionian seas were to undergo a seismic activity and if in these cases a tsunami would develop in marine dimensions.

Secondly the physical structure can be damaged by the force of the wave itself, the physical removal of flora and fauna and the growth of sediments which can kill species that are sensitive to sediments and the disturbance of underwater vegetation [9].

**Discussion**

First in the north at the Drini estuary the tsunami wave has a high probability that if it occurs in a position close to the coast as a wave of a tsunami of the V degree with a height of 1 m and a tsunami of the VI degree with a tsunami wave of a height of 2 m there are many opportunities for wide spread on the coast and in the surroundings and in the villages and even on the streets. Normally, a tsunami wave with a height of 2 m will be more damaging. Secondly, in Sarandë, the tsunami occurring near the coast will have an impact only on the parts very close to the coast due to the high profile of the coast.

Thirdly, in Vlora, Grykëderdhjen e Vjosa, Divjakë are the areas with the most risk because in these profiles due to the low height of the areas near the coast there is a risk that in the case of a tsunami the areas will be flooded and have a great impact on the beach period of holidays when these areas have a lot of population [10].

The figures below show the tsunami wave simulations for two of the main profiles we have in the study Rodon Cape and Durres. The dark blue indicates the depth zone, the yellow dot located on the first map indicates the source from which the earthquake will be taken, and then the blue areas on the side of the map show the areas that may be flooded [11]. The figure on the left shows the unimulated scheme and the points where the generations were taken, while on the right it shows after the simulation and the areas where the wave can propagate.

**Conclusion**

The mapping of the depths of the Adriatic Sea as well as the mapping of the depths and focal mechanisms of earthquakes of recent years has been calculated the maximum value of the wave that may have the tsunami generation in these areas [12].

If a thrust type earthquake with magnitude M> 6.5 Richter occurs in the area of Adriatic with with distance more than 25 km from the coast it can generate a tsunami on the coast at coordinates from Durres 41.292260, 19.503316 to Shengjin 41.809225, 19.597102 up to a height of 0.5-1m. problems can be shown even in the south of Adriatic near Divjaka with coordinates 40.832932, 19.368522.

In the recent earthquake events in addition to the damage to people and material damage we had, we can consider as something very positive the fact that the earthquakes occurred very close to the ground and there was no possibility of generating a tsunami wave.

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# Smart digital education in the context of Industry 4.0 technologies

**Madhuri Vangeti** *1 , **Ramesh Rudrapati** 2 , **Parmod Kumar** 3

*1Bule Hora University, Electrical & Computer Engineering Department, Ethiopia, rameshrudrapati@gmail.com*
*2Bule Hora University, Industrial Engineering Department, Ethiopia, rameshrudrapati@gmail.com*
*3Jiangxi University, Department of Electronics & Information Engineering, China, dr-kumar2019@yandex.com*

**Keywords**
Industry 4.0
Digital learning
Smart digital education
Smart learning tools

**Abstract**
Technology advancements in Industry 4.0 (I4.0) tools have the potential to create smart digital education environments (SDE). SDE aims to utilize various digital learning approaches to provide learners with modern skills and advancements quickly. The present study is focused on exploring the advantages of critical digital components of I4.0 technologies like artificial intelligence, augmented reality, Bigdata, cloud computing, internet of things to integrate with different digital learning methods in SDE platforms to explore the possibilities. From the study, interpretation can also be made. Based on the analysis and the results, SDE platforms have been enhanced by integrating digital learning methods with I4.0 tools to improve the teaching & learning process.

## Introduction

The fourth industrial revolution has proposed various digital technologies to change modern people's social, economic, and cultural fields [1]. These changes also impacted on the education sector in a significant way. Using industry 4.0 (I4.0) tools to transform traditional education into smart digital education is one way to enhance the efficiency and effectiveness of education in this new millennium. Providing systematic learning support to learners means that the smart environment and learning principles are closely connected, giving learners a seamless experience. The present study is planned to address the importance of integrating digital learning approaches with I4.0 technologies to create smart digital education environments.

## Material and Method

In a new education paradigm, many pillars are pushing the education system in a new direction, such as imagination, innovation, inspiration, interactivity, interconnection, and improvement. Netexplo's perspective of smart digital education mentioned by Cathelat, in his study that digital smart education is evolving into a new direction to directorate the various teaching methods to enhance the education levels to the sophisticated stage to reach modern people [2]. Netexplo's perspective of modern learning methods to benefit the learners from functional education is adaptive, blended, continuous, customized, immerse, interactive, and social. The details of various types of modern learning methodologies are described as follows:

i.  **Adaptive Learning:** This concept of adaptive learning refers primarily to the process of learning that adapts to an individual's learning style. With the inherent benefits that digital ecosystems provide, leveraging these platforms can be used to create training programs and make sure that they're presented to the right people at the right time. It is a method that integrates data collection in real-time, analysis of learner behavior, analysis of results, and the adjustment, if necessary, of the difficulties of training sequences.

ii. **Blended Learning:** Blended learning is in line with the user experience requirements as far as user experience is concerned. With this method, one can mobilize diverse approaches and types of materials.

iii. **Continuous Learning:** In the digital learning environment, there are technologies available that can monitor the activities that are taking place. The ability to offer the appropriate training and assist in acquiring new skills is a constant characteristic of these consultants. Although this seems self-evident, it is surprising that relatively few people aspire to continue training throughout their lives.

iv. **Customized Learning:** The digital technologies in this learning era facilitate a personalized and localized delivery of content, which enables profiling and assimilation of information. The effectiveness of customized learning seems to be immediately apparent.

v. **Immerse Learning:** Learning using digital innovation allows the learners to experience real-life situations, train in a specific skill or technique, and practice it in various situations. An immersive learning environment creates a more engaging learning experience for learners and instructors.

vi. **Interactive Learning:** For learning and teaching to become more engaging, the interaction between teachers and students is vital. For the teacher to achieve this, greater flexibility and responsiveness are required, as well as adaptation to the changing conditions in real time. In this age of digital era, teachers and their digital aids are more agile than ever before, thanks to the internet.

vii. **Social Learning:** With social learning, learners can create fun games and quizzes to learn and rehearse to better recall what they have learned. There will be a standard screen around which the participants will be grouped, and they will all be able to participate simultaneously.

**Industry 4.0 (I4.0) concept**

Industry 4.0 (I4.0) is framed by considering the rapid developments in communication and information technologies to make transformation from traditional systems to digital system [1]. The important components of I4.0 are artificial intelligence, augmented reality, Bigdata, cloud computing, internet of things.

**i. Artificial Intelligence (AI):** Artificial intelligence enhances students' educational experience with various personalized and innovative academic approaches. Artificial intelligence in smart digital education enables students to receive customized feedback on their work. AI is pioneering and applying to digital education in several ways, including text mining, visual search, and more.

**ii. Augmented Reality (AR):** Real-time integration of digital information into a user's environment is the concept of augmented reality (AR) [3]. With these technologies, students can participate actively in any situation, anywhere. Providing students with the opportunity to gain hands-on experience, practice, experimentation, and training through digital educational ecosystems will enable them to find their learning path.

**iii. Big Data:** With the advent of Big Data technologies, education is now being improved in a significant way. Bigdata has transformed education from a traditional method to a smarter one. Big data can be used to evaluate learning styles, student performance, and employment success efficiently. An educational system can be improved through Big Data by using it efficiently, effectively, and reliably.

**iv. Cloud Computing (CC):** Education has been revolutionized by cloud computing. Digital education offers several benefits with the adoption of cloud computing. By creating an open, flexible, and unified learning environment, cloud computing technology can enhance educational environments for many different purposes.

**V. Internet of things (IoT):** The Internet of Things is a network of connected sensors that collect and store information and transmit it locally or remotely [4]. A key benefit of IoT is that it allows teachers and students to engage in a continuous process of educating students. Consequently, educational institutions can enhance their students' learning experience by creating more agile learning systems, improving the quality of their education, and improving the educational quality of their institutions.

**Results and Discussion**

Industry 4.0 (I4.0) technologies are expected to play a major role in creating smart digital educational (SDE) environments [5]. Table 1 shows the level of support of I.40 technologies with different digital learning approaches to develop SDE platforms. To achieve better yields, SDE systems require various learning methods such as adaptive, blended, continuous, customized, immerse, interactive, and social learning. For the SDE to use the potential advantages of advanced technologies being proposed through industry 4.0, there may be a requirement for modernized infrastructure like smart digital campus, smart digital classroom, smart digital learning, smart digital learning analytics, [5] etc. The use of digital education, accompanied by good learning techniques, may

increase equality, also apart from gender, race, and background, among students. The emerging trends of I4.0, such as AI, augmented reality, big data, cloud computing, and the internet of things, will make it easier to create digital environments in the future, significantly impacting the SDE system. Learning, teaching, interacting, and collaborating has become easier than ever via modern technology, and obtaining instant information is also more effective and efficient.

**Table 1.** Industry 4.0 tools and their level of support for various learning approaches

| S. No | Parameter / learning method | Adaptive learning | Blended learning | Continuous learning | Customized learning | Immerse learning | Interactive learning | Social learning |
|---|---|---|---|---|---|---|---|---|
| 1 | AI | EH | EH | EH | EH | EH | MH | MH |
| 2 | AR | EH | S | MH | EH | EH | EH | MH |
| 3 | Big data | EH | EH | EH | MH | EH | MH | S |
| 4 | CC | MH | S | MH | S | S | EH | EH |
| 5 | IoT | EH | S | EH | EH | MH | MH | EH |

EH = Extreme Help; MH = Moderate Help; S = Supportive

**Conclusion**

This paper proposes integrating digital learning approaches with Industry 4.0 technologies like artificial intelligence, augmented reality, Bigdata, cloud computing, and internet of things to explore sophisticated learning experiences for teachers and students. Creating smart digital education for learners will be possible once smart education and digital content orientations meet. Using smart devices in the education system provides students with more opportunities to choose the type of education they will receive and the profession they will pursue. Additionally, it represents a sort of liberation regarding how time is regarded in education.

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# Review on impacts of climate change on water resources in Turkey

**Joudi Rustem** [*1] , **Mustafa Günal** [1]

[1]Gaziantep University, Civil Engineering Department, Türkiye, joudi.rustem@gmail.com, gunal@gantep.edu.tr

**Keywords**
Climate change
Greenhouse gas emissions
Water resources

**Abstract**
Climate change has an impact on precipitation and temperature. The geographical availability of water resources is significantly impacted by these changes. Due to its location in the Mediterranean Basin, Turkey is expected to suffer greatly from the negative consequences of climate change, notably in terms of its water supplies. examine the climate change situation in Turkey, the impact of Turkey's greenhouse gas emissions on temperature and precipitation, the possible impact of climate change on water resources, and the impacts of sea level rise and floods. examples from the nation and strategies for adjusting to the effects of climate change.

## Introduction

According to the Intergovernmental Panel on Climate Change Assessment Report [1], there is evidence that human activity is primarily to blame for the majority of the warming that has been recorded over the past 50 years. The 21st century is likely to see more climate change due to the anticipated accumulation of greenhouse gases in the atmosphere. Furthermore, global warming is expected to have a significant impact on river basin hydrology and water resources. Because temperature determines the fraction of precipitation that falls as snow and the timing of snowmelt, basins with a high proportion of runoff driven by snowmelt will be especially vulnerable to global warming. Few individual and regional research on the effects of climate change on Turkey's water resources have been published. The broader picture of the situation in Turkey, however, had not before been looked at in the literature. As a result, the purpose of this article is to examine, using prior studies in the field, how climate change is affecting Turkey's water resources on a national scale.

## Material and Method

### Greenhouse gas emissions in Turkey

Between 1990 and 2008, Turkey's total greenhouse gas emissions increased steadily. The 2008 emissions (365.5 million tons) were 96.0% (nearly double) higher than the 1990 emissions (187.03 million tons). By 2008, the emissions from the energy sector accounted for 75.8% of total emissions, waste disposal accounted for 9.3%, and industrial processes accounted for 8.1% of total emissions. Land use and land use change, as well as forestry, which serve as carbon dioxide sinks, should be considered in greenhouse gas emissions. The steady increase in greenhouse gases from 1990 to 2008 was primarily due to changes in the energy sector and industrial processes [2].

**Effects of climate change on temperature and precipitation**

Climate change has an impact on water availability, as well as its quality and distribution. Changes in runoff and the source of a region's renewable water supply are the direct result of temperature-driven changes in precipitation and evaporation. Because of the presence of several climatic regions, Turkey can be considered a country that is extremely vulnerable to the effects of climate change. However, for a relatively large country with a diverse climate like Turkey, it is important to consider local conditions rather than the entire country. Desertification threatens arid and semi-arid regions such as Middle and Southeast Anatolia. The semi-humid Aegean and Mediterranean regions, on the other hand, will be affected due to a lack of water resources. Because of climatic differences, different regions of the country will be affected differently. Changes in temperature and precipitation are both important components of climate change. Similarly, to global temperature changes, mean ambient temperatures in Turkey tend to rise. Turkey's mean temperature has steadily increased with a trend of 0.64°C/100 years [3]. A statistical analysis of rainfall in Turkey between 1930 and 1993 revealed that area averaged annual rainfall decreased slightly during this period, though the decreasing trend in annual rainfall was statistically significant in some of the country's stations located in the Mediterranean region. However, precipitation has decreased more pronouncedly since the 1990s. In the last 25 years, precipitation in the Mediterranean Basin has decreased by 20% [4]. It is also expected that the decreasing trend will continue, with a significant drop in precipitation in Turkey's semi-arid Mediterranean, Aegean, and Central Anatolian regions, as well as an increase in mean annual temperatures. The annual mean temperature increase in Turkey is expected to be around 2-3 degrees Celsius until the end of the twenty-first century. Precipitation generally decreases along the Aegean and Mediterranean coasts while increasing along the Black Sea coast [5]. According to IPCC scenarios, a 20% decrease in precipitation is predicted in both winter and summer months in Turkey during the twenty-first century.

**Effect of climate change on water resources potential in Turkey**

In Turkey, the average annual precipitation is 643 mm, which equates to 501 billion $m^3$ of water. Evaporation consumes 274 billion m3. 158 billion m3 of water forms the surface flows, while 69 billion $m^3$ feeds groundwater, 28 billion $m^3$ of which rejoins the surface waters. Including the 7 billion $m^3$ of water imported from other countries, the country's renewable water potential is 234 billion $m^3$. Annual precipitation is expected to fall to 325 billion m3 by 2050, with surface flow falling to 130 billion $m^3$ from the current value of 193 billion $m^3$ [6]. River water temperature appeared to be increasing linearly at a mean annual rate of about 0.2 °C. Warmer water, in addition to having a higher potential for evaporation, can result in lower dissolved oxygen concentrations in surface waters [7]. As a result, rising temperatures degrade both the quality and quantity of river water, Climate change is also expected to affect the relative amounts of snow and rain, as well as the timing of snowmelt and runoff. Climate change may cause a shift from snow to rain, increasing the likelihood of flooding early in the year and reducing water availability.

**Results**

The paper summarizes Turkey's situation in terms of climate change's impact on water resources. There have been few studies in the past that focused on specific regions. According to these studies, climate change will have a negative impact on water availability in Turkey overall. However, the majority of the country's hydrological basins have yet to be evaluated. A large-scale research project is needed to thoroughly examine the impact of climate change on water resources at the local level, taking into account all meteorological regions and hydrological basins in the country. Although some adaptation measures have been implemented in recent years. A more thorough investigation will yield stronger regulations that could serve as a model for other nations in the area.

**Discussion**

Predicting the effects of climate change, as well as effective mitigation and adaptation strategies, is critical for ensuring sustainable water management. The emission of greenhouse gases is the driving force behind climate change. As a result, greater efforts should be made to reduce emissions and develop new technologies to combat climate change. Groundwater must be protected, and its use and upkeep must be adapted to climate change. Artificial groundwater recharge is a critical alternative or supplement to the preservation or restoration of natural infiltration conditions.

**Conclusion**

The results showed that:

1. Compared to now, decreased precipitation will result in significantly lower inflow, with the peak monthly inflow occurring earlier than now.
2. The ratio of water withdrawal to discharge will increase due to the effects of global warming (decreased discharge), though it is possible to meet future water demand using the water resources system.
3. Water scarcity will result from the effects of global warming and increased demand for water.

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# Stone material problems in Mardin historical İzzetpaşa Old Prison

**Lale Karataş**\*1 , **Aydın Alptekin** 2 , **Murat Yakar** 3

*1Mardin Artuklu University, Department of Architecture and Urban Planning, Mardin, Türkiye, lalekaratas@artuklu.edu.tr*
*2Mersin University, Department of Geological Engineering, Mersin, Türkiye, aydinalptekin@mersin.edu.tr*
*3Mersin University, Geomatics Engineering Department, Mersin, Türkiye, myakar@mersin.edu.tr*

**Keywords**
Mardin
Material Deterioration
Stone Material
Historical Building
Sustainability

**Abstract**
Types of deterioration in stone structures have different effects when they occur on different elements of the building. Therefore, the identification of material deterioration along with the classification of structural elements is important for accurate damage classification. The aim of the study is to reveal the material problems of the historical Mardin İzzetpaşa Old Prison. In this context, the deteriorations occurring in the structure were classified and exemplified with visuals. ICOMOS (illustrated Glossary) stone deterioration classification was used to define the deterioration types in the structure. When the structure was examined, it was observed that deterioration caused by physical, chemical and human effects was common. Physical deterioration in the structure, loss of surface, wear and joint discharge; chemical degradation, surface pollution, color change examples are seen. There are also deteriorations caused by human effects such as faulty repair and lack of maintenance.

## Introduction

Conservation of stone cultural heritage is a primary concern in all countries. In this context, it is crucial to develop effective and integrated methodologies aimed at diagnosing material problems of a structure [1-4]. If the necessary investigations and precautions are not taken on the cultural heritage structures that have suffered material deterioration, small-scale deterioration types can turn into a larger-scale anomaly. This causes loss of historical trace over time. Therefore, the detection of deterioration, which is the most important step in preserving the traces of cultural heritage in historical areas, constitutes one of the most important stages of restoration work [5-16]. Types of deterioration in stone structures have different effects, especially when they affect structural (roof, facade, etc.) and non-structural elements (windows, doors, etc.). Therefore, the classification of structural elements and the identification of material deterioration is important for a systematic damage diagnosis [17]. In this context, the aim of the study is to make a detailed damage classification of the structure by revealing the types of deterioration on the different elements of the building.

## Study area

İzzet Paşa Police Station Building is located in Mardin Province, Artuklu District, Nur Neighborhood. It is referred to as the Gendarmerie Station Building in 1400 block 4 parcel with an area of 18,612,42 square meters. The Police Station Building, Çelbira 1st Degree Archaeological Site, remains in the interaction area and was registered and protected as a Class I Cultural Heritage with the decision of Diyarbakır Cultural and Natural Heritage Conservation Regional Board dated 11.07.2008 and numbered 1690. The area where the building is located is located in a location where concentration is foreseen in terms of urban planning and where the establishment of important living spaces is planned. In addition, it is an important advantage that it is located in the Çelbira 1st Degree Archaeological Site interaction area (Figure 1).

**Figure 1.** A view from the Celbira Workshop Area, 1st Degree Archaeological Site

**Material and Method**

In the first stage, the general features of the architecture of the historical structure of Mardin İzzetpaşa Old Prison were examined. Secondly, the information and documents obtained from the building were examined, and its current situation was documented with photographs and drawings. As a result of the documentation and field work, the deterioration of the structure and the factors causing the deterioration were determined. In the study, observations were made about the stone deterioration that occurred in the Mardin İzzetpaşa Old Prison building within the borders of Mardin province. The different types of degradation detected were identified and photographed and documented. ICOMOS illustrated Glossary stone deterioration classification was used to define the deterioration types in the structure. Finally, the documentation and research on the building are summarized in the conclusion, together with the suggestions.

**Results**

Joint loosening, use of cement, color change, loss of surface, loss of parts, incorrect paint application, stone material problems were encountered in the building (Figure 2-5).



Joint discharge (a), Cement use (b, c), Surface loss (d), Color change (e)
**Figure 2.** Stone deterioration on the south façade of the building



Joint discharge (a), Cement use (b, c), Surface loss (d)
**Figure 3.** Stone deterioration on the east facade of the building



Cement Usage(a,c,d), Surface Loss(b), Surface Loss(c), Joint Discharge(e)
**Figure 4.** Stone deterioration on the northern façade of the building




Joint discharge (a), Surface loss (b), Incorrect paint application (c)

Joint discharge(a), Color Change(b), Piece Loss(c)

**Figure 5.** Stone deterioration in the interior of the building

**Conclusion**

In this study, the deteriorations in the historical structure of Izzetpasa Old Prison in the central district of Mardin province were examined. When the structure was examined, it was observed that deterioration caused by

physical, chemical and human effects was common. As physical deterioration in the structure: loss of surface, wear and joint discharge; As chemical degradation: surface pollution, color change examples are seen. In addition, there are deteriorations caused by human effects such as faulty repair and lack of maintenance. Combining the above-mentioned data with a GIS system in future studies will help to monitor the life cycle of the structure under consideration in terms of sustainability. Various repairs on the building, using insufficient materials in the last centuries, have increased the damage and created critical stability problems, especially on the south wall. Within the scope of the study, the forms of decomposition were mapped in detail. In situ analyzes (micro-piercing resistance, Schmidt hammer rebound test, capillary water absorption) provided data on the degradation state of the major lithologies. Petrophysical data show that stratigraphically comparable building blocks exhibit different technical properties and weathering behavior. All data serve to characterize the weathering state and provide dataset for planning future restoration work.

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# Increasing the usage of green concrete in conflict areas

**Mazen Alhamidi** *1

*1Gaziantep University, Civil Engineering Department, Türkiye, mazen.ah38126@hotmail.com*

**Keywords**
Green concrete
Demolished construction
Debris
Fly-Ash
Glass powder
Reusable material

**Abstract**
Green concrete is the most recent advancement in construction technology, offering a sustainable and environmentally friendly alternative to traditional concrete as a building material. The cement used in traditional concrete contributes significantly to the release of dangerous carbon dioxide into the atmosphere. Green concrete is a concept that involves the partial or complete substitution of cement with a variety of elements that are either by-products of the manufacture of other materials or recovered garbage. The following article discusses. Green concrete is created by partly substituting fly ash for cement, which is derived from the combustion of pulverized coal in electric power plants, and totally substituting fine aggregate for a 60 percent – 40 percent replacement rate. A mixture of crushed glass and destroyed building trash that has been transformed until it reaches a fine powdered state. Building debris obtained from the remnants of buildings destroyed due to the conflict. Additionally, a comparison of the characteristics of normal concrete and green concrete materials.

## Introduction

Concrete is the most prevalent building material used in the construction industry. Its great strength, long-term durability, and mechanical qualities make it a highly useable material with a diverse range of uses. Despite its tremendous benefits, it does have some drawbacks. Conventional concrete is not considered a reusable product since the raw materials required to make it are not generated in an environmentally friendly way and do damage to the environment. Cement, one of the components of concrete, is responsible for more than 6% of all $CO_2$ emissions, which contributes to global warming (Greenhouse gas). $CO_2$ emissions range between 0.05 and 0.13 tons every ton of concrete produced. Cement manufacture accounts for 95% of all $CO_2$ emissions from a cubic meter of concrete. The Middle East is one of the world's biggest consumers of cement and an important producer of it. Green Concrete created to mitigate this detrimental effect [1]. It produced for the first time in 1998 in Denmark BY Dr. W.G. Green buildings and reusable construction practices have proved very effective in reducing Green House Gas emissions by using green concrete. It is an eco-friendly concrete that emits a tiny quantity of $CO_2$ during the manufacturing process, posing no environmental hazard. It incorporates waste materials into its design. Numerous benefits of Green Concrete make it the most appropriate material for the building sector include the following:

**- It contributes** to the reduction of structure's dead weight.

**- It contributes** to complete the building construction more quickly by shortening the total build duration.

**- It contributes** to a 30% decrease in CO2 emissions [2].

**- It contributes** to the re-use of waste material.

**- It is thermally** and fire resistant.

**-It has a stronger** compressive strength than traditional concrete at the same water-cement ratio. Fly ash, granulated blast furnace slag, recycled concrete, demolition debris, micro silica, glass powder, marble powder, and quarry dust are all examples of materials that may be utilize in place of standard components. To save on energy and transportation costs, recycled material or industrial waste might be chosen depending on its availability near the building site. The following items fall within this category and are addressed in detail below.

**- Aggregate made from demolished construction debris-** These construction material fractions are the remnants that can be reuse from the destroyed structure. A mixture of natural and recycled aggregates. Concrete's characteristics are unaffected by demolition aggregate [3].

**- Fly Ash** – Fly ash is the product of coal combustion Coal- fired power and steam plants. fly ash provide environmental benefits by improves concrete durability, reducing energy and greenhouse gas emissions and conserving other natural resources. Cement can be replaced by fly ash up to 80% without changing the property of the final product. A cheap, economical and abundant material can be it is easily used as a substitute for cement.

**- Slag from a kiln** - has a property equivalent to cement. That obtained as a by-product of iron and steel in the steam     industry or water from the blast furnace.

**- Husk of rice** - obtained as a by-product of rice milling. It contains 83-87% of amorphous silica. Considered as the most important alternative of cement material producing green concrete this reduces carbon dioxide emissions.

**- A mixture of marble powder** - waste marble powder is industrial waste contains heavy metals in the ingredient. Marble powder has a very high blain purity of about 1.5m2/g with 90% of particles passing through a sieve are 50 μm and 50% are under 7 μm [4].

**Material and Method**

**- Cement** - Ordinary Portland cement grade 43. Was used Emphasis on IS 8112-1989 with normal consistency of 28% with the characteristics listed in Table 1.

**- Aggregate with a coarse texture** - coarse aggregate usually available, which passes through a sieve with a size of 12.5-20 mm corresponding to IS 383:
1970 is used.

**- Soft Aggregate** - Medium sized sand passing through 4.75 mm   Sieve conforming to IS 2386: 1963 in use. Water - tap water is used to prepare green and normal water concrete.

**-Fly ash** - fly ash obtained when pulverized coal is burned produce heat. Fly ash produces cement compound calcium silicate
Hydrate (C-S-H) when reacting with lime and alkali. Reaction.  It represented by the following equation [3]:

Cement Reaction:  $C_3S + H \rightarrow C - S - H + CaOH$
Pozolanic Reaction:  $CaOH + S \rightarrow C - S - H$
The characteristics of the fly ash used are shown in Table1.

**Glass powder** - Glass is mainly composed of silica. Garbage glass created after its service life is converted into small- sized particles or in powder form, and also undergoes pozolanic reactions with cement hydrate, secondary calcium silicate hydrate is formed (C -S - H).

**Concrete and brick rubble** - concrete and brick debris after the demolishing of buildings, it can be converted into powder form and can be used as a substitute for fine as well Coarse aggregate in the preparation of green concrete.

**Design mix**

The concrete mix design of M20 grade both normal and green concrete has been done confirming to the specification of code IS 10262-2009. The design mix proportion is shown in Table 1. The proportion by Bulk Density for the materials are given in 9 cubes of 150 mm 150 mm 150 mm are prepared for normal concrete and 9 cubes of 150 mm 150 mm 150 mm are prepared by replacing 50% cement by fly ash and 100% fine It is prepared

by replacing 50% of the cement with fly ash and 100% fine tell us. The characteristics of the fly ash used are shown in Table 1.

**Table 1.** Material Prosperities

| Material | Color | Specific Gravity | Bulk Density |
|---|---|---|---|
| Cement | Grey | 3.15 | - |
| Fine Aggregate | Grey | 2.57 | 1427 kg/m |
| Coarse Aggregate | Grey | 2.62 | 1211 kg/m |
| Fly Ash | Grey | 2.09 | 623 kg/ m |
| Glass powder | white | 2.39 | 1110kg/m |
| Concrete and brick debris | Grey | 1.98 | - |

**Results**

The test on concrete has been conducted during two stages: (1) the workability and consistency of fresh concrete is measured by slump test before the hardening of concrete, according to IS 1199-1959. 2) Compressive strength and water absorption test have been performed on hardened concrete.

**Conclusion**

The data from the experiments prove that green concrete is a feasible alternative to traditional concrete. Though it is showing that there is not much difference between the properties of both the concrete, but economic cost of green concrete is coming out to be less and if produced in large quantities may further create a huge difference. Further, green concrete utilizes waste products of other industries thus acting as a sink for these materials which otherwise creates a disturbance to the environment.

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# Comparison of performance evaluation of an existing reinforced concrete structure and post-retrofitting analysis results with linear and non-linear calculation methods

**Buğra Çeltik** *[1] , **Hüsnü Can** [2]

[1]KTO Karatay University, Department of Civil Engineering, Türkiye, bugra.celtik@gmail.com
[2]Gazi University, Department of Civil Engineering, Türkiye, husnucan@gazi.edu.tr

**Keywords**
Linear Analysis
Non-linear Analysis,
Damage Situations
Existing Reinforced
Concrete Building

**Abstract**
According to AFAD data, a significant part of the country's population is settled in regions with high earthquake risk. For this reason, performance analysis and retrofitting issues are extremely important for the buildings in Türkiye and the building designs should be calculated in the most realistic way under the influence of earthquakes. In this study, a building in İzmir, which was built according to the 2007 Turkish Earthquake Code, was analyzed. Within the scope of the analyzes, performance analyzes were made in the Sta4-CAD 14.1 software using the linear and non-linear calculation methods in TBDY 2018, and it was determined that the structure did not provide the required performance levels. For this reason, the structure was retrofitted with additional reinforced concrete shear walls and the analyzes were repeated. Structural performance of the building and the damage of the structural elements were examined using both calculation methods before and after retrofitting, and attention was drawn to the effect of solutions made with different methods on the analysis results.

## Introduction

As a result of the loss of life and property in Turkiye, especially in the earthquake disaster we have experienced in recent years, the need for new approaches has increased both in the design phase of new structures and in assessment of the earthquake performance of existing structures. In TBDY-2018, linear and non-linear calculation methods can be used to determine the performance of buildings under earthquake effects depending on their height and earthquake design classes. In linear calculation methods, it is assumed that the materials are linear elastic and the displacements of the structural system are small. In nonlinear analysis methods, there is an approach that the displacements are larger considering the effects of the nonlinear inelastic behavior of the materials on the system [1-2]. In addition, linear calculation methods are strength-based, non-linear calculation methods are strain-based.

Advances in structural engineering and computer technology help engineers calculate earthquake motion and its effects on structures more realistically and accurately. These developments allow the nonlinear behavior of building systems during earthquakes to be monitored more closely and their safety against collapse to be determined more realistically [3].

In this study, it is aimed to draw attention to the effect of solutions made with different methods on the analysis results.

**Material and Method**

The building was built in Izmir according to 2007 Turkish Code and consists of 10 floors; It is designed to 10.50 x 15.50 meters dimensions and story heights of 2.72 meters (Figure 1). The total height of the building, including the basement level, is 28.2 meters. The building type is reinforced concrete shear-frame, slab type is beam and slab floor, and the foundation type is continuous foundation arranged with bond beams. Hollow bricks are used for interior and exterior walls. As a result of the stripping and x-ray tools of the structural elements in the existing structure, it was seen that the rebar application was obeyed for the project, and it was understood that the rebar class was S220 from the experiments. According to the concrete core results, the concrete strength was c20. Soil class is Z2 and earthquake design class is DD2. The purpose of use of the building is residential.

With Sta4-CAD 14.1 software and calculation methods specified in TBDY 2018; Performance analyzes were performed using linear (mode combination method) and nonlinear (multi-modal method) calculation methods, respectively. In both calculation methods, collapse conditions were observed according to the current regulation, and then, taking into account the architectural project, retrofitting was made with 3 pieces of 2.50/0.30 m and 1 piece of 3.20/0.30 m reinforced concrete shear walls (Figure 2). In the new shear walls added, the reinforcement class is designed as s420 and the concrete quality as c30. After retrofitting, analyzes were repeated with linear and nonlinear calculation methods and the results were examined.
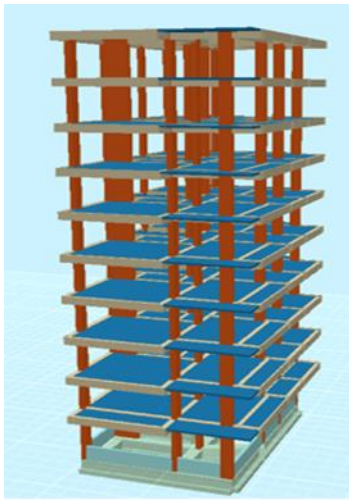


**Figure 1.** Building 3D View
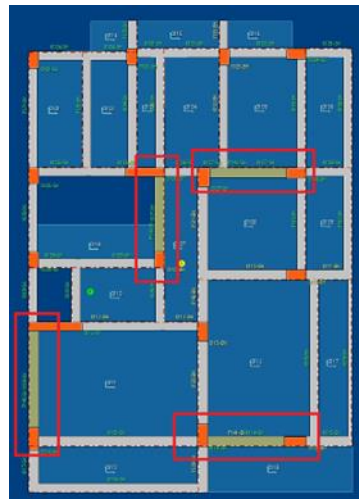


**Figure 2.** Floor Plan–Reinforcement Curtains

**Results**

One of the most important stages of the performance-based design method is to determine the damage levels of each of the structural elements [4]. Three damage states and damage limits were defined in TBDY-2018 for ductile sections. These are Limited Damage (IO), Controlled Damage (RC) and Collapse Damage (AR) states and their limit values. These criteria are important to achieve the targeted building performance level of Controlled Damage. The current and post-retrofitting conditions of the building were analyzed linearly and non-linearly, and the damage percentages of the structural elements were presented in the graphic (Figure 3-4). When we evaluate the element damages in the current situation; the linear calculation method showed approximately 2 times more damage value than the nonlinear calculation method. In the post-retrofitted situation, as expected, element damage remained at the targeted damage points, and no difference was observed.
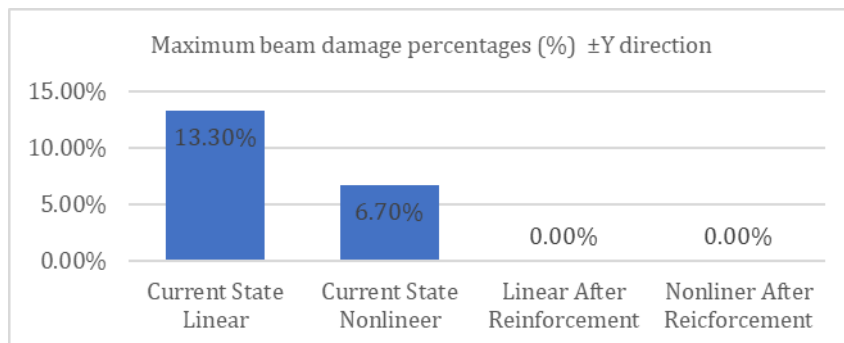


**Figure 3.** Damage Percentage of Beams in the Failure Zone
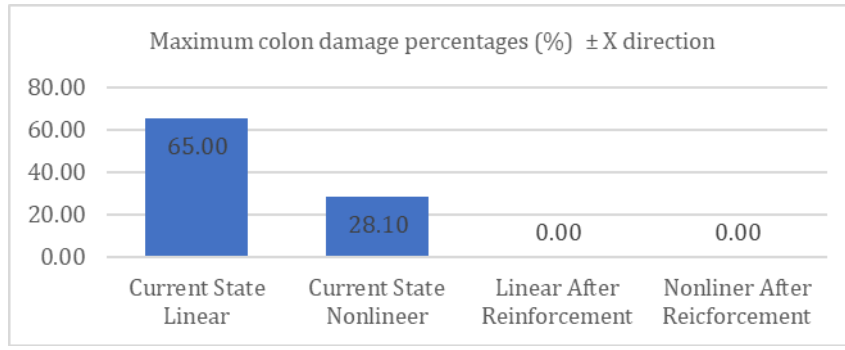
**Figure 4.** Damage Percentage of Columns in the Failure Region

When we look at the peak story drift values in the x and y directions, it is seen that the drift values decrease after retrofitting as expected in both calculation methods. In addition, the fact that the drift values are higher in the nonlinear analysis than the linear analysis shows that the nonlinear analysis calculates the structure behavior more realistically (Figure 5).
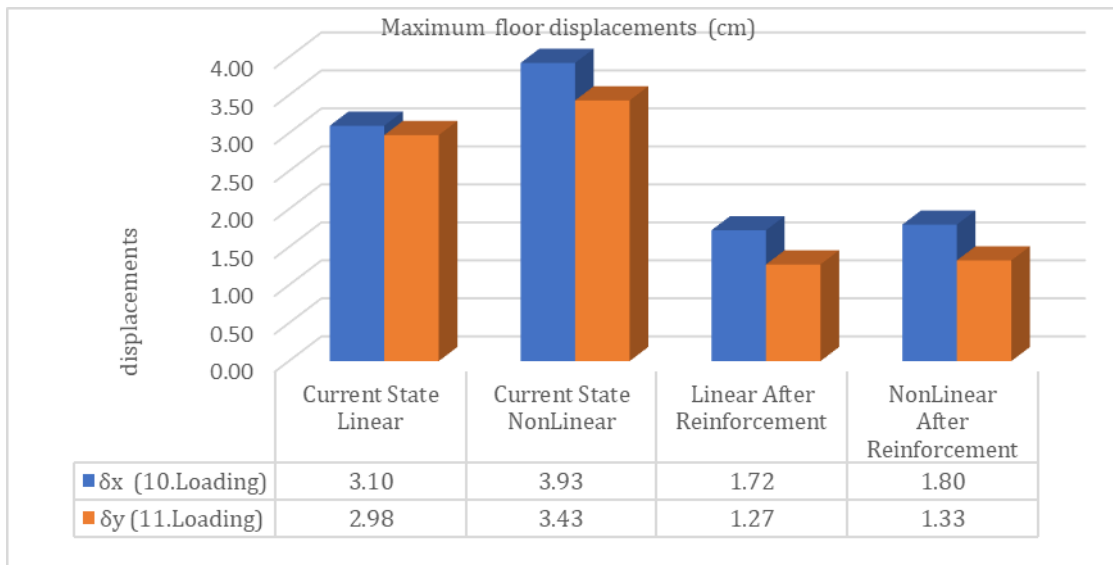


**Figure 5.** Maximum floor displacements in X and Y directions

## Discussion

It is also seen in the literature research that non-linear methods, which are among the calculation methods in the standards, give more realistic economic and safe results. For this reason, it is of great importance that the structures are calculated in the most realistic way against earthquakes during the design and that the designs are made according to this principle. Generally, at the projects, linear calculation methods are predominantly preferred due to obtaining fast solutions.

## Conclusion

In the performance analysis of existing buildings and in the design of new buildings, separate analyzes should be made in the calculation methods in TBDY 2018 and control should be ensured.

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# Examination on the contribution of Turkey's building stock future by the regulation of structural joint problems in reinforced concrete buildings according to 2018 Turkish Building Earthquake Code

**Halil Emre Arıtan** [*1] , **Hüsnü Can** [2]

¹KTO Karatay University, Department of Civil Engineering, Türkiye, emrepusat2002@yahoo.com
²Gazi University, Department of Civil Engineering, Türkiye, husnucan@gazi.edu.tr

**Keywords**
TBEC 2018
Structural joints
Regular buildings

**Abstract**
Turkey is an earthquake country due to its geological location. Our existing structures are frequently exposed to earthquakes. These exposures cause buildings to become unusable before they reach the end of their useful life and cause great loss of life. Torsional irregularity should be avoided when designing the framed structure. In reinforced concrete buildings, the structural system should be designed in such a way that hyper static behavior can be effective under earthquake effects. When the behavior in question is valid, some structural system members will not be exposed to forces beyond their strength under the effects of earthquakes and loads will be shared by other carrier system members. With the Turkish Building Earthquake Code 2018 article 3A3.2 (a), it is recommended to design framed structure without making structural joints by preventing irregularities. In this study, jointed and jointless analyzes of a 10-storey reinforced concrete building were made. According to the jointed and jointless conditions of the building, its behavior under the effects of earthquakes and its damages were investigated.

## Introduction

In static projects created in our country, earthquake joints were required to be placed in buildings exceeding 40 m until the 2018 earthquake regulation was published by the public sector project approval authorities in accordance with TS500 6.3.4 article and it was recommended to design framed structure without making structural joints [1].

This rule was also valid for buildings that were designed very close to the center of gravity and rigidity, where all precautions were taken against torsion, and were adequately designed against dynamic effects. A large part of the building stock consists of residences. The designs of the architectural projects that must be followed while creating the framed structure cannot be changed easily, and they are user-oriented and commercial concerns.

In this study, a 10-storey building which was designed very close to the center of gravity and stiffness, and used for residential purposes was examined. Joint and jointless cases were analyzed separately with Opensees building performance program, which is an extension of STA4CAD static analysis program.

In the study, the benefits of avoiding the separation of buildings with structural joints due to their length in plan in the 2018 regulation will be shown in practice.

**Material and Method**

The building in question has 10 floors and the floor heights are designed as 3m. The design of the building was made according to the 2007 earthquake code.

While forming the framed structure, the center of gravity and rigidity is designed to be very close. C30 was used as the concrete class and S420 was used as the reinforcement class. The length of the building is 51.90m and the width is 19.65m. According to TBDY 2018 regulation article 4.9.3.2, the joint spacing was created as 11cm. The design showing the center of gravity and stiffness of the building with and without joints is presented in Figures 1 and 2. After the building in question is separated with the joint, the divergence in the centers of gravity and stiffness formed in the blocks can be observed from the plan.

The analyzes were carried out using the nonlinear calculation method in the time history analysis. The nonlinear calculation in the time history corresponds to the step-by-step direct integration of the differential equation set, which expresses the equations of motion of the structural system under the influence of earthquake ground motion, with time increments. During this process, the variation of system stiffness matrix with time due to non-linear behavior is taken into account [2]. In the literature, earthquake acceleration records are obtained in three ways. The first is the use of the real acceleration record of the earthquake that occurred. The second is the use of an artificial acceleration recording, in which the desired response spectrum is obtained by obtaining the spectral density function from the corrected response spectrum. The third is the use of virtual acceleration records produced from seismological source models. Real ground motion recordings are used because of their superiority over other recording types [3].

Earthquake records were selected in accordance with TBDY 2018 section 2.5. Earthquake records 11 earthquake records were selected from the University of California PEER [4] in accordance with the regulation (item 5.7.2.1), and they were selected to include a maximum of 3 sets from the same earthquake. While selecting the earthquake records, earthquake magnitudes, fault distances and local ground conditions compatible with the location of the building and the earthquake ground motion level used in the design were taken into account. In particular, earthquake records with appropriate PGA values were selected. The scaling of earthquake records was also done according to TBDY2018 rules. Earthquake records were scaled with the OPENSEES program and the conditions of TBDY 2018 item 2.5 sub-clauses were complied with. Selected 11 earthquake acceleration record sets were applied to the building in two directions, then the acceleration records were rotated 90 degrees to create a total of 22 analyzes. All earthquake acceleration records were affected on the building in a horizontal direction perpendicular to each other. The displacement and torsion values of the building for both cases are given in Figures 3 and 4.
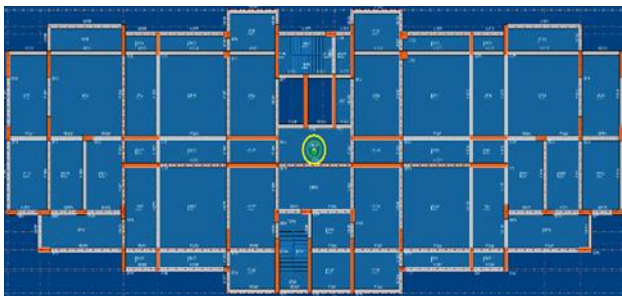


**Figure 1.** Jointless design
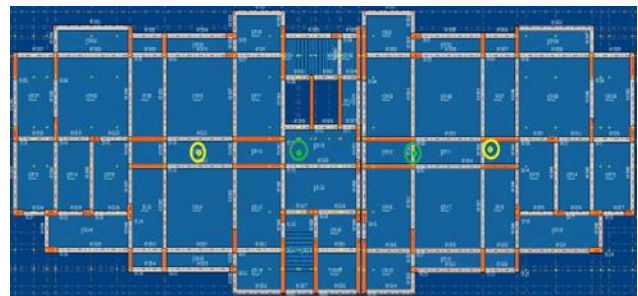


**Figure 2.** With joint design
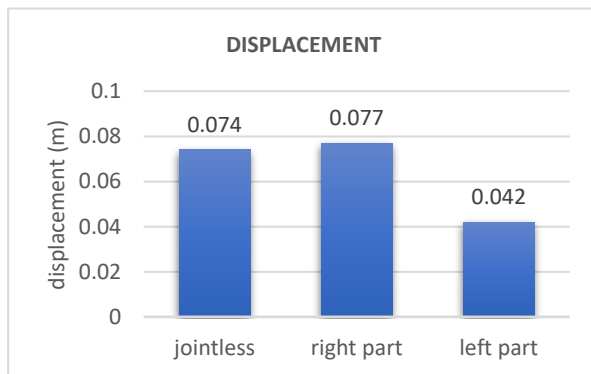


**Figure 3.** Displacement
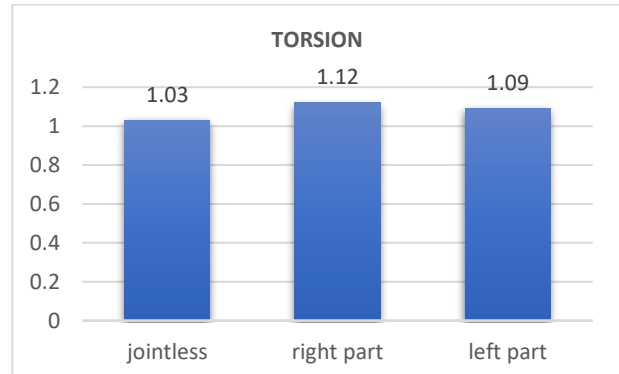


**Figure 4.** Torsion

**Results**

The displacements are plotted taking into account the x-direction. The reason why the displacement is less in the left block can be explained by the large curtain wall area perpendicular to the x direction.

The results were obtained by averaging the largest absolute values of the 22 analysis results. As a result of combined and averaged performance calculations, jointless and jointed construction performance has given the failure damage in x and y directions. As a result of the analysis, the amount of damage on the basis of elements in the structure, with and without joints, according to the damage class, is given in Table 1 for the ground floor of the building. While 7% damage occurs in the jointless structure for failure damage in the columns, this rate is 10% in the jointed structure. As a result of the analysis carried out in the time history, the jointless design resulted in failure structure performance in 15 analyses of 22 analysis, and failure performance occurred in 17 analyses of 22 analysis when separated by joint. It has been proven that the building suffers less damage in the jointless condition. It is known that the strengthening of the buildings will be made on the damaged structural system elements or additional curtains will be created.

With the 2018 earthquake code article 3A3.2 (a), wrong designs caused by joints were prevented in our country's building stock. It is understood from the damage results that there will be a decrease in the reinforcement costs after possible earthquakes during the first constructing (While creating the joints, the foundation makes more, the columns, beams and walls are manufactured twice on the same axis, etc. non-production) and life of the building.

**Table 1.** Element damages on the ground floors

| Damage | Limited | | Apparent | | Higher | | Failure | |
|---|---|---|---|---|---|---|---|---|
| Items | Beam | Column | Beam | Column | Beam | Column | Beam | Column |
| Jointless | 118/118 | 40/55 | - | 9/55 | - | 2/55 | - | 4/55 |
| Jointed | 119/121 | 42/60 | 2/119 | 9/60 | - | 3/60 | - | 6/60 |

**Discussion**

The Italian Building Regulations for the Construction to be Made in the Earthquake Zones, taken from Italy, which was first published in our country in 1940, started to be implemented. In the Earthquake Zones Temporary Building Regulation published in the same year, joints were mentioned for the first time under the title of Article 13-Earthquake joints (antiseismic) joints. In the Turkish Earthquake Zones Building Regulation published in 1947, it is stated in Article 14 that adjacent buildings constructed at the same time can be considered as a building without dilatation if they are built at the same height and in the same construction systems. In the 1968 Regulation on the Structures to be Constructed in the Disaster Areas, the joint condition was introduced again in 6.8.1 and it was continued until the 2018 code. The regulation of torsion was first mentioned in Article 22 of the 1953 Regulation on Structures to be Built in Earthquake Zones.

With the innovation brought by the 2018 earthquake regulation, structures that do not have torsion irregularities and provide hyperstatic over-connection behavior that are much more resistant to earthquake effects are prevented from separating with the joint, and the risk of damage to the blocks by colliding in an earthquake is prevented.

In this way, it has been revealed that the new building stock of our country will consist of structures that are more resistant to earthquakes.

**Conclusion**

While designing the framed structure of the buildings, attention should be paid to the symmetry and the placement of vertical structural elements, especially care should be taken to place the curtain walls equally on the x and y axes. Thus, it should serve to design buildings with close centers of gravity and stiffness and regular in terms of torsion. While designing, it is necessary to provide hyperstatic behavior. During an earthquake, it should be ensured that each element in the system receives a load as much as its capacity and transfers it to other elements.

Structural joints should be avoided as much as possible by anticipating that the structural elements will be damaged by hammering in buildings separated by joints under horizontal loads.

The recommendations under the title of Article 3A.2 Regular and Symmetrical Arrangement of the Carrier System and Article 3A.3 Ensuring the Over-Dependency Feature in the Structural System of the 2018 earthquake code should be followed meticulously.

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# Comparison of a 9-story reinforced concrete structure using the equivalent seismic load method according to the TSC 2007 and TSC 2019

**Furkan İnal** *1 , **Hüsnü Can** 2

¹Mersin University, Civil Engineering Department, Türkiye, furkaninal@mersin.edu.tr
²Gazi University, Civil Engineering Department, Türkiye, husnucan@gazi.edu.tr

**Keywords**
Seismic code
Equivalent seismic load method
Concrete structures

**Abstract**
This study analyzed a 9-story reinforced concrete structure with a floor plan of 35x25 m² using the Equivalent Seismic Load Method following the TSC 2007 and TSC 2019. Using effective cross-sectional stiffness, it was calculated that spectral acceleration values came out more from the solved building according to the TSC 2019 compared to analyses carried out according to TSC 2007. However, because the structural behavior coefficient was taken to be smaller in TSC 2019 due to the shear wall placement, the equivalent seismic loads were close to each other in both analyses. In the new seismic code, the reduction of the stiffness of the load-bearing elements has led to an increase in the period values, which has led to a more ductile behavior of the building.

## Introduction

An earthquake has a unique feature among natural disasters in that it occurs without prior warning. Although some preliminary signs can be seen before the earthquake occurs, reliable results on predicting the earthquake in advance are not yet available today [1].

Seismic codes constitute the basis of earthquake-resistant building design and reflect the technology and knowledge of that day's building design. Therefore, to design structures, designers and practitioners should understand current seismic codes well. For this purpose, a 9-story concrete structure with a floor plan of 35x25 m, the height of each floor of which is 3 m, was analyzed using the equivalent seismic load method by TSC 2007 [2] and TSC 2019 [3] and the results obtained were compared.

## Material and Method

Version 17.0.1 of the ETABS program was used in the analysis of the reinforced concrete structure [4]. The class of reinforced concrete elements is selected as C35, the modulus of elasticity of the material is taken as $E_c$=33000 MPa, while the reinforcement class is B420C, and the modulus of elasticity is $E_s$=200000 MPa. Dead and live loads applied to the structure are given in Table 1 and Table 2.

**Table 1.** Dead loads affecting the structure

| | |
|---|---|
| Weight of the structure | $\gamma_c$ = 25 kN/m³ |
| Flooring load (Normal story) | g = 1,5 kN/m² |
| Partition wall | g = 4 kN/m³ |
| Flooring load (Rooftop) | g = 4 kN/m³ |

Effective section stiffness factors, one of the biggest innovations brought by the 2019 Seismic Code, were used in the analyzes made according to the TSC 2019, and the stiffness factors of the load-bearing elements were not changed in the analyzes made according to the TSC 2007.

**Table 2.** Live loads affecting the structure

| Slab live load | q = 3,5 kN/m² |
|---|---|
| Rooftop live load | q= 1,00 kN/m² |
| Snow load | q = 0,75 kN/m² |

Istanbul/Avcılar was chosen as the place where the structure will be built. According to TSC 2007, the soil class was designated as Z3, while according to TSC 2019, the soil class was selected as ZD.
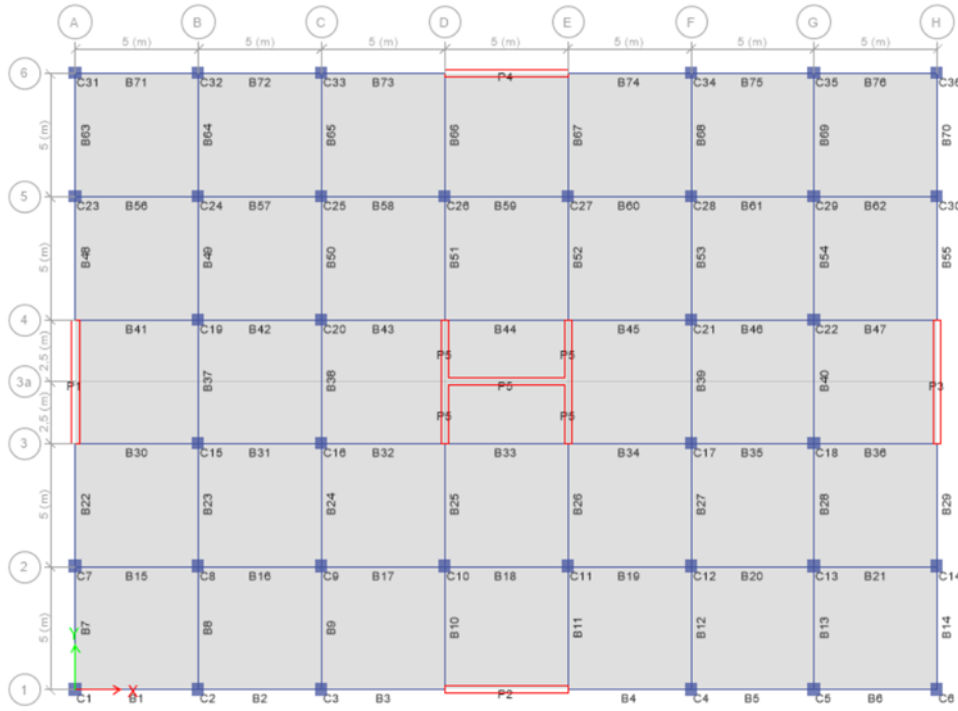


**Figure 1.** Floor plan of the building

The height of all floors is 3 m. The floor plan of the building is shown in Figure 1, the sectional and perspective views are shown in Figure 2. The building was planned to be used as a residence, the floors were considered as a rigid diaphragm and ±5% additional eccentricities were calculated in two vertical directions perpendicular to each other.
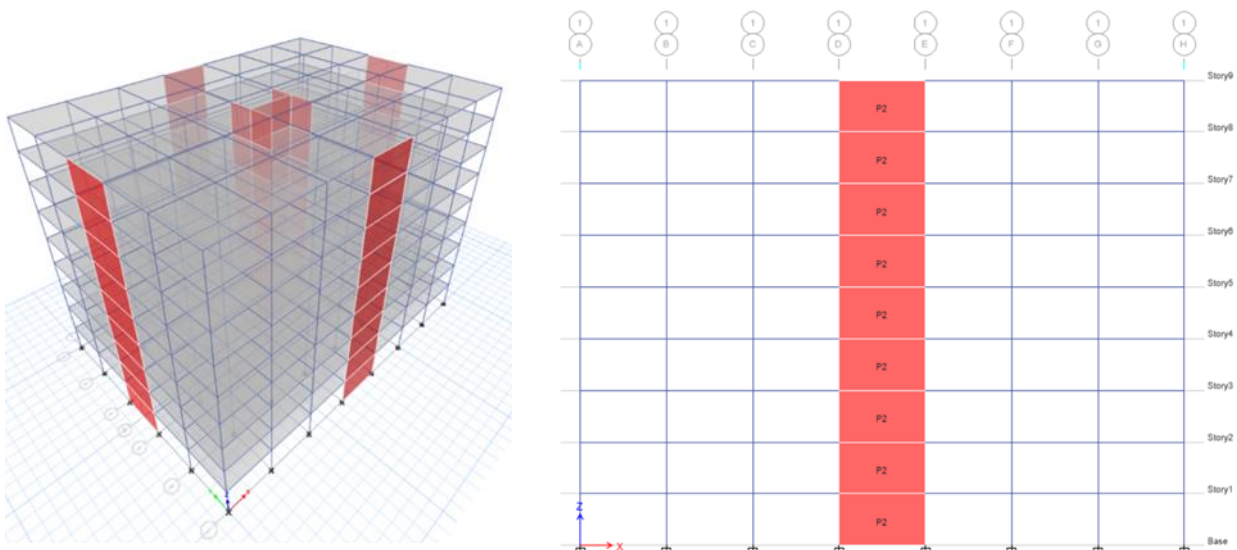


**Figure 2.** Perspective and 1-1 cross-sectional view of the 9-story building

In Table 3, the overturning moment ($\Sigma M_{DEV}$) values of the shear walls of the structure and the overturning moments ($\Sigma M_o$) for the whole building due to seismic loads are given.

**Table 3.** Overturning moments of the shear walls and the whole building

| Shear walls | X-X Direction Bending Moment (kNm) | Y-Y Direction Bending Moment (kNm) |
|---|---|---|
| P1 | 369 | 83913 |
| P2 | 80920 | 353 |
| P3 | 369 | 83913 |
| P4 | 80920 | 353 |
| P5 | 323459 | 168591 |
| $\Sigma M_{DEV}$ | 486037 | 337122 |
| $\Sigma M_o$ | 1048224 | 935587 |

In Table 4, it is seen that the overturning moment calculated for the whole building ($M_o$) is less than 1/3 of the calculated earthquake direction for any of the shear walls.

**Table 4.** $M_o/3$ control in a 9-story structure

| Shear walls | X Direction $\Sigma M_{DEV}/\Sigma M_o$ | Y Direction $\Sigma M_{DEV}/\Sigma M_o$ |
|---|---|---|
| P1 | 0,04% | 8,97% |
| P2 | 7,72% | 0,04% |
| P3 | 0,04% | 8,97% |
| P4 | 7,72% | 0,04% |
| P5 | 30,86% | 18,02% |

In Table 5, the structural response coefficient (R) will be used as 5.60 since the sum of the base overturning moment of the shear walls ($M_{DEV}$) at the side axis of the building is less than 1/6 of the total overturning moment for the entire structure ($M_o$).

**Table 5.** $M_o/6$ control in a 9-story structure

| Shear walls | X Direction $\Sigma M_{DEV}/\Sigma M_o$ | Shear walls | Y Direction $\Sigma M_{DEV}/\Sigma M_o$ |
|---|---|---|---|
| P2 | 7,72% | P1 | 8,97% |
| P4 | 7,72% | P3 | 8,97% |

**Results and Discussion**

The distribution of the shear forces calculated in the X and Y directions to the floors of the building as a result of the analyzes made using the Equivalent Seismic Load Method specified in the 2007 and 2019 seismic codes are given in Figure 3.
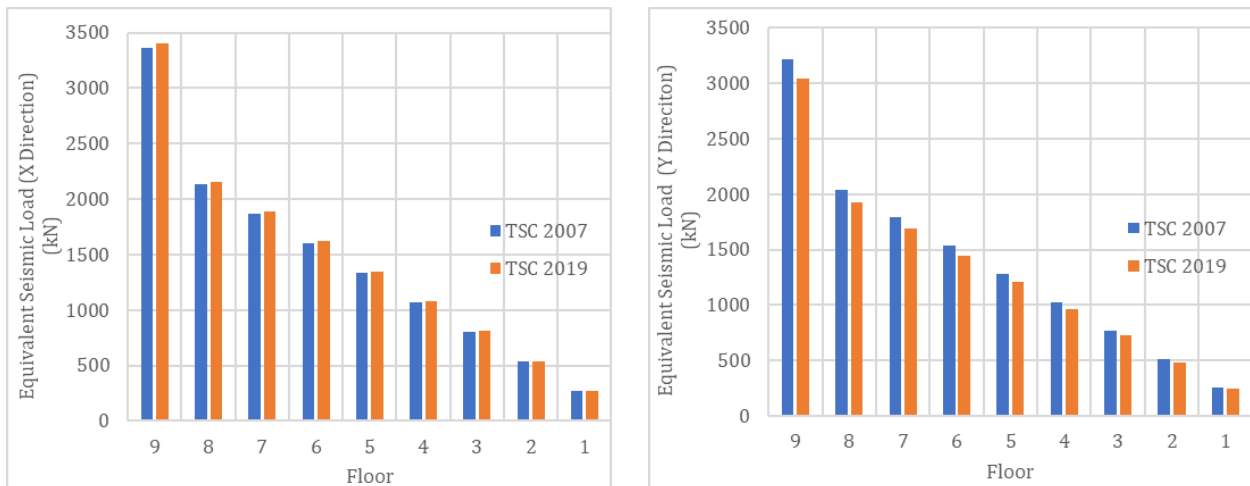


**Figure 3.** Equivalent seismic forces acting on the structure in the X and Y directions

When Figure 3 is examined, it was found that the seismic loads in the X and Y directions were almost the same. To better understand the role of effective cross-sectional stiffness in calculations, it is necessary to examine the spectral acceleration values corresponding to the given natural vibration periods in Table 6.

**Table 6.** Elastic spectral acceleration values corresponding to the natural vibration periods of the structure

| | TSC 2007 (sec) | Structural Behavior Coefficient (R) | Spectral Acceleration (g) | TSC 2019 (sec) | Structural Behavior Coefficient (R) | Spectral Acceleration (g) |
|---|---|---|---|---|---|---|
| X Direction | 0,57 | 7.00 | 1 | 0,833 | 5.60 | ≈ 0,808 |
| Y Direction | 0,634 | 7.00 | ≈ 0,96 | 0,93 | 5.60 | ≈ 0,724 |

According to the new code, changing the effective sectional stiffness of the load-bearing elements has led to a longer period of the structure, which has led to a greater increase in the unreduced seismic load values of the previous code. However, because of the new code penalizing the structure due to the shear walls placement, the unreduced seismic loads were divided into 7 in the previous regulation, while in the new regulation it was divided into 5.60, which led to the fact that the values of seismic loads calculated according to the TSC 2019 were close to the values of seismic loads calculated according to the TSC 2007.

**Conclusion**

When the results of the analysis made according to both seismic codes are examined, it has been determined that the structure solved with the TSC 2019 exhibits a more ductile behavior, since the effective section stiffness is taken into account. Compared to the horizontal elastic design spectra of the 2007 and 2019 Seismic Codes, the spectral acceleration values of the TSC 2019 are higher. However, in TSC 2019, it was observed that the equivalent seismic loads were similar to each other since the structural behavior coefficient was taken to be smaller due to the shear walls layout. While the differences between the shear forces calculated for the X direction were insignificant, the shearing forces calculated with TSC 2019 for the Y direction were discovered to be 5.5% less compared to TSC 2007.

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# The role of HAMLET in cancer treatment

**Harika Topal Önal** *[1] , **Furkan Ayaz** [2]

[1]Toros University, Medical Laboratory Techniques, Vocational School of Health Services, Türkiye, harika.topal@toros.edu.tr
[2]Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr

| Keywords | Abstract |
|---|---|
| HAMLET<br>Lactalbumin<br>Oleic acid<br>Anticancer agents | HAMLET (Human Alpha-lactalbumin Made Lethal to Tumor cells) is a new antitumor protein-lipid complex that largely kills cancer cells while protecting healthy cells. HAMLET is formed by the incorporation of incompletely folded alpha-lactalbumin oleic acid found in large quantities in human milk. HAMLET is thought to activate apoptosis by targeting pathways that maintain cell viability in cancer cells. Clinical studies with HAMLET have identified HAMLET as an anticancer agent that kills tumor cells. In this proceeding we will review HAMLET as anti-tumor agent. |

## Introduction

HAMLET (Human Alpha-lactalbumin Made Lethal to Tumor cells) is a complex formed by binding oleic acid to alpha-lactalbumin found in human milk to destroy tumor cells [1]. While this complex is capable of promoting apoptosis for cancer cells, it has no lethal effect on healthy cells. The term HAMLET first entered the literature in 1995 [2]. It has been reported that a structure in human milk encourages tumor cells to die, and healthy cells are resistant to this structure. It was later discovered that this structure is the oleic acid-alpha lactalbumin complex [2]. Antitumoral effects have been reported in *in-vitro* and clinical studies with HAMLET [3]. In this review, recent studies investigating the molecular structure and mechanisms of action of HAMLET and its effects on cancer cells are discussed.

## Molecular structure of HAMLET

Three-dimensional structure of alpha-lactalbumin, the main protein component of the human milk contains four alpha helices, a triple beta layer, and a calcium binding site [4]. In this state, it is a cofactor for lactose synthesis and does not lead to cell death. For this structure to be antitumoral, the protein structure must be opened and the oleic acid compound must be attached to this structure [5]. There is no information in the literature regarding the *in-vivo* formation of HAMLET, but the acidic condition of the stomach is thought to be a suitable environment for the HAMLET formation. It is known that the low pH of the stomach causes the α-lactalbumin to be partially opened by releasing the strongly bound calcium ion [6]. During the HAMLET *in-vitro* formation process, α-lactalbumin is removed from the calcium ion with ethylenediamine tetraacetic acid (EDTA) or acid and partially opened. Then, the oleic acid binds to the protein and the complex structure are completed [7].

## Mechanisms of action of HAMLET on tumor cells

Cancer cell death can occur in various ways such as apoptosis, necrosis, and autophagy. However, cancer cells have death escape mechanisms such as gene amplification, gene, and chromosomal mutations. In tumor treatment, cell death is promoted by targeting apoptosis pathways and mitochondrial signaling pathways that lead to phagocytosis with ionizing radiation and chemotherapeutic agents. Hamlet binds to the cell surface in tumor cells,

invades cells, causes mitochondrial membrane disruption, increases cytochrome c release, initiates caspase activation, and thus performs apoptosis [8]. Tumor cells exposed to HAMLET cause an excessive increase in unfolded protein load, which contributes to the death of cells by activating 20S proteosomes [9]. When tumor cells encounter HAMLET, they reach the nucleus after about one hour. H3 and H4 histones in the nucleosome structure bind to proteins with high affinity and form insoluble chromatin complexes in the nucleus. As a result of this cytotoxic effect, DNA damage and degradation occur [10]. It is thought that the mechanism of macroautophagy is induced by enlargement, damaged mitochondria, and formation of double membranes in the cytoplasmic vacuols of the tumor cells exposed to HAMLET [8].

**HAMLET's effect on cancer**

There are *in vitro* and clinical studies in the literature investigating the therapeutic efficacy of HAMLET in cancer types such as bladder cancer, colon cancer, and glioblastoma. HAMLET has been reported to reduce tumor growth in mouse bladder cancer [11]. It has been reported that the residence time of HAMLET in the body of mice with tumor development is longer than in the healthy control group. In addition, it has been reported that HAMLET treatment reduces tumor volume and there is a substantial reduction in new tumor formation [12].

In a study focusing on the effect of HAMLET in colon cancer induced mice, it was reported that it accumulates especially in tumor tissue, and it has been reported that the secretion of important oncoproteins, cyclooxygenase-2 inhibitor, and vascular endothelial growth factor (VEGF) are significantly decreasing after HAMLET administration [13].

In a study investigating the effect of HAMLET on glioblastomas, it was stated that HAMLET promoted apoptosis in tumor cells by invading the tumor cell. Studies investigating the effects of HAMLET on bladder cancer and skin papillomas are limited. In a clinical study investigating the effects of HAMLET in bladder cancer, patients with bladder cancer were given HAMLET intravesically five times a day before surgery and it was observed that dead tumor cells were excreted in the urine for five days. In the study data, it has been shown that the majority of cancer cells have the signs of apoptosis. It has been reported that cells undergoing apoptosis are in the majority in cystoscopy biopsy specimens in which the tumor size is reduced during the bladder surgery [14].

In a study investigating the effectiveness of HAMLET on skin papillomas, it was found that a significant reduction in lesion volume was seen when HAMLET was administered to a patient with severe, treatment-resistant papilloma for 3 weeks. It has also been reported that in approximately 83% of patients treated with HAMLET, all lesions healed completely after two years [15].

**Conclusion**

In line with the studies investigating the effects of HAMLET in cancer treatment, it can be considered an alternative treatment method to chemotherapy and radiotherapy. While it was reported to have a cytotoxic effect in *in-vitro* studies, these effects were not fully studied in *in-vivo* studies. However, due to the small number of studies, it is not yet possible to qualify HAMLET as a stand-alone treatment. It can be concluded whether HAMLET is an alternative treatment by increasing the number of studies trying it in different types of cancer.

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# Bone grafts' usage areas and β-TCP (tricalcium phosphate) mechanical strength properties

**Ebru Öner Usta** *1 , **Furkan Ayaz²**

¹Mersin University, Biotechnology Department, Türkiye, oner_ebru@hotmail.com
²Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr

**Keywords**
Bone Graft
Beta-Tricalcium Phosphate
β-TCP (tricalcium phosphate)
Mechanical strength

**Abstract**
The process of completing the exposed areas with surgical procedures due to the deformation in the damaged bone for the purpose of repairing bone fractures is called bone grafting. With this invasive procedure, the grafts placed in the damaged bone area are absorbed by the living structure with the repair process in the bone. The healing process takes a few months, depending on the type of the graft used. With the precondition that the patients are not too old, the bone structure usually has the ability to completely regenerate. In order to activate the regeneration ability, the fracture area in the bone must either be very small or have a support structure that will act as a scaffold. Bone grafts can be evaluated in four basic groups; Autograft (contains structures taken from the patient's own body), Allograft (structures taken from another patient of the same type), Zenograft (taken from another living thing), Synthetic (Ceramic materials, materials in block, granule, injectable form produced from polymer materials). Bone grafts serve as scaffolding to regenerate the losses in the bone with their osteoconduction feature. Supporting the osteoconductivity in the area where the deformation occurs in the bone depends on the bioactive chemicals (Beta-Tricalcium Phosphate) of the implant used during the surgical procedure to support the regeneration. The graft used to repair (regenerate) the damaged bone should have osteoinduction, osteoconduction, and osteointegration properties. Although the allograft structure is observed to be more successful when evaluated in terms of these three features, it is observed that synthetic grafts are used at very high rates in surgical operations when the accessibility, cost, and applicability are evaluated. In this study we will review and evaluate synthetic bone grafts.

## Introduction

Synthetic bone grafts, which are frequently used in surgical applications, are usually made from biomaterials due to their biocompatibility. The surface properties of these grafts are compatible with the surface properties of the implanted tissue. These properties are known as wettability, and surface adhesion and increase the proliferation and adaptation of the tissue it comes into contact with. Thanks to its 3D structure, its pore widths support cell transport and development. Porosity and pore width are other important features but are critical for vascularization and colonization. The mechanical properties of bone grafts should be both similar and compatible with the properties of the region to be used. Mechanical properties are also important in terms of being a parameter that shows the suitability of the quality control processes of the implant. Viscoelasticity, shear strength, and resorb ability are the most critical evaluation parameters in bone grafts [1].

When the features of bone grafts are evaluated in terms of their contribution to the healing of the defects, the reasons for their preference are summarized. A graft with osteoconduction is important because it supports osteoprogenitor cell growth and the completion of the lost parts. The osteoinduction feature has undertaken the task of sending a warning for the regeneration by enabling the transformation of the osteoprogenitor cells into osteoblasts. Thanks to its osteogenicity feature, the bone graft used helps the living bone cells to be reshaped by sending warning signals. The characteristics of four different graft types are given in Table 1 comparatively. Autografts seem to have the highest compatibility naturally. However, it is known that synthetic grafts in the table are widely used because of their osteoconductive properties and their reparative role in bone loss [2].

**Table 1.** Bone grafts (Autograft, Allograft, Xenograft, Synthetic) evaluation of conformity [2]

|  | Osteoconductive | Osteoinductive | Osteogenic |
| --- | --- | --- | --- |
| Autograft | + | + | + |
| Allograft | + | +/- | - |
| Xenograft | + | - | - |
| Synthetic | + | - | - |

Ceramics are the most commonly used biomaterials with inorganic structures, and the most preferred calcium phosphates in tissue engineering are Hydroxyapatite, Tricalcium Phosphate, and a combination of these two. β-TCP (tricalcium phosphate) exists in alpha and beta phases, in forms with two different crystallographic properties. Autografts leave their place for products with high bone compatibility due to their superior properties as well as the difficulty of obtaining them. Especially β-TCP + SiO2, β -TCP + HA, Bioglass, β -TCP + HA + Hydroxypropyl methylcellulose (HPMC), β -TCP + Poly (L-lactide-co-ε-caprolactone), which is defined as Synthetic Bone Graft, are the most common of the materials used.

**Material and Method**

β-TCP Production methods are listed in Figure 1 β-TCP Precipitation Method and Figure 2 Sponge Impregnation Method. The final control tests to be done for the finished products are listed in Table-2 β-TCP Beta Tricalcium Phosphate (β-TCP) Quality Control Tests [3].

**Table 2.** Beta Tricalcium Phosphate (β-TCP) Quality Control Tests [3]

| No | Quality Control Test Parameters |
| --- | --- |
| 1 | 1 PH control |
| 2 | Appearance – color, matte |
| 3 | XRD - β -TCP ratio > 95% |
| 4 | FTIR - % β TCP 723 cm-1 β -TCP Peaks |
| 5 | Elemental Residue ICP/MS (ISO 13175-3) |
| 6 | Particle size and shape - Laser diffraction |
| 7 | Ph-Solution Test (ISO 13175-3) |
| 8 | Sieve Control – Powder |
| 9 | Porosity – Mercury porosimetry |
| 10 | Mikropar-Macropar Dimension Control – SEM |
| 11 | Compressive strength - 1-16mpa |
| 12 | LAL Test Endotoxin Ratio <0.25 IU/ml |
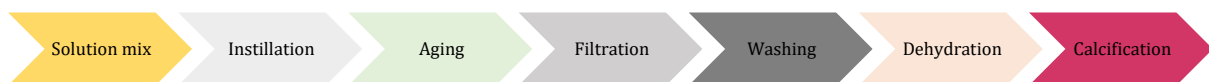


**Figure 1.** Beta Tricalcium Phosphate (β-TCP) production technology by precipitation method [3]



**Figure 2.** Production technology of Beta Tricalcium Phosphate (β-TCP) with sponge impregnation method [3]

After the production is completed, specific tests of the product should be recorded and special processes (water system-TCP production, mixing, drying, sintering, screening, shaping, filling, sterilization, packaging) should be regularly validated by the manufacturer [4].

**Results**

Like all implants produced, bone grafts are expected to meet legally determined requirements and international standards for the relevant product. In order to control the reliability of the product and the repeatability of the production technology at the same quality, the defined tests should be recorded and reported. The instructions for use of these products, which are defined as medical implants, should contain the necessary information (contraindications, warnings, and precautions). In addition, instructions should be established for proper placement and storage in the desired treatment area. The warning not to implant the device in a patient with a pre-existing calcium metabolism disorder (e.g., hypercalcemia) should be included in the relevant guidelines. A precaution against overfilling the defect area, a warning against its use in infected areas. Methods for cutting and shaping block-form grafts should be determined and shared with consumers. In addition, for grafts in injectable form, there should be warnings against sending them with excessive pressure [5]. Beta Tricalcium Phosphate (β-TCP) production technology, which is one of the lower-cost products developed as an alternative to allograft bone grafts, has successful results when evaluated in terms of its reliability, its suitability for GAMMA sterilization after production, its high histocompatibility ability, and mechanical strength test results. It is preferred in surgical interventions due to its widespread use and preference [6].

**Conclusion**

Synthetic implants should be biocompatible to enable proper tissue remodelling and repair. In this proceeding we discussed several synthetic materials that can be used in bone grafts. These should be studied in more depth to develop more compatible and repair inducing materials.

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# Epilepsy disease and treatment approaches

**Ümmühani Önder** *1 , **Furkan Ayaz**2

¹*Mersin University, Biotechnology Department, Türkiye, 20133024@mersin.edu.tr*
²*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Chronic disease
Paroxysm
Spasm
Neural disorder
Brain damage

**Abstract**
Epilepsy is a chronic disorder characterized by seizures resulting from disturbances of neural activity in the brain. As a result of sudden and uncontrolled discharges in the neurons in the brain, involuntary contractions, mood changes and changes in consciousness occur in the person with epilepsy. Because epilepsy affects the brain, it can disrupt many functions that the brain manages. The occurrence of abnormal functions in the balance of nerve cells in the brain, other than the normal course of the electrical current, may cause situations such as loss of consciousness and inability to control the body in the person with epilepsy. Conditions that can cause damage to the brain such as a difficult birth, brain traumas, infections in the brain, meningitis, tumors in the brain can cause epilepsy. In some cases, genetic factors may predispose to the disease. In this proceeding we are discussing epilepsy and some of the treatment approaches against it.

## Introduction

Epilepsy can occur at any age and in any gender. This disease, which can occur during birth or later for different reasons, manifests itself in the form of sudden crises [1]. Disorders in neurons that affect the whole or a specific part of the brain can cause changes in seizure types, depending on which part of the brain it occurs. In some epileptic seizures, unconsciousness and uncontrolled contractions occur, while in some seizure types, the symptoms are vague, so patients may not be aware of the symptoms. Most seizures last between 30 seconds and 2 minutes. Seizures lasting longer than 5 minutes may require medical attention [2].

Epileptic seizures may differ according to the damaged area of the brain. Epilepsy crises can be examined in 3 categories.
1. Simple partial epileptic seizure
2. Complex partial epileptic seizure
3. Generalized epileptic seizure

Generalized epileptic seizures are the best known of these types of epileptic seizures, but not all epileptic seizures show visible symptoms like generalized seizures [3-4].

## Simple partial epileptic seizure

In simple partial seizures, consciousness is open and can be examined under three subheadings. Seizures originating from the temporal lobe; sudden fear is manifested by feeling as if something happened before or as if something has not happened, smelling bad smells and tastes, and an unpleasant internal feeling are among the discomforts that patients go through [5].

In seizures originating from the frontal lobe, problems with movement are seen. In seizures originating from the parietal lobe, temporary drowsiness symptoms and feelings that are difficult to describe are observed [6-7].

**Complex partial epileptic seizure**

Consciousness gets impaired in some of the complex partial seizures. In complex partial seizures, chewing, licking, swallowing and looking confused may be seen. Sometimes the patient may tug on their clothes and walk around. When he or she wakes up minutes or even hours later, he or she may not remember anything [8].

**Generalized epileptic seizure**

Generalized seizures spread to the entire brain. It is the seizure known as the epileptic seizure among the people. The person first becomes rigid and falls to the ground. After this, contractions and relaxations occur in all body muscles. Violent movements during the seizure develop out of the person's control [9]. In addition to this, in some generalized seizures called absences or petit mal, the person may lose consciousness even though the body does not lose its shape [10].

**Epilepsy disease symptom**

- Sudden contractions in the body, uncontrollable shaking of the arms and legs
- Loss of consciousness and focusing on a fixed point
- Fear, anxiety, or déjà vu
- Inability to respond to sounds or speech for a short time [11]

**Pre-seizure symptoms (Auras)**

If the seizure starts in a small area of the brain, the person may experience some symptoms at the onset of the seizure. These symptoms are called "aura".

- Numbness
- Sudden fear
- Changes in vision or hearing
- Nausea or pressure in the stomach [12]

**Results**

In some patients, there may be situations that trigger epileptic seizures. For example, prolonged hunger, insomnia, extreme fatigue, discontinuation or change of medications, hormonal changes can cause seizures [13].

The frequency of seizures in epilepsy, how long they last, and at what age they start give important clues to the doctor. For this reason, your doctor will take your detailed medical history and perform a physical examination [14].

EEG is a device that measures the electrical activity of the brain; It helps to diagnose epilepsy and to determine from which part of the brain the uncontrolled electrical discharges start. MRI and Computed Tomography examinations, which show whether there is a structural problem in the brain that may cause seizures, are the methods used in epilepsy [15].

**Treatment method**

Most people with epilepsy can be treated with epilepsy drugs called anti-epileptics. Medications are intended to stop seizures [16]. Therefore, regular use of drugs is important. Although drug therapy is effective in the majority of patients, it may not provide the expected effect in some patients. In these patients, surgical treatments can be applied according to the underlying condition causing epilepsy.

There are two types of epilepsy surgical methods. The first is the removal of the epileptic focus itself (resective surgery). The second is the surgical method (functional surgery, palliative surgery) that aims to reduce the spread, frequency and severity of seizures by cutting the ways of seizure spread [17].

In some suitable patients, a treatment called vagus nerve stimulator can be applied. The battery placed under the chest stimulates the vagus nerve at certain intervals and can reduce these seizures. Significant improvement can be achieved in patients with this treatment method.

Another treatment option is the ketogenic diet. This diet, which is effective in some types of epilepsy, is based on the principle of eating very rich in fat. However, with the approval of the specialist physician, it should be applied under the control of a dietician [18].

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# Heat shock proteins and their functions

**Havva Türkben** *[1] , **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, havvaturkben5153@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Heat Shock Proteins
Immunity
Immunotherapy
Cancer

**Abstract**
Heat shock proteins are a group of proteins that are observed to be produced in large amounts after cells are exposed to high temperatures. It is characterized by rapid gene expression at high temperature such as 42-46℃. These proteins are also called stress proteins because cells accept high temperature as a stress factor and synthesize heat shock proteins. There is no increase in gene expression of heat shock proteins due to high temperature alone. In addition to high temperature, there is an increase in gene expression of heat shock proteins in conditions such as UV rays, radiation, inflammation, exposure to starvation, lack of trace elements, pH change, exposure to heavy metals, and oxidative stress. The molecular weight of heat shock proteins ranges from 15 kDA to 110 kDA, and they are examined in 5 types according to their molecular weights. HSP100, HSP90, HSP70, HSP60 and (sHSP) are small heat shock proteins. Each type of HSP is located in different parts of cells and has more than one isoform. In this proceeding we will briefly discuss some of the heat shock proteins and their functions.

## Introduction

Heat shock proteins are a group of proteins that were first observed to be produced in large amounts after *Drosophila Melangoster* cells were exposed to high temperatures in 1962. It is characterized by rapid gene expression at high temperature such as 42-46℃. These proteins are also called stress proteins because cells accept high temperature as a stress factor and synthesize heat shock proteins [1,2].

There is no increase in gene expression of heat shock proteins due to high temperature alone. In addition to high temperature, there is an increase in gene expression of heat shock proteins in conditions such as UV rays, radiation, inflammation, exposure to starvation, lack of trace elements, pH change, exposure to heavy metals, and oxidative stress [1,2].

The molecular weight of heat shock proteins ranges from 15 kDA to 110 kDA, and they are examined in 5 types according to their molecular weights. HSP100, HSP90, HSP70, HSP60 and (sHSP) are small heat shock proteins. Each type of HSP is located in different parts of cells and has more than one isoform [1-4].

All living things have heat shock proteins. It is one of the important protein groups that is expressed in all cell types, including prokaryotes and eukaryotes, and has managed to be preserved in the evolutionary process. It contains approximately 5% of the proteins expressed in eukaryotic cells. The strong hydrophobic interactions, hydrogen bonds and bipolar helix structure in the HSP group prevent these proteins from being denatured [1,5].

There are two factors known to be effective in the transcription of heat shock proteins. these; They are HSF1 and HSF2. In normal cells, HSF molecules are monomers and are not bound to DNA. In certain situations, for example, under stress conditions, the cell transforms into a form that has the capacity to bind HSP DNA and increase transcription to increase HSP transcription. Environmental factors in increasing transcription of HSPs

include; chemotherapeutic agents, heavy metals, inhibitory substances in energy metabolism and temperature changes are counted [1,6].

In the detection and determination of heat shock proteins; Methods such as PCR, electrophoresis, ELISA and Western blot are used [1].

**Results**

One of the primary functions of heat shock proteins in healthy cells, they undertake cytoprotectant functions such as correct folding of synthesized proteins and elimination of misfolded proteins, if any, folding of denatured proteins, stabilization of proteins, protein conformation, protein homeostasis, and prevention of protein aggregation. Because of these functions, they are called molecular chaperones [2].

In addition to its cytoprotectant functions, in the control of cell metabolism, regulation of cell cycle, prevention of apoptosis, mitogenesis, regulation of kinases, function of "vascular growth endotheial factor" (VGEF) receptors, which are effective in the development of many different tumors, presentation of antigens against any pathogen in the immune system, immunity It also plays a role in the cellular signal transmission pathway and intracellular substance transport [2,3].

**Small Heat Shock Proteins Family (sHSP>60)**

It is located in many different parts of the cell, but it is mostly seen in the cell nucleus and cytoplasm. They are usually 12-43 kDA in size. It takes part in the polymerization of protein structures such as microfilaments, microtubules and actin in the structure of the cytoskeleton. There are varieties such as HSP 16.3, HSP20, HSP25, HSP27, HSP32, HSP B9. It has effects that do not require energy use. With these effects, it prevents the agglutination of proteins. However, it maintains the continuity of other activities by interacting with HSP groups larger than itself. It acts as a chaperone, prevents cataract formation in the eye, and its mutated forms play a role in the pathogenesis of Alzheimer's and Parkinson's diseases, which are neurodegenerative diseases [1-3, 7].

**The HSP60 Family**

They are found in the mitochondria, cytoplasm and chloroplast of eukaryotic cells. It consists of 14 subunits. It has important roles in the realization of apoptosis, secretion of proinflammatory cytokines and insulin secretion. In addition to working alone in protein metabolism that requires energy, it also acts as a chaperone by combining with HSP10. It undertakes to provide new conformation in the folding of proteins together with HSP70. They ensure that damaged proteins are repaired without being destroyed or degraded in the cell [1-3, 7].

**The HSP70 Family**

It is found in the cytoplasm, nucleus, mitochondria and endoplasmic reticulum in cells. Among the heat shock protein groups, it is the protein with the most research and studies. It is available in two different forms. These; HSP72 and HSP73. It is involved in the folding of proteins, the regulation of misfolded proteins, and the control of protein activities. HSP70 is involved in more than 20% of correct protein folding [1-3, 7].

**The HSP90 Family**

It shows activity together with HSP100. Its best-known feature is tumorigenesis. It acts as a molecular chaperone in communication between cells, protection of morphological structures of cells, antiapoptotic pathways, regulation of steroid hormone receptors, regulation of tumor spread [1-3, 7].

**The HSP100 Family**

It acts as a molecular chaperone in normal cells. It is the largest family of the HSP protein group. It is also responsible for the separation of aggregating proteins, refolding and arrangement of proteins, and providing heat tolerance in plants and yeasts [1-3, 7].

**Discussion**

Heat shock proteins are a group of proteins that emerge under the stress condition of the cell. These stress situations occur during the formation of cancerous tissue; Self-sufficiency in cell growth, unlimited dividing ability, recovery from apoptosis with programmed cell death, invasion of tissues, and continuous angiogenesis and metastasis can be stress factors [5].

Increased HSP transcription causes suppression of these stress mechanisms. Based on this feature, it is clearly seen in the light of recent studies that it is possible to use heat shock proteins as an anticancer agent [6].

**Conclusion**

Future studies should focus on the utilization of the Heat shock proteins groups. For example, 17AAG, which is an inhibitor of HSP90 from heat shock proteins, not only inhibits cancerous tissues, but also increases gene expression of mutant proteins produced in cancer. Since HSP, which is used therapeutically, does not affect normal cells but only inhibits cancerous tissues, its use as a natural biological adjuvant also contributes to cancer immunotherapy studies [7].

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# Immunotoxin effect of Lambda Cyhalothrin (LC) insecticide on mammalian macrophages

**Ceren Canatar*1** , **İsmail Korkmaz2** , **Havva Türkben1**, **Derya Yetkin3** , **Badel Arslan4**, **Serdal Arslan2**, **Furkan Ayaz1,5**

*1Mersin University, Biotechnology Department, Türkiye. cerencanatar07@gmail.com , havvaturkben5153@gmail.com*
*2Mersin University Department of Medical Biology, Türkiye. ismailkrkmazz@gmail.com , arserdal@yahoo.com*
*3Mersin University, Faculty of Medicine Histology Department, Türkiye. deryayetkin84@gmail.com*
*4Mersin University Department of Stem Cell and Regenerative Medicine, Türkiye. badelarsln@gmail.com*
*5Mersin University, Biotechnology Research and Application Center, Türkiye. furkanayaz@mersin.edu.tr*

**Keywords**
Insecticide
Plants
Pesticide
Agriculture
Lambda-cyhalothrin

**Abstract**
Plants are affected by some different factors such as harmful weeds and insects, and depending on this situation, inefficiency and loss occur both in agricultural areas and production rates. In this context, although pesticides are frequently used in the fight against pests, they also have some positive and negative effects. Pesticides, which are used to reduce the existing effects of harmful factors, have toxic effects on both human health and the environment. Insecticides, on the other hand, are frequently used against insects, which are among the harmful factors, and are included in the pesticide groups. Pyrethroids are synthetically produced insecticides and contain more than 40 active ingredients, and lambda-cyhalothrin is one of these active ingredients. In this proceeding study we will review the toxic effect of lambda-cyhalothrin by specifically focusing on the immune system.

## Introduction

Plants are eukaryotic species that play a key role in the regulation of many ecological processes, especially the photosynthesis reaction in the ecosystem. Plants that undertake such important tasks are exposed to many factors that are considered harmful, like other organisms in nature. Among these factors; insects, weeds, worms, mites and rodents. These living organisms, which have harmful effects on plants, damage plants in various ways. Living organisms with harmful effects exploit the energy that plants will use to maintain their own metabolic activities. Apart from this, there are other vectors that feed on the nutrients of the plants and lead to the malnutrition and poor growth in the plants [1-4].

Insects and weeds constitute a large part of the decrease in productivity in agricultural areas and crops created in agricultural areas. Firstly, chemical control methods are used within the scope of combating these pests. Pesticides are at the forefront of the chemically preferred methods in agricultural areas. Pesticides can be chemical substances as well as living organisms. These living organisms include bacteria or viruses [1-4].

Pesticides have different names according to their target organism. For example; pesticides targeting insects are called insecticides, pesticides targeting weeds are called herbicides, pesticides targeting nematodes are called nematicides, pesticides targeting fungi are called fungicides, and pesticides targeting rodents are called rodenticides [1-4].

The main purpose of this chemical control is to eliminate the factors that are considered as harmful, to reduce the effects of these factors or to control them. One of the most negative effects of pesticides used in agricultural areas; they cause death of non-target organisms because they do not directly affect the targeted organism. Pesticides have genotoxic and cytotoxic effects on the environment and human health. Among the known negative

effects on the environment are; pollution of ground/surface waters and soil which eventually cause a decrease in the number of beneficial microorganisms in the soil, air pollution and pollution of the flora [1-6].

## Results

Insecticides, which are frequently used among chemical pesticide groups, prevent the infertility of plants in the agricultural fields by targeting insects. Insecticides, according to their origin, are divided into two as synthetic insecticides and natural insecticides (bioinsecticides) created by extraction from plant sources. Synthetically produced insecticides have many advantages over other insecticide types [2,5].

The group that has the largest usage area in insecticides in the world is called pyrethroids. Pyrethroids constitute approximately 1 out of 4 insecticides in the world market [1].

Pyrethroids, which are synthetically produced insecticides, continue to be widely used in agricultural areas due to their photostability, low toxicity to mammals, short duration of action, strong lethal effect against insects, and many other superior features. Pyrethroids contain more than 40 active ingredients, and lambda-cyhalothrin is one of these active ingredients [1].

## Discussion

There are not enough studies in the literature on the immunotoxic, genotoxic and cytotoxic effects of lambda cyhalothrin, which belongs to the insecticide group of pesticides used against insects, on mammalian macrophage cells. Therefore, it is anticipated that this issue will be addressed in the future [7,8].

## Conclusion

Insecticides have been widely used in the field to increase the crop yield but their toxic effects should be studied in more details. There are studies showing toxic effect of these chemicals on different organisms and cells but to our knowledge there is no study focusing on their possible effects on the immune system. Future studies will shed light on their effect on the immune system cells and will inform the field about their toxic activities to either generate novel formulations and active ingredients or to feel safe to use them more frequently if they lack toxicity

## Acknowledgements

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# Effect of intestinal microbiota on health

## Ceren Canatar *1 , Furkan Ayaz 2

*1Mersin University, Biotechnology Department, Türkiye, cerencanatar07@gmail.com*
*2Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Intestinal microbiota
Microorganism
Immunity

**Abstract**
Some tissues and organs of the body provide a suitable environment for the colonization of many organisms which are as whole known as the human microbiota. The gastrointestinal tract, which contains a large number of microorganisms, is one of the major examples of such a suitable environment in this context. The gut microbiota plays a key role in many situations. Among some of the situations in which it plays a role; both defense and physiological development of the host, and some events that are expressed metabolically can be counted. In general, the composition of the microbiota can be affected by some factors (such as antibiotic use, stress, lifestyle, and dietary habits). Characterization of the gastrointestinal tract from healthy individuals; strengthening the beneficial microflora, regulating the microflora, and maintaining the body functions both regularly and in a healthy way are among the therapies considered to overcome some metabolic and inflammatory disorders. In this proceeding we will discuss intestinal microbiota and its effects on the health.

## Introduction

Different microorganisms in the human microbiota colonize some tissues and some organs of the body. Gastrointestinal system, genital system, nose, skin, throat and mouth are among the settlement areas of these microorganisms in the human microbiota. The gastrointestinal tract is characterized as a suitable environment for colonization in terms of some of its features (such as its large surface area), and it hosts a large number of microorganisms. Bacteroidetes, Actinobacteria, Firmicutes, Verrucomicrobia and Proteobacteria are considered to be the dominant microorganisms in the gastrointestinal tract [1-3].

The intestinal microbiota, which is controlled by the disease-preventing, constructive or enhancing bacteria and is known as a complex ecosystem, plays primary roles in both the defense and physiological development of the host [4, 5]. A symbiotic relationship develops between the host and the microorganisms in the gut. Thanks to this relationship, the number of harmful bacteria in the intestine is kept at a minimum level [6, 7].

It is known that the intestinal microbiota is involved in some events, both immunologically, physiologically and metabolically, and in addition to these events, the abrupt changes in the intestinal microbiota is also effective in the pathogenesis of some diseases [8, 9].

Since the gut has a very large immunological ecosystem, there is a relationship between the immune system and the intestinal microbiota [10]. The gut microbiota, which affects the immune response to many bacterial antigens and immunogens, is also involved in the immune development of the host [5, 11]. IgA is the immunoglobulin class with the highest production in the intestine. Secretory IgA (sIgA) plays a role in controlling the intestinal microbiota and preventing the spread of toxins and pathogenic microorganisms [10].

In general terms, the microbiota, which has duties in human disease and health, can be affected by many external factors. Among these external factors; lifestyle, geographical origin, nutritional habits, gender, age, genetic status, antibiotic use, stress and some previous diseases can be listed. In this context, the microbiota is greatly

affected by nutritional status. In addition to the factors mentioned above, factors such as host secretion and pH can also affect the microbiota composition [3, 7, 9].

Disruption of the intestinal microflora balance and alteration of the flora is expressed as dysbiosis. Dysbiosis, which causes changes in intestinal permeability, can be associated with some gastrointestinal and extraintestinal diseases [9, 12].

**Results**

In order to maintain the body functions in a regular and healthy way, it is necessary for the gastrointestinal system to be healthy. The regulation of the intestinal microflora and the strengthening of the beneficial microflora are among the effective factors in the realization of this situation. In this direction, probiotics and prebiotics can be used [9, 13].

Live microorganisms that have beneficial effects on the health of their hosts when taken in appropriate amounts are coined as "probiotics" [12, 14]. In this context, some of the effects of the probiotics include; contributions to the stronger functions of both the immune system and intestinal health, providing the balance between the pro-inflammatory response and anti-inflammatory response in the intestine, preventing some deteriorations that may occur in the microflora of the intestine (by controlling the proliferation of undesirable yeasts and bacteria) [1, 10, 11].

In line with some effects of the probiotic microorganisms, the proliferation of the pathogenic microorganisms can be prevented. Some of the effects of the probiotic microorganisms in this context include the secretion of some antimicrobial peptides and lowering the pH value of the intestine [15].

Bifidobacterium, Lactobacillus and Streptococcus species are among the important microorganisms frequently used as probiotics [12].

Nutrients can stimulate the effectiveness of some microorganisms with beneficial properties in the intestine and the ones that play a role in the multiplication of these microorganisms are known as "prebiotics" [13, 16]. Prebiotics play a role in increasing the effects of probiotics, protecting and improving the health of the host [11, 12].

Galacto-oligosaccharides, insulin, and fructo-oligosaccharides are given as examples of some compounds with prebiotic properties [12].

Breast milk contains some oligosaccharides with prebiotic properties. Oligosaccharides in breast milk play an important role in shaping the microbiota of the infant gut [2, 17].

**Discussion and Conclusion**

It is thought that better examination and understanding of the microbiome activity will be effective in opening new doors in the treatment of human diseases and drug development methods for the future, and studies in this context are continuing. A greater focus on the immune system's connection both to the probiotics and the microbiota could also be beneficial for therapeutic applications against inflammatory and autoimmune disorders [1, 18].

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# Exosomes and their function

**Begüm Çelik** [*1] , **Furkan Ayaz** [2]

[1]*Mersin University, Biotechnology Department, Türkiye, begumclk.37@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Exosomes
Cardiovascular disease
Cancer

**Abstract**
Exosomes are structures that carry small molecules such as peptides, RNA, and DNA for different functions in our system. They have a role as intercellular transmission and transfer agent. They provide the protection of homeostasis through these transmission activities. They are involved in the pathogenesis of many different disorders such as cancer, neurodegenerative, cardiovascular and infectious diseases. Exosomes have great importance in the diagnosis of the clinical diseases as biomarker carriers. In this way, they enable early diagnosis and treatment for the patients. Common techniques used today when isolating exosomes are differential ultracentrifugation and exosome purification. In this study, we will review exosomes and their importance in different diseases.

## Introduction

Exosomes are vesicles secreted from cells [1]. Exosomes are small nano-sized (30-100nm) arrays with a lipid cell membrane that are secreted in all cell types [1]. Exosomes released by all cells that are involved in biological activities such as intracellular communication, signal transduction, molecular transfer and immune response [2]. Microvesicles are formed by the development of the buds from the cell membrane towards outside. They are formed by the budding of the exosomes from the cell [3].

Exosomes provide extracellular delivery of intercellular lipids,non-coding RNA such as miRNA and circRNA, mRNA and DNA *in vitro* and *in vivo*. These structures contain cytosolic and nuclear proteins [2]. They can be secreted from the cell in two ways; as constitutive and stimulatory. Structural secretion is regulated by certain RAB GTPases, glycosphingolipids and flotilins. The last common step in the secretion of the exosomes in constitutive and stimulatory release, is the integration of the microvessels with the plasma membrane [2,3].

It is secreted by different cell types such as mast cells, lymphocytes, epithelial cells, dendritic cells, thrombocytes, endothelial cells and neurons [3-5]. Exosomes send specific interactions and signals to each cell. For example, it results in the activation of the downstream signaling in ligand-receptor interaction [2]. Exosomes are classified as microvesicles, apoptic bodies or exosomes, depending on their size and biogenesis [5]. Exosomes are involved in the immune system by completing antigen presentation, immune activation, and immunosuppression [2,4].

While isolating the exosomes methodology depends on different factors such as: morphology, buoyancy consistency and the construction of the marker proteins for example Alix, TSG101, flotillin 1, HSP70 and CD9. The following techniques are generally used during their isolation process: Differential centrifugation, size exclusion chromatography, immune affinity capture, commercially available kits or microfluidic technologies [3,6]. The most common of the above techniques that is used when isolating the exosomes is; differential ultracentrifugation [3,6].

**Results**

Exosomes can get involved in the pathogenesis of versatile diseases such as diabetes, cardiovascular disease, endothelial dysfunction, coagulopathies, cancer, neurodegeneration and polystic ovary syndrome [5,8].

Exosomes have utilization in cancer detection; they are detected in the biological fluid samples such as urine, semen, saliva, amniotic fluid, cerebrospinal fluid, bile, acid, tears, breast milk and blood [8]. They transmit nucleic substances and proteins from the host cells. For example, tumor cells secrete exosomes containing tumor-specific RNAs that can be used for the cancer diagnosis [8]. In cancer, exosomes are mostly defined as factors that reinforce tumor progression. In addition, some studies suggests that exosomes can also have antitumor properties [2,8]. Depending on the content they carry they can have either tumor promoting or suppressing roles.

It has been shown that tumor immune-derived exosomes carry tumor antigens and support immunity, and this leads to the destruction of the tumors via CD8-T cells. In addition, through the signals they recieve from exosomes, CD4-T cells are thought to show resistance to tumor growth and tumor development [8].

In order for the cancer treatments to result in effective outcomes, the drugs used must be delivered to tumor cells quickly and accurately. Exosomes, called biomarkers, offer promising treatments with nanotechnology-based drug delivery systems. Exosomes are used effectively in cancer therapy and as RNA delivery vectors by using their natural distribution capabilities when they are present in a wide range of biological fluids [3,8].

Signal transmission between cells in the heart is regulated by the fibroblasts, endothelial cells and cardiomocytes [9]. This regulation leads to cardiac remodeling [9]. By measuring endothelial microvesicles,, patients who are vulnerable to coronary heart disease can be identified [6]. Some studies showed that exosomes are involved in cardiovascular diseases including but not limited to cardiomyocyte hypertrophy, periportum cardiomyopathy and cardiomyopathy.[9] Natural distribution ability, small size and easy accessibility suggest that exosomes can play a major role in the treatment of the heart diseases. However, studies are still ongoing for this type of treatment [9,10].

**Discussion**

The main known role of exosomes is the removal of the intact endosomal proteins and cell membranes. Exosomes are well tolerated by the body since they are not recognized as foreing since they can be formed by all type of cells, resemble cell membranes, and can cross obstacles such as blood brain barrier [11]. Exosomes are mostly known for their anti-tumor activities by suppressing the immune reaction against the tumor cells [12]. Most of the studies focus on their utilization as early cancer diagnosis markers [3,6].

Exosomes are also involved in the pathogenesis of cancer, neurodegenerative and cardiovascular diseases. Recent studies have proven that exosomes play an important role in the development of the infectious diseases. In addition, some other studies showed that hepatitis B, C and E viruses use the exosomal pathway mechanism to transmit disease persistence [13,14]. It is very important to diagnose clinical diseases through exosomes for such diseases. However, clinical applicability is limited due to the standard isolation and purification technologies [13].

**Conclusion**

New studies are needed for the development of effective treatment methods against infectious diseases, cardiovascular and neurodegenerative disorders. Exosomes can be great candidates as early diagnosis markers besides their utilization as peptide, non-coding RNA and DNA carriers to cure certain disorders. Although exosomes have been mostly studied in areas such as cell biology and biomedicine, recent studies have determined that they can be utilized in industries such as food and agriculture [11]. More studies should be conducted to determine the efficacy and safety of the exosomes as delivery agents for different purposes.

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# Studies on cytokine storm

**Şule Merve Aslan** *1 , **Furkan Ayaz** 1,2

*1Mersin University, Biotechnology Department, Türkiye, 2102030171002@mersin.edu.tr*
*2Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Cytokine
Immune system
Infections
Interleukin
Tumor necrosis factor
Alpha

**Abstract**
The term cytokine storm or cytokine cascade was first used in an article published in 1993 and is still a term used for uncontrollable inflammatory responses, but it still cannot be fully explained today. Cytokine storm can occur in many diseases of the central nervous system, either infectious or non-infectious. In most of the patients, the release levels of proinflammatory cytokines such as interferons, tumor necrosis factor, interleukins and chemokines are significantly high. The molecular mechanism of the cytokine storm has not been clearly elucidated and most cases result in death. Since clinical treatments and immunomodulatory treatment methods in this area are insufficient, this issue should be discussed and investigated in more detail. In our current proceeding we are briefly discussing the cytokine storm.

## Introduction

Cytokines are low weight molecules, about 8-40 kD, in the form of glycoproteins or peptides. Cytokines are also known as signaling proteins and intercellular communication providers that play an important role in protection against dangerous invaders, wound repair, and inflammation. They are produced by many cells and are named according to these cell types (monokine, interleukin, etc.). Cytokines are basically divided into two sections, proinflammatory cytokines aggravate the condition while anti-inflammatory cytokines work in opposite directions to repair and alleviate. Most commonly known proinflammatory cytokines can be listed as; TNF-a, IFN-y, IL-1, IL-6, IL-8, IL-12, and anti-inflammatory cytokines can be listed as; transforming growth factor (TGF-B), IL-10, is secreted as IL-4 [1 ,2]. Two well-known cytokines, TNF and IL-6, have important roles in the cytokine cascade by releasing large number of cytokines. IL-6 is involved in B cell transformation, immunoglobulin secretion, and suppression of inflammation and inflammation, supporting host defense against tissue damage and autoimmune diseases [3]. Too much secretion of this cytokine causes a cytokine storm, resulting in a systemic inflammatory response. TNF-α is a cytokine secreted by most of the immune system cells, plays a role in damage caused by the inflammation, and it is the first cytokine produced in the immune response. It can trigger inflammation, has functions in tumor necrosis [4]. When the uncontrolled production of these cytokines increases, symptoms of fever, swelling, hypotension occur and can cause tissue or organ damage and death [5, 6].

## Results

The immune system creates an immune response against invading pathogens and eliminates these pathogens. As a result of this reaction, the tissue or organ environment returns to equilibrium, but if this balance cannot be achieved, the cytokines produced by the immune cells can increase uncontrollably and generally cause different disorders such as liver damage, heart muscle diseases, kidney failure, and cholestasis in patients [7]. Some studies have been done to prevent the cytokine storm. Understanding the exact mechanism is very important. In one study,

it was tried to prevent the cytokine storm by targeting the response of the immune system cells, but the result was not effective [8]. Immunoglobulin receptors are excitatory and inhibitory receptors known as Fc receptors. Immunoglobulins' Fc receptors are present on the surface of some immune system cells (macrophages, dendritic, NK and B cells). These Fc receptors are important to regulate the inflammatory response of different immune system cells. Positive results have been obtained in literature studies by blocking the Fc receptors [8,9]. In the literature, there are studies showing that the application of COX-2 inhibitors in therapeutic treatments modulates the immune response [5]. Inhibition of COX-2 can also be an efficient way of suppressing the cytokine storm. Various treatment modalities have been investigated, but most are not effective, so treatment strategies in this area need to be developed.

## Conclusion

There are many studies focusing on the treatment of the cytokine cascade, but currently there are treatments that can only act on the upstream mechanisms, that is to reduce production levels of the peptides. Apart from this, although many methods have been investigated, they have not been effective. There are studies in the literature suggesting that immunomodulatory treatment can be applied to prevent the cytokine storm of severe influenza [10,11]. It is very important to maintain the balance in the main proinflammatory cytokines (TNF-α and IL-6, etc.) in the cytokine storm [5]. In general, since the agents applied in for the immunomodulatory targeting of the intracellular signaling pathways seem more potent, the development of this method will probably be more efficient. Targeting the signaling pathways will shut the downstream mechanisms to suppress the cytokine storm. Future studies will clarify this subject matter in more details.

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# RNA-Based therapeutic oligonucleotide strategies

**İsmail Korkmaz** *¹ , **Gamze Taşkan** ¹ , **Serdal Arslan** ¹

*¹Mersin University Department of Medical Biology, Türkiye, ismailkrkmazz@gmail.com, gamzecaakirr@gmail.com, arserdal@yahoo.com*

**Keywords**
Oligonucleotide
RNA
Therapeutics

**Abstract**
Oligonucleotides, which have RNA-based therapeutic effects, constitute therapeutic strategies with very high potential with the elucidation of the mechanism of action of RNA molecules in cellular processes and with the developing technology. These strategies offer new alternatives for the mechanisms, pathophysiological processes, diagnosis, treatment, and prevention of many diseases. It also opens new doors to many pathophysiological pathways previously known as "non-targetable". RNA-based oligonucleotides are promising new therapeutic modalities thanks to the diverse reservoir of molecular tools they provide.

## Introduction

Oligonucleotides are single- or double-stranded nucleic acid molecules produced in vitro that can silence, block or suppress a target by direct interaction [1]. The disadvantages associated with the therapeutic potential, stability, distribution, rapid degradation, and immunogenicity of oligonucleotides began to decline with advancing technology [2]. However, the addition of chemical modifications to the backbone structures of oligonucleotides highly improved the efficacy of oligonucleotide therapeutics [3, 4].

**Antisense oligonucleotide (ASO) therapeutics:** ASO; are short, single-stranded, typically 8-50 nucleotides long, synthetic RNA (or DNA) oligonucleotides. These oligonucleotides bind to target mRNA, pre-mRNA, or ncRNAs via complementary Watson-Crick base pairing. After binding to their targets, they mostly function by causing endonuclease-mediated transcript degradation and consequent reduction in transcript levels [1, 5]. The mechanisms of action of these therapeutics in the cell are diverse and these mechanisms are classified into five categories. (I) DNA-based ASOs bind to an RNA target to form a DNA: RNA hybrid. This hybrid structure acts as a substrate by RNase H and enables this hybrid to be degraded. (II) ASOs stop the translation of mRNA targets that bind to the AUG start site of the Open Reading Frame (ORF), which blocks the assembly of ribosomal subunits. (III) regulates translation by sterically interfering with RNA-binding proteins. (IV) Regulates pre-mRNA splicing by binding to exonic or intronic sequences in the splice regions of pre-mRNA leading to the omission, omission, or inclusion of a particular exon. By binding to the Upstream Open Reading Frame (uORF) located in the (V) 5'UTR region, it can enhance translation by supporting the efficiency of the main ORF located downstream of this uORF. [1, 4, 6].

**Small interfering RNA (siRNA) therapeutics:** siRNA is short, synthetic, 19-22 nucleotide duplexes that typically contain asymmetric nucleotide overhangs at their 3' ends and are inserted directly into the cytoplasm of cells. siRNAs exploit the RNA interference (RNAi) pathway, which is a cellular defense mechanism. These RNAs are produced from endogenous long, double-stranded RNAs (dsRNA) by cleavage by an endoribonuclease Dicer

enzyme [7]. Composed of two single strands, dsRNA combines with the endonuclease Argonaute (AGO) to form the siRNA-induced silencing complex (siRISC). The sense strand is then released and the antisense strand is loaded into the RISC. Under the guidance of the antisense helix, RISC is activated and binds to the target mRNA with a completely base-complementary pairing, leading to degradation, thereby inhibiting gene expression. The binding of siRNA to its target is highly selective and can distinguish even between sequences that differ by a single nucleotide [8]. This specificity in binding has made siRNA suitable therapeutic tools. Moreover, RISC and guide siRNA are recyclable and therefore one siRNA molecule can degrade a large number of mRNA molecules, resulting in high-efficiency gene silencing [4, 9, 10].

**MicroRNA (miRNA) therapeutics:** miRNAs are small, non-coding RNAs that exist endogenously throughout the genome where complementary regions lead to the formation of a defective RNA hairpin. When processed by the RNAi mechanism, the result is a 19-25 nucleotide RNA duplex containing regions of mismatch. Endogenously formed miRNAs mostly bind the 3' untranslated region (3' UTR) of mRNAs and prevent them from being translated into protein. miRNAs can have many targets in the cell, as the miRNA needs to complement the target mRNA to suppress the translation of only a few nucleotides. The mechanism of gene repression by miRNA depends on the degree of complementarity of an RNA target; [11, 12] miRNA mimics or synthetic miRNAs can be used therapeutically to reduce the expression of mutant proteins [7]. A miRNA can regulate hundreds or thousands of genes, and a gene can be regulated by many different miRNAs. Therefore, identifying the miRNA to regulate a particular gene is difficult and may cause unexpected side effects [13]. The use of miRNA-based therapeutics has dual advantages. First, miRNAs are molecules that occur naturally in human cells as opposed to synthetic ASOs and therefore have all the mechanisms for their processing and downstream target selection. Second, miRNAs act by targeting multiple genes in a pathway, thereby causing a broader but specific response. The use or targeting of naturally occurring miRNAs could represent a promising alternative to existing RNA-based therapies and potentially enhance therapeutic effects compared to synthetic siRNAs or ASOs that only affect a single target gene [14].

**Short activating RNA (saRNA) therapeutics:** saRNA is a 21-nucleotide, double-stranded, non-coding RNA with two nucleotide overhangs at the ends. Inside the cell, saRNAs are first loaded into the AGO protein, into which the antisense helix is split. The saRNA-AGO complex then enters the nucleus and binds to the promoter regions of genes to increase transcription [15]. saRNAs targeting specific gene promoters induce transcriptional gene activation and induce RNA activation (RNA-a). RNAi and RNA-a pathways show similarities in terms of molecular mechanism. In RNA-a, the RNA-induced transcriptional activation (RITA) complex is formed by the saRNA-AGO complex. The RITA complex consists of RNA helicase A and RNA polymerase-associated protein CTR9, which interacts with RNA Polymerase II to trigger transcription initiation and elongation. saRNA plays a role as a new therapeutic modality for upregulating gene expression in diseases with suppressed transcriptional or translational activity. There are several advantages to developing saRNAs therapeutically, including low immunogenicity and locus-specific gene transcription activation; however, disadvantages such as RNase degradation sensitivity and off-target effects are also critical challenges [13].

**RNA Aptamers:** Aptamers can form complex structures, binding proteins, and disrupt multiple protein complexes or inhibit their function. They are short, 25-80 nucleotides, single-stranded oligonucleotides that can consist of both DNA and RNA. Thanks to its three-dimensional structure, RNA aptamers show activity by binding to their targets through an appropriate interaction [16, 17]. Because of the similarity of the way aptamers bind to their targets to the immune system, they are considered "chemical antibodies". This situation; Thanks to the special chemical synthesis, provides advantages such as scalability, low intergroup variability, ease of post-synthesis modification, and low immunogenicity [4, 15].

**Synthesis and Modification of Oligonucleotide Therapeutics:** Oligonucleotide synthesis is accomplished by a chemical process using nucleoside phosphoramidides, which are analogous nucleotides with conserved reactive groups. RNA oligonucleotides can be synthesized via solid-phase synthesis. The synthesis is carried out in a flow column reactor with a pump-driven system. The first nucleoside is attached to the solid support and then loaded into the column reactor. Typically, there are four steps involved in adding the second nucleoside on top of the first: (I) Detritylation: The 5'-dimethoxytrityl protecting group is removed from the support-bound nucleoside. (II) Binding: The appropriate phosphoramidite monomer (A, G, U, C) is coupled with the aid of an activator. (III) Thiolation/oxidation: The newly formed phosphite triester internucleotide bond is converted to phosphorothioate or phosphodiester by thiolation or oxidation agents. (IV) Capping: unreacted 5'hydroxyl groups are capped with capping agents. After these four steps, a cycle is completed and a new cycle is started [4]. In addition, siRNAs can also be synthesized enzymatically by in vitro transcription with a subsequent DNase treatment and colon purification [18, 19]. If RNA aptamers are to be produced, a prior design is required. A widely used methodology for designing aptamers is the systematic evolution of ligands by exponential enrichment (SELEX) [4, 20].

RNA molecules are inherently highly unstable as they have a 2'-OH group. Chemically modifying the base, sugar, or backbone of a synthesized RNA molecule aids stability, increases their resistance to nucleases, improves efficiency and target specificity, or aids delivery into a cell [21]. However, excessively modified RNA can have toxic effects or make the molecule less efficient [22]. Synthetic RNA-based oligonucleotides are usually modified with phosphorothioate, 2'OMe, 2'-fluoro, 2'-O-methoxyethyl (2'MOE), or 2'4'-methylene [23]. These modified RNA-based oligos have an increased affinity to bind to and inhibit their targets in vivo, are more resistant to degradation and have increased bioavailability [24].

**Results**

As a result, these oligonucleotide therapeutics using the RNAi pathway constitute therapeutic strategies with very high potential with the developing technology. These strategies offer new alternatives for the mechanisms, pathophysiological processes, diagnosis, treatment, and prevention of many diseases. Today, 16 FDA-approved RNA therapeutic drugs are used in the clinic, and many RNA therapeutics are under development. This will open the door to new treatment methods for many diseases shortly.

**Discussion and Conclusion**

Increasing knowledge of the versatile roles of RNAs has spurred the development of new classes of RNA-based drugs. Drugs under development are used with mechanisms that show activity from many pathways, such as inhibiting gene expression, producing functional proteins, and changing splices. Although it is difficult to use these mechanisms and turn RNAs into drugs, we are on the verge of a revolution in drug development. Successful application of RNA-based therapeutics requires an unprecedented interdisciplinary approach, including technical advances in molecular biology, immunology, pharmacology, chemistry, and nanotechnology. The development of RNA drugs is rapidly increasing. In the near future, RNA-based drugs could become an increasing component of the pharmacopeia, greatly expanding the universe of drug-applicable targets to provide treatment for previously incurable diseases and potentially ameliorate genetic diseases.

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# Effect of breast milk on infant intestinal flora

## Umutcan Hendekci *1 , Furkan Ayaz 1,2

*1Mersin University, Biotechnology Department, Türkiye, 19133005@mersin.edu.tr*
*2Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Breast Milk
Oligosaccharide
Infant Intestinal Flora

**Abstract**
The best food that can meet all the nutritional elements that babies need is breast milk. Breast milk contains nutrients such as vitamins, minerals, iron, water, fat, protein and carbohydrates in necessary amounts for the baby. Molecules found in breast milk are responsible for the development of the infant's immune system and gut microbiota. It is known that breastfed babies are more resistant to diseases such as asthma, diabetes and diarrhea. In this proceeding we will briefly discuss the effect of the breast milk on the immunity and microflora.

## Introduction

Breast milk is the most important nutritional source for babies as it contains all the nutritional needs of the baby in the required amount. In addition to containing carbohydrates, fatty acids, nucleotides, immunoglobulins, lysozyme, lactoferrin, polyamines, cytokines, living immune cells and other immune regulatory substances, it is a constant source of bacteria for the infant gut. Breast milk contains bacteria with potentially probiotic properties. These bacteria play an important role in the infant gut. It is thought that breastfed babies are protective against respiratory diseases and diarrhea, and in the long term, it may be protective against diseases such as obesity and diabetes [1]. It is recommended that the baby be fed only with breast milk in the first 6 months after birth, and continued breastfeeding with appropriate complementary foods until the age of 2 years [2]. Breast milk adapts to the baby's health and age. For this reason, if we compare the milk of two different mothers who gave birth prematurely and those who gave birth normally, their contents are different from each other. Breast milk is examined according to the period it is secreted and its composition. The milk secreted within the first 5 days after birth is called colostrum. It is richer than other periods in terms of zinc, sodium, vitamin A, vitamin D and antibodies. Apart from the nutrients it contains, colostrum has a protective effect against infections. Transitional milk is secreted between the 5th and 15th days. Mature milk is the milk secreted after the 15th day and approximately 88% of its composition is water [3]. Compared to milk of animal origin, breast milk has a higher oligosaccharide content. Monosaccharides, D-glucose, D-galactose, L-fucose, N-asteylneuraminic acid and N-acetylglucosamines form breast milk oligosaccharides. The production of breast milk oligosaccharides (BMO) is genetically determined. Secretory and Lewis blood group genes plays an important role in determining the BMO profile. Lactose can be converted into lacto-oligosaccharides and lactuloses, both of which are involved in the growth of probiotic bacteria for intestinal function [4]. The prebiotic feature of breast milk triggers the growth of beneficial bacteria such as Bifidobacterium infantis in the gastrointestinal tract of the baby and protects the baby against the proliferation of pathogenic bacteria [5]. In addition, breast milk oligosaccharides prevent microorganisms from adhering to epithelial cells. Another feature is that they interact with immune cells [6]. They balance cytokine production and regulate T-cell responses. Sialic acid plays a role in nerve cell transmission and memory. While 2.9% of sialic acid in breast milk is free, 73% is bound to oligosaccharides. In the baby, sialic acid production is insufficient for brain development and myelination in the liver and it meets this with breast milk [4].

**Results**

Breast milk is a very important food source for the baby because of the nutrients it contains. In the first 6 months, the baby should be fed with breast milk. The effect of breast milk on the development of the baby and the intestinal flora of the baby is quite high. It has been proven by research that breastfed babies are more resistant to diseases than other babies [1,2].

**Conclusion**

The content of the breast milk has all the necessary nutrients for the development of the infants in their first 6 months. Infant nutrition should continue with appropriate complementary foods and breast milk from 6 months to 2 years of age. Breast milk is the source of bacteria in the infant intestinal flora. Microbiota is regulated by the probiotic and prebiotic properties of oligosaccharides in breast milk. They also interact with immune system cells. Considering all these important effects, mothers who have just given birth should be made aware of breastfeeding [1-6].

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# Transferring Galanthus's stress resistance genes to other plants

**Simay Ayden** *[*1] 🆔 **, Furkan Ayaz** [1,2] 🆔

[1]*Mersin University, Biotechnology Department, Türkiye, 21140940006@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Snowdrop
Galanthus
Transgenic plants

**Abstract**
Drought has become a huge problem in changing climatic conditions. Now drought-resistant plants can grow, while other plants are disappearing. Snowdrop flower is a plant that does not need much water to grow and can grow in harsh environmental conditions. We can transfer this resistance gene of the snowdrop to other plants, and in this way, we can grow the plants that are needed for the increasing population, regardless of environmental conditions. At the same time, by using this gene in the production of valuable and high-priced plants, we can make it durable and thus contribute to the country's economy. In this proceeding, we are briefly discussing the possibility of utilization of Galanthus's stress resistance genes for better crop growth and yield.

## Introduction

Snowdrop flower grows in Romania, Albania, Austria, Belarus, Bulgaria, Turkey, Czechoslovakia, Greece, Hungary, Italy, Poland, Sicily, Spain, Germany, Switzerland, Ukraine, Yugoslavia, and France [1]. They are easy to grow. In addition to being an ornamental plant, it also provides the treatment of Alzheimer's disease and the snowdrop lectin protects other plants against insect pests [1]. The flowers bloom from late January to March, the optimum flowering period is mid-February: the fruits ripen in June and shed their seeds [2]. Many studies have been done on snowdrops. The first of these was to produce transgenic rice using the lectin found in snowdrops and provide protection from insects [3]. Another study is the use of galantamine found in snowdrops in the treatment of Alzheimer's disease [4].

## Results

In order to transfer genes in plants, we first isolate the piece of DNA we want to transfer. Then we insert this piece of DNA into a suitable vector and we get recombinant DNA [5]. We can transfer recombinant DNA to plants in 3 ways [5].

1. Via viruses
2. By biolistic, micro-injection, electroporation
3. We can transfer it via Agrobacterium.

Snowdrop is a plant that can withstand harsh winter conditions and can grow in an arid environment. We can produce a transgenic plant by transferring the gene that makes it resistant to another plant. And so we can produce plants that need less water.

Ornamental plant exports in Turkey contribute very little to the economy compared to other countries [6]. We can grow valuable ornamental plants with the endurance genes of the snowdrop. In this way plants will be more resistant, will grow with less water, and will not need the sun to grow, and we can export more.

**Conclusion**

We can use the features of the snowdrop, which enable it to bloom in harsh winter conditions and need less water, not only in ornamental plants, but also in plants that are the main food source for humans [3, 4]**.** In this way the production efficiencies of the economically important plant species can be increased with less cost. Future studies should be conducted to examine the effectiveness of such methods to find the best working genes to increase the stress resistance in strategically important plants for human consumption.

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# Asthma immunopathogenesis and biomarkers in asthma treatment

## Hülya Servi*[1] ⓘ, Furkan Ayaz [1,2] ⓘ

[1]Mersin University, Biotechnology Department, Türkiye, 19133015@mersin.edu.tr
[2]Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr

| Keywords | Abstract |
|---|---|
| Asthma<br>Th1<br>Th2<br>Th17<br>Treg<br>Biomarker | Asthma is a disease that affects millions of people all over the world. In terms of socio-economic status, especially low and medium-level countries are more affected by this situation. Intestinal and lung microbiota play an important role in the basis of the disease. In previous years, the paradigm between Th1 and Th2 was thought to be responsible for airway inflammation in asthma. But over the years, Treg and Th17 cells, which are subgroups of these cells, have been discovered, unlike Th1 and Th2 cells. It was thought that the connection between these cells may also be an effective factor in asthma. In the following years, it was possible to gain knowledge by using factors such as onset of symptoms, presentation of symptoms, allergy, eosinophil and disease severity in determining phenotypes. Today's biotechnological developments are increasing rapidly. In this way, there are developments in the field of targeted therapy. |

## Introduction

Asthma is a disease that affects children and adults of different age ranges. Airway remodeling, reversible airway obstruction, excessive mucus secretion, airway hyperresponsiveness, and chronic airway inflammation in the form of recurrent attacks, which are characteristic features of asthma [1]. The frequency of the disease varies between populations, but it is one of the most common respiratory diseases affecting children and adults [2]. The disorder affects 300 million people around the world. In our country, this situation is approximately 3.5 million [1]. The characteristics of this disease is shortness of breath, wheeze, cough and a feeling of pressure in the chest. These symptoms are evident in the morning or at night, recurring at regular intervals, occur or worsen after exposure to irritants (infection, cigarette smoke, exercise, cold air) or allergens (cat hair, pollen, house dust mite, etc.) and recovery on its own or with appropriate treatment is the classic symptom pattern [3].

Environmental and genetic factors, which are the main causes of asthma, cause this disease to be heterogeneous [4]. In addition to these, there are also epigenetic and etiological factors. Atopic, one of the etiological factors, constitutes 50% of asthmatic patients. However, asthma development is observed in a small number of atopic patients. The conclusion to be drawn from here is that asthma is an unpredictable disease [5]. Human genetics contributes to the pathogenesis of asthma [4]. Many genes are involved in the pathogenesis, and over 600 genes have been identified that are associated with asthma. Despite this high number, only a few of these genes have been replicated. Asthma-associated signaling proteins include beta 2 adrenergic receptor gene, cytokines, receptor genes of transcriptiom factors involved in Th1 and Th2 cell differentiation. STAT6, GATA3, IL-4, IL4RA, ADAM, TBX21, IFNG, IFNGR1, TLR4, FCER1B, CD14, IL13 and IL13 receptors are among the genes associated with asthma. In addition to beta-2 agonists, genes responsible for regulation of the response to leukotriene antagonists and steroids have also been identified in asthma. We can collect the genetic changes associated with these genes under four main headings:

a- Production of antibodies in the IgE structure specific to the allergen (atopy),

b- Genes that have an effect on the hyperresponsiveness of the airway,
c- Inflammatory mediators whose synthesis is affected by some genes (growth factors, cytokines and chemokines),
d- Th1 in relation to the hygiene hypothesis and determining the balance between the Th2 immune response [6].

In airway inflammation associated with asthma, basophils are associated with infiltration of cells such as T helper (Th) cells, eosinophils, and mast cells in the airway submucosa. Airway epithelial cells form the first line of defense against respiratory environmental factors such as pollutants and pathogens. One of its functions is to initiate airway inflammation. As a result of the initiation of inflammation, different cell structures are stimulated and the release of interleukin-25 (IL-25), IL-4, IL-9, IL-13, IL-5, IL-33, thymic stromal lymphopoietin (TSLP) cytokines is initiated. As a result, IgE synthesis takes place. The allergen-specific IgE receptor, which is carried by mast cells, starts airway inflammation by causing leukotriene, prostaglandingin and histamine release as a result of re-exposure to the antigen. Within the allergic and non-allergic phenotypes of asthma, a number of changes occur in the dynamic structure that includes all layers of the bronchial wall of the small and large airways. With the inclusion of biological mechanisms, the resulting changes initiate the "remodeling" transformation, which is determined by the increase of bronchial vasculature, thickening of smooth muscle cells, subepithelial thickening, and epithelial changes [7]. With high-dose allergen intake, there is a shift from allergic Th2 inflammation to Th1 inflammation and the formation of regulatory "suppressor" lymphocytes called Treg (T regulator) [8]. Treg cells are the cells whose basic function causes suppression of the immune response in periods when it is not needed. This mechanism is mainly useful in eliminating the pathogenic microorganism as a result of infection and suppressing the autoimmune response. Th2-related inflammation can be exploited to control the increased function of Treg cells in asthma [9]. Mild to moderate allergic asthma is characterized by Th2 cell-mediated hyperplasia of mucus-secreting cells, eosinophil infiltration, remodeling, bronchial hyperreactivity and metaplasia. In severe asthma, neutrophil inflammation and infiltration induced by INFγ, TNFα, IL-25 and IL17 cytokine variants are thought to be responsible for the development of resistance to corticosteroids [5]. As a result of the comparison of asthma patients with healthy individuals, an increase in IL-17A+ cells was observed in peripheral blood mononuclear cells. In addition, IL-17A mRNA was found to be responsible for increasing inflammatory mediator synthesis in fibroblasts isolated from bronchial biopsy in asthma patients [9]. The orientation of the treatment of asthma to targeted therapy has been with the discovery of omalizumab and, more recently, anti-cytokine and anti-cytokine receptor antibodies. To date, physicians have gained knowledge of asthma phenotypes based on the onset of symptoms, allergies, eosinophils, presentation of symptoms, and severity of the disease. The mainstay of asthma treatment is inhaled corticosteroid (ICS) therapy. The reason is that the basis of asthma is accepted as eosinophilic inflammatory.

Until recently, traditional treatment was always used due to the lack of biomarkers used to identify different types of asthma. Today, there are different treatment methods for homogeneous groups, thanks to endotype and phenotype classifications according to biomarkers and physiological-clinical characters. While the concept of endotype deals with the occurrence and molecular mechanism of the disease, the concept of phenotype is the clinically observed features. They define the pattern and determine the physiological and clinical characters. Understanding whether patients respond or not to treatment is thanks to the use of biologic agents in phase studies and in the clinic. Owing to the observed heterogeneity, asthma has been further subdivided into specific subgroups.

In the coming years, it is possible to perform a more detailed analysis of gene expression in patients who have responded to treatment. This analysis will enable the further development of further analysis and to identify specific biomarkers for treatment targets. The reason why the concept of personalized medicine is acceptable is that it leads to an endotype definition for each patient that addresses the causal pathways. The main rationale in personalized treatment is to ensure that phenotyping is done in an unbiased manner. In the definition of a biomarker, it is expressed as that which can be measured and evaluated as an indicator of normal or pathological biological processes or a biological response to a therapeutic challenge. Defining biomarkers as predictive markers and increasing our capacity of the response allows us to make reliable and accurate determinations. In the treatment of asthma, mostly a Th2 biomarker is utilized for the diagnosis of the disease. These biomarker types also include serum IgE, exhaled exhaled nitric oxide level, blood eosinophil count, sputum eosinophil count, and serum periostin levels. Today, biomarkers are used more and more to identify patients specifically [10].

**Results**

Gender, body mass index and age are important factors in the phenotyping of patients with asthma. The reason for this is that asthma at an early age is related to the atopic phenotype. In addition, the patient should be questioned more in situations such as exercise that trigger asthma symptoms. Determining the number of exacerbations per year is an important factor in defining poor asthma control. This factor is an important variable to classify as a frequent exacerbation group and also to advance the patient one step in the treatment. Two of the

most important features of biomarkers in asthmatic patients are that they enable the identification of all phenotypes covering the asthma range and identify patients who can respond specifically to treatments [8].

**Conclusion**

In order for biomarkers to benefit clinicians, the identification of asthma molecular phenotypes, especially non-Th2 pathways, is an important element in the coming years. For these definitions, predictive biomarker and more phenotypes should be developed. Because in the goal of targeted therapy, there is a need for a biomarker capable of predicting the response. A point to be considered in defining the phenotype is to define the asthma phenotype in an unbiased manner. While creating the patient's phenotype, the final goal of the applicability of personalized medicine, it is important to have sufficient information about the patient's environment and condition [8].

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# Application of flow cytometry in plant science

**Deniz Aksoy** [*1] , **Furkan Ayaz** [2]

[1]*Alata Horticultural Research Institute, Türkiye, denizsanal06@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

**Keywords**
Flow Cytometry
Plant Science
Polyploid

**Abstract**
Chromosomal determinations have been used in the identification of many diseases and anomalies. In the first studies, the biochemical and physical properties of cells were determined using a primary microscope. Flow cytometry technique has become an important part of modern plant breeding programs as conventional chromosome counting methods via microscope etc. become insufficient. Flow cytometry is an application in which the properties of biological particles, especially cells, are measured in a liquid stream. Flow cytometry has been widely used in plant science since the 2000s due to its fast setup, quick sample preparation and reading of thousands of particles per second. In this proceeding we will discuss the flow cytometry applications in plant science studies.

## Introduction

Chromosome measurements first gained importance in human health research. Chromosomal determinations have been used in the identification of many diseases and anomalies. In the first studies, the biochemical and physical properties of cells were determined using a primary microscope. Clinical use of chromosome measurements has expanded further ın recent years and started to be used frequently in microbiology, plant and animal sciences [1]. Changes in the number of chromosomes in living organisms are called "ploidy", and the presence of more than two sets of chromosomes in somatic cells is called "polyploidy". Polyploidy is an increase in the number of all chromosomes in a plant's genome at the same rate. An issue where the ploidy level gains importance is plant breeding studies. Knowledge of plant DNA contents has become essential for many plant breeding programs or techniques [2]. One of the biggest problems encountered in plant breeding is the narrowing and insufficiency of genetic variation over the years [3]. Especially in crossbreeding breeding programs, wild and semi-wild plant forms with genetic variation are used [4]. It is important to determine the cytogenetic information of wild forms.

Flow cytometry technique has become an important part of modern plant breeding programs as conventional chromosome counting methods take a lot of time and become insufficient. Information on the DNA content of plants has increased over time. This has led to the emergence of breeding programs that directly target ploidy changes, called 'Ploidy breeding'. Polyploidization in plants often results in increased cell size leading to positive morphological changes. Organs of polyploid plants such as stems, leaves and flowers are larger than diploid ones and their surface areas are wider. Since these plants have larger cells and a higher amount of chlorophyll, they attract attention with their dark green color. Their photosynthetic potential is also higher than diploids. It is also estimated that there is a positive correlation between genome size and ploidy level [5,6]. Flow cytometry is a very useful tool for identifying DNA contents in plant cross-breeding.

**Results**

Flow cytometry is essentially both a technique and a device. It is technically the measurement of the properties of cells or particles when they are in a flowing fluid. With this method, the structural features and DNA amounts of cells can be determined. When evaluated within the scope of the device, it is a machine that creates usable information by transmitting different wavelengths formed by the laser radiation of the device to the system through fluorescent dyes that are attached to the structure of DNA. Propidium iodide, ethidium bromide and acridine orange fluorescent dyes are mainly used in flow cytometry.

Cells go through a series of stages known as cell cycle. Flow cytometry technique which is developed for plant research basically uses this cycle of grow. With Flow, it is possible to determine the number of cells in which division phase of the cells. In this way, information about the proliferation rate of cells is collected. During the process of device while diploid sample cells are in G0/G1 phase, DNA content of cells in S (synthesis) phase will be between diploid and tetraploid cells. Cells in G2 and Mitosis will be viewed as tetraploid since they carry 4n DNA.
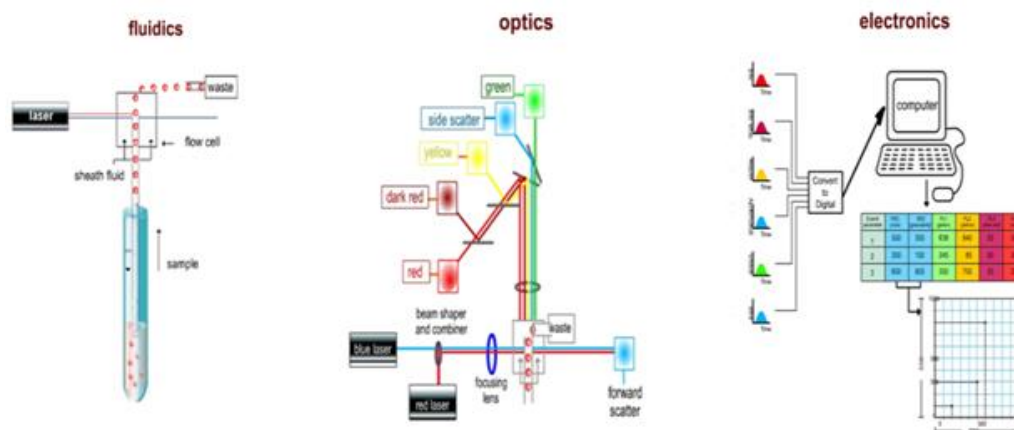


**Figure 1.** Components of flow cytometry device [9]

Flow cytometry consists of 3 basic steps; fluidics, optics and electronics. The sample solution, which is put through the liquid flow system, moves in front of the laser in a single line through the liquid called sheath fluid, which surrounds it and does not mix with the sample solution. While passing in front of the laser, the beam hitting the particles is dispersed at different wavelengths and this fluorescent dispersion is collected by filters and transmitted to the photodetector. The optical signals from the detectors are converted into electrical signals with Photomultiplier tubes and finally transferred to the computer [7,8].

**Conclusion**

Although the flow cytometer setup costs are high, the operating and maintenance costs are low. Correct calibration is required. Otherwise, it is possible to measure all structures other than the particles desired to be measured. Flow cytometry has been widely used in plant science since the 2000s due to its fast setup, quick sample preparation and reading of thousands of particles per second [5, 6].

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# Investigation of homogeneity test of annual total precipitation of Konya Closed Basin with standard normal homogeneity test

**Beyza Değişli [1] [iD], Şeyma Aksu [1] [iD], Nazlı Nergiz [1] [iD], Hilmi Emre Göktaş [2] [iD], Mehmet Selim Geyikli [3] [iD], Vahdettin Demir *[1] [iD], Mehmet Faik Sevimli [1] [iD]**

*[1] KTO Karatay University, Civil Engineering Department, Konya, Türkiye, beyza.degisli@ogrenci.karatay.edu.tr; seyma.aksu7007@gmail.com; nazli.nergiz@ogrenci.karatay.edu.tr; vahdettin.demir@karatay.edu.tr; mehmet.faik.sevimli@karatay.edu.tr*
*[2] Mersin Yusuf Kalkavan Anatolian High School, Mersin, Türkiye, goktashilmiemre@gmail.com*
*[3] Tokat Gaziosmanpasa University, Civil Engineering Department, Tokat, Türkiye, selim.geyikli@gop.edu.tr*

**Abstract**
In this study, the homogeneity of the total precipitation data of 11 Meteorology observation stations located in the Konya Closed Basin was examined using Standard Normal Homogeneity Test (SNHT). The data used in the study are between 1972 and 2020. The analyzes were performed using the XLSTAT software at the 95 percent confidence interval and the results were mapped using the Inverse Distance Weighting (IDW) method. When the results were examined, it was determined that the data were homogeneous in only 1 of the 11 stations in the region (Niğde station). This result showed that the data in many stations in the study area did not come from the same cluster and the data may show an increasing or decreasing trend over time. The IDW map provides information about the spatial distribution of the results. When the IDW interpolation map of the results was examined, it was determined that the Niğde station located in the east of the study area was homogeneous, the stations in the other regions were not homogeneous and the SNHT p values were higher in the middle inner parts of the study area.

## Introduction

In recent years, the demand for water has been steadily increasing. On the other hand, the limited water resources have revealed the need to use the existing resources at optimum levels to meet the needs [1]. For this reason, it is an important issue to make analyses that will ensure the effective use of water in water resource planning and projecting. The most important of these analyses is the trend analyses used to predict the future behavior of precipitation based on its past behavior. Trend analyses for precipitation are of great importance in terms of flood and drought studies as well as in terms of water supply [2]. The reliability of trend analysis is provided by homogeneity analysis. The fact that the data show a homogeneous distribution and come from the same population, in other words, the separation from the anthropogenic effects makes trend analyses more powerful.

In this study, the homogeneity of the annual total precipitation data recorded between 1972 and 2020 of 11 meteorological observation stations located on the borders of the Konya Closed Basin were examined. The most preferred Standard Normal Homogeneity Test (SNHT) method was used in the literature and the analyses were performed using the P test at 95% of confidence interval. In the implementation of the method, the XLSTAT program was used. In the end, the result map was made with the Inverse Distance Weighting (IDW) method.

**Material and Method**

Within the scope of the study, SNHT was applied to the annual total precipitation data of 11 meteorological observation stations located in the Konya closed basin. The obtained results were mapped by IDW method.

**Standard Normal Homogeneity Test (SNHT)**

This method developed by Alexandersson is used to test the homogeneity of many hydro-meteorological parameters [3].

**Inverse Distance Weighting (IDW)**

The IDW method was used to obtain the interpolation maps of the homogeneity test results. IDW is an interpolation method used to estimate the values of points or regions that cannot be sampled with sampling points [4].

**Study Area**

Konya Closed Basin, which is located in Central Anatolia in Turkey and covers a large part of Konya's territory, is one of the most important basins of the country in terms of agriculture. Semi-arid continental climatic conditions prevail in the basin. It is located between latitudes 36°51'N and 39°29'N and longitudes 31°36'E and 34°52'E. As a location, it is located between latitudes 36°51'N and 39°29'N. And longitudes 31°36'E [5]. The study area is shown in Figure 1.
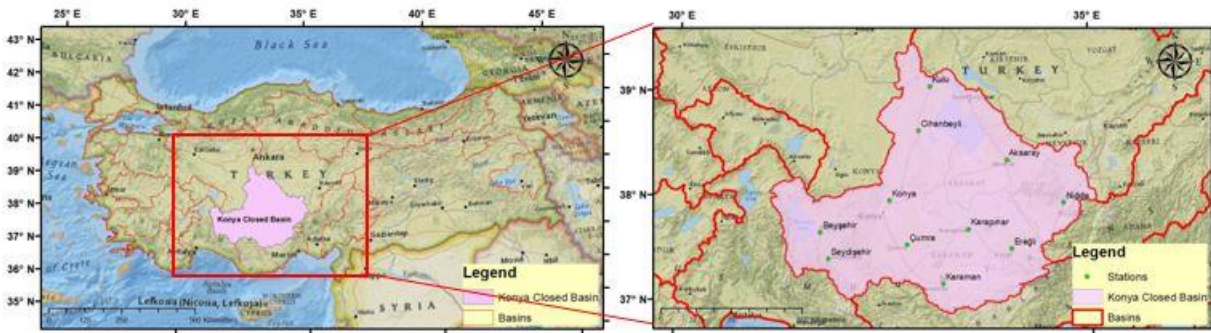


**Figure 1.** Konya Closed Basin and stations

**Results**

The homogeneity of the data was analyzed by obtaining XLSTAT software, selecting SNHT from the analysis section on this software, and using the total precipitation data of all stations. All data in the analyzes were continuous and analyzes were performed at 95% of the confidence interval. The results of the analyzes are given in Table 1. The IDW map of the analysis results is shown in Figure 2.

**Table 1.** SNHT p values and hypothesis states

| Station Name | Period | SNHT (P value) | Hypothesis |
|---|---|---|---|
| Aksaray | | 0.417 | Ha |
| Beyşehir | | 0.072 | Ha |
| Cihanbeyli | | 0.427 | Ha |
| Çumra | | 0.843 | Ha |
| Ereğli | | 0.421 | Ha |
| Karaman | (1972-2020) | 0.603 | Ha |
| Karapınar | | 0.304 | Ha |
| Konya | | 0.63 | Ha |
| Kulu | | 0.158 | Ha |
| Niğde | | 0.026 | $H_0$ |
| Seydişehir | | 0.111 | Ha |

**Figure 2.** IDW map of analysis results
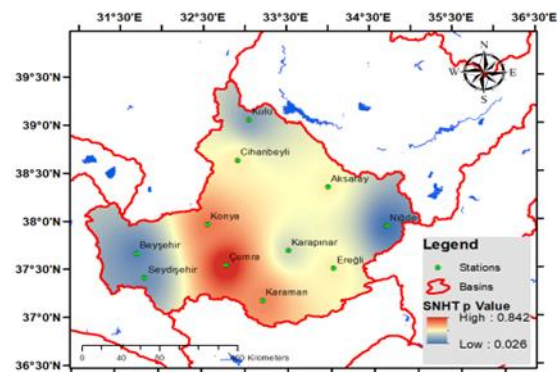
In Table 1, the p-values and hypothesis states of the SNHT were compared according to the critical value of 0.05 at 95% of the confidence interval. Stations that exceed this value are inhomogeneous stations, while stations below this value are homogeneous stations. In Figure 2, IDW map of the results is examined, the only homogeneous station in the east of the study area is Niğde. When the distribution of the p values of the test in the region was examined, the p values were close to the critical value at the Seydişehir, Beyşehir (west of the study area) and Kulu stations (north of the study area) after the Niğde station, while the highest p values were obtained at the Çumra station (in the middle of the study area).

**Discussion**

In their study, Zeybekoğlu and Keskin used the homogeneity control of the annual maximum precipitation data for Turkey using the homogeneity analyzes Pettit, Buishand, Von Neumann and SNHT tests. In the study, the reliability of 103 stations was analyzed [6]. Arıkan and Kahya analyzed precipitation data in Turkey with SNHT and other Homogeneity tests. As a result of their studies, it was observed that there was no homogeneity in 3% of the stations evaluated [2]. It was observed that there was no homogeneity in the Niğde station in the study and it was compatible with the findings of our study. Demir investigated the trend of changes in water level, precipitation, temperature, evaporation and groundwater trends in lakes and sinkholes located in Konya Closed Basin. As a result of the study, the trend of precipitation and other parameters was indicated [7].

**Conclusion**

Investigating the precipitation change in a region is important for the management of water resources. When examining the precipitation change, trend analysis of the data is usually made in the time series. Homogeneity tests are applied as the reliability and support of these analyzes. In this study, the homogeneity test, which is the preliminary stage of the trend analysis study planned to be carried out in the future, was carried out by using the annual total precipitation data in the Konya closed basin. In the study, the method was carried out using the XLSTAT software and the homogeneity of the stations was determined by the critical p test at 95 percent of the confidence interval. At the end of the study, it was determined that the data was homogeneous in only 1 station (Niğde) out of 11 stations with a data length of more than 30 years in the region. The results were also mapped with the IDW method, and it was determined that the p values were lower in the northern and western parts of the region.

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# Development of autonomous progress payment system integrated blockchain and IoT technologies in construction industry

**Mehmet Vefa İlgün** *[1] , **Zeynep Işık** [2]

[1]*Turkish-German University, Faculty of Engineering, Department of Civil Engineering, İstanbul, Turkey, vefa.ilgun@tau.edu.tr*
[2]*Yildiz Technical University, Faculty of Civil Engineering, Department of Civil Engineering, İstanbul, Turkey, zeynep@yildiz.edu.tr*

**Keywords**
Blockchain
Progress Payment
BIM
IoT
Laser Scanning

**Abstract**
Typically, construction projects entail many contracts with particular billing methods. In fact, dealing with complicated contract arrangements presents major difficulties, particularly in terms of early payment and assured cash flow. In addition, a lack of openness diminishes trust. Consequently, late or nonpayment is a prevalent issue in the construction sector. That article introduces the notion of applying smart contracts for automated, transparent, and traceable financial transactions in construction projects using a dam building project as an example. Combining robotic reality capturing technology, Building Information Modeling (BIM), and blockchain-based smart contracts enables automated billing. Utilizing detecting, intelligent machines, and building information models for existing structures the construction process is recorded, evaluated, and documented (BIM). The progress data is transmitted through knowledge of addressable file-sharing and afterwards broadcast to a smart contract that manages payouts and transfers creditor rights utilizing cryptocurrencies. Consequently, portions of standard standards form of contracts are converted to smart contracts. The smart contract is created utilizing digital BIM-based tender papers and includes all pertinent financial transaction information. Once the client has accepted the contractual building work, payments can be issued automatically through authorized banking institutions. The architecture for container-based information interchange and the digital contract administration process are described in this thesis.

## Introduction

One of the issues that affect many points of the system in the building production process at the same time is the progress payment practices that regulate the financial relations between the employer-contractor and the contractor-subcontractor. Progress payment arrangements, which impose serious procedural and bureaucratic obligations on the participants, have a vital importance in the project cycle. Some authors foresees that it is healthier for the process to ensure the financial control of the project with the progress payments arranged at regular intervals throughout the construction process, rather than the contractor not receiving any payment until the end of the work or providing the entire payment at the beginning of the work, since building production is a long-term investment that requires a lot of resources [1]. Progress payments made regularly and on time are directly related to the responsibilities of the participants in the construction process, their roles in the project and their relations with other participants [2].

In recent years, commercial solutions known as digital payment administration systems have been created that permit project members to submit their payment applications electronically rather than on paper. As a result, 84 percent less effort is needed to handle payments [3]. These digital platforms, however, are unable to handle automated payments. This is due in part to the fact that they cannot utilise reality capture technology's output and in part to the fact that they use the relatively similar manual and intermediary processes as paper-based apps.

Centralized control methods and a absence of reliable implementation hurt them as a result [4]. The construction sector requires a trustworthy and automated way to convert product stream (job site findings) to cash stream (construction payouts); recent methods are generally mediated, manual, and unable to automate payment processing using reality capture technology.

**Material and Method**

Scan to BIM is the procedure of creating a BIM using a 3D point cloud taken by laser scanning a specified building or object. The quality of the BIM model obtained by this method can be different, there are no standardized procedures or tools that would automate this task. The scan to BIM procedure is most widely used for contracts where a BIM model of an existing building is to be prepared, for example for the purposes of reconstruction, rebuilding, documentation of the actual construction or extension planning in a building, but also for the protection of monuments. The scanning itself can take place in several ways, which can be static or mobile. Before scanning, it is necessary to acquaint the subject of the measurement and its immediate surroundings. These generally serve to improve the accuracy of the connection of individual scans to a point cloud. The fitting points should form triangular to polygonal configurations around the built scanner and be arranged at different height levels. At the same time, it must be visible on multiple scans in order for the connection to be possible at all [5].

**BIM AND IoT**

There are different concepts for dealing with the challenges that arise. The main tools in these concepts are IoT, web services and BIM. The main goals of such approaches are established to enable the communication and trading building information using web services and to enable this information to be consolidated and managed. Developments in this direction are associated with far-reaching positive effects on urban systems [6].

The combination of BIM and IoT leads to the transformation of a building into a "cognitive building" [7]. The IoT framework enables the real-time use of data through the use of sensors and wearables and their integration into the BIM process. BIM is conceptually developed for maximum interoperability and is based on an open standard data format. These open standards, like the IFC, are used as neutral exchange formats when a platform-to-tool exchange takes place. An example could be getting a certain subset of data from the main model that was created by another software tool. In such a case, a model view based on the native model is defined to contain the desired data and transmitted either via direct exchange between applications, if configured in this way, or via the mentioned transmission using open standards.

**BIM and blockchain**

Building Information Modeling, or BIM, is a process that is based on intelligent 3D models and provides architects, engineers, and construction workers with the knowledge and tools necessary to plan, design, construct, and manage facilities and infrastructure in a manner that is more time and cost effective. This definition comes from Autodesk. Even though BIM is advancing at a fast pace, the majority of the developed world still employs Level 2 BIM, which requires various disciplines to construct their work on separate models. Level 3 BIM aims to encourage deeper cooperation by suggesting that all stakeholders collaboratively develop on a single, shared model. However, this level of BIM has not yet been implemented. The utilize of blockchain technology has the potential to significantly enhance BIM in terms of security, accountability, transferability, and the capture of live data [8,9]. In the use of the Blockchain-based Building Information Model (BIM), who did what, when and when is recorded and therefore reliable information management is provided for any legal argument that may occur [10]. Every single record on the blockchain is permanent. Because there are many people and teams working on a project, it is inevitable that a BIM model will be changed at the same time. Tamper-proof and time-stamped data can be saved for all collaborators in the project thanks to the blockchain. A record of all model changes can be kept. With the implementation of this record, the efficiency of data sharing can be increased significantly and the cooperation and trust between each participant can be increased [11–13].

Several phases of payment procedures must be formalized as scripts and executed using computer resources in order to automate construction payments. These phases include, but are not limited to, the assessment with on-site findings, the evaluation of completion of the project, and, most importantly, contract implementation and the issuing of banking operations. Before bank transactions can be made, each project stakeholders must run these computerized commands and distribute the conclusions to the others.

The client-server architecture presents solitary marks of failure, and the centralization and unequal distribution of resources expose payment processing to denial-of-service assaults, data rewriting, and asymmetric information.

Consequently, this kind payment automation is subject to relatively similar restrictions as modern payment programs.

This suggested method avoids this risk through the use of Blockchain-enabled smart contracts; the use of smart contracts increases the reliability of payment automation by avoiding a centralized client-server architecture and

assuring contract execution. All blockchain miners freely run the contract commands, calculate the outcomes, and establish agreement on banking operations and cash management.

However, smart contracts are only as trustworthy as the agreement algorithms that govern the blockchain that underpins them. Architecture of these agreement procedures fluctuates according on the blockchain type used. public, private, or consortium. In private and consortium blockchains, project members function as miners, implement contract code, and find agreement on the actual status of social and physical facts. This kind allowed blockchain applications present antitrust issues [14,15], since users may conspire and damage the decentralized origin of the agreement process. There is no assurance that the preservation, unchangeability, and execution guarantees of public and consortium blockchains will always stay true.

As previously said, the deployment of smart contracts functioning on public blockchains decentralizes both payment government and cash flow records, giving trustworthy access to the social reality of a project. However, the use of smart contracts by itself cannot enable payment automation because of technology's separation from physical reality and inability to integrate off-chain and on-chain situations. This is a significant challenge to the implementation of smart contracts in project management systems.

This work leverages reality capture techniques to give the smart contract with a view of the actual life (i.e., an oracle) in order to circumvent this difficulty. The term "reality capture" refers to the process of gathering, evaluating, and establishing the condition of physical actuality on building project areas through the use of sensing, machine intelligence, and BIM.
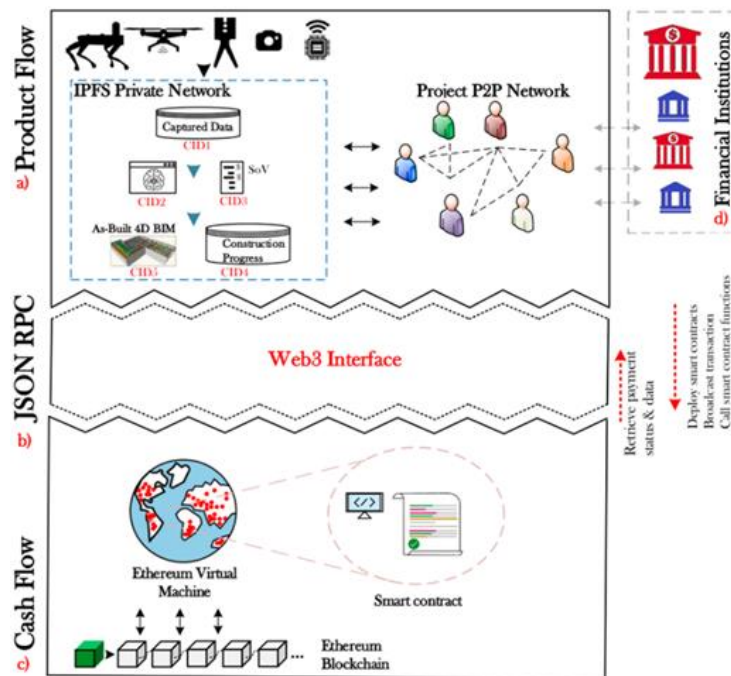


**Figure 1.** Autonomous progress payment system sample diagram [16]

i)      product stream recorded on secret IPFS network;
ii)     the JSON RPC functionality allowing circulation of data;
iii)    Funds circulation controlled by smart contract residing on the Ethereum blockchain;
iv)     Institutions of finance on the fringes.

Through the use of reality capture technologies, IPFS, smart contracts, and public registers, centralized, mediated, and asset processes like billing collection and payment application/certification are rendered unnecessary, as shown in Figure 1. This allows for the automation of payment processing, which translates advancement at job sites (Figure 1a, product stream) into construction progress payments (Figure 1c, Funds circulation).

**Conclusion**

Payment autonomy requires a change away from today's conventional and strongly payment operations, which comprise payment application preparation, review, and execution. Due to two essential aspects of smart contracts provided by blockchain technology, it is anticipated that these constraints may be overcome: decentralization and execution assurance. The absence of a connection between on-chain payment settlement and off-chain actual world hinders the technology's adoption in payment systems, despite its potential advantages.

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# Experimental investigation of the mechanical properties of geogrid reinforced stone column groups

**Furkan Tuter** [*1] , **Özgür Lütfi Ertugrul** [2]

[1]*Mersin University, Civil Engineering Department, Mersin, Türkiye, furkan.tuter@gmail.com, ertugrul@mersin.edu.tr*

**Keywords**
Geogrids
Stone column
Group Effect
Soil improvement

**Abstract**
Increasing trend in the population density of the cities causes rising demand on high rise construction projects. High-rise structures bring high vertical loads on foundation soils. Especially in shallow foundations built on weak soils, large amounts of soil settlements may occur due to high vertical loads, which can cause varying levels of damages to the superstructural load bearing elements. In weak soils accommodating high liquefaction potential, settlement and stability problems, it becomes generally necessary to establish piled foundations or to use soil improvement methods under the building foundations since sole application of shallow foundations may not be sufficient to transfer superstructure loads to the soils. At this point, stone columns appear as one of the economical and efficient soil improvement solutions. Within this study, a physical modeling study were performed on small-scale stone column group models. The deformations and the pressure acting on the stone column group were monitored during the tests. The performance of ordinary stone columns was compared to those of the stone columns wrapped with geotextiles. It was observed that wrapped stone columns may handle higher foundations loads for the same deformation levels.

## Introduction

Stone columns are considered as one of the important soil improvement methods in the field of geotechnical engineering. The stone column method was first used in France in 1830 and in the United States in 1972. The stone column technique was adopted in European countries in the early 1960s. In the following decades, it became more widespread [1]. The theoretical studies regarding the design of stone columns were performed in these years. In one of these studies, Han et al. developed a simplified theoretical closed form solution for the capacity and consolidation ratio estimation of stone column reinforced soils [2]. Rao et al. carried out loading tests for single and group stone columns. The results for the stone columns having a center to center spacing of 2 m indicated that the settlements were within good limits after the application. In the preliminary design phase, it is recommended to determine the amount of settlement in the stone columns and to determine the most effective interval in the design to increase the feasibility of the project and reduce the cost [3]. In a thesis study, physical model experiments were carried out to examine the loading behavior of the stone column reinforced clayey soils. Besides single stone columns, stone columns groups were also studied by model experiments. The length and diameter of the stone column and the distances of the stone columns to each other were changed to observe their effect on the bearing capacity [4]. In another study, it is seen that the longer stone columns behave more rigid when compared to shorter ones in terms of bearing capacity. When the behavior of stone column groups is compared, it is seen that long columns exhibit more rigid behavior when a vertical load higher than 820 kN is applied to the column top [5].

In this paper, the results of a study carried out on model stone column groups were reported.  This study was funded by Mersin University Scientific Research Projects Office under project number 2021-1-TP2-4293. The equipment used in this project was integrated into Mersin University Geotechnical Engineering Laboratory as a result of extensive research and design processes. Within this study, the load-deformation characteristics of model scale stone column groups having different center to center spacing values were investigated. Loading tests were performed using a custom manufactured hydraulic loading press with a novel electronic speed controlled integrated in the test setup. Besides, the data acquisition system was also specifically manufactured for this study. Besides the center-to-center spacing values for the stone columns, the effect of geosynthetic wrap applied along the columns were investigated in this research. It was observed that there exists an optimal spacing for the stone column applications. The geosynthetic wrapping provides additions confining support for the stone columns which lead to smaller vertical deformations under the same loading.

**Material and Method**

Physical modeling tests of this study were performed in Mersin University Department of Civil Engineering Soil Mechanics laboratory. For the tests, a custom sand box was used to prepare the sand bedding for the stone column group.

For the filling of the bedding box, 856 kg granular sandy material with a relative density of 40% was utilized in such a way that the box was filled for every 10 cm lifts. Sand weighing 171.2 kg was weighed and firmly filled by hitting the steel plate 25 times. This process was repeated until a height of 50 cm sand fill was achieved. The experiments were carried out on wrapped and unwrapped stone column groups having a center to center spacing (s) value of 2×D, 3×D, 4×D distances where D denotes the diameter of the stone column. In order to form geogrid wrapped stone column groups with s=2×D, 3×D, 4×D spacing, a two-dimensional geogrid having 40mm×40mm spacing were brought into a cylindrical shape where it would be installed in a 100 mm diameter PVC pipe. The aggregate which will form the stone column body were poured into the PVC pipe where geogrid wrapping was present around the inner side of the PVC pipe. The geogrid material with a tensile strength of 10 kN/m was placed with the help of construction wire. Sand was compacted and placed in every 10 cm layer and at the same time, the aggregates were compacted and placed with the help of a hammer. When the 10 cm layers were completed, the guide was pulled up and the geogrid was ensured to completely surround the stone column. It was placed on the sand by means of a plumb line, centered on a 60x60 cm steel plate. It is fixed on it with the help of hydraulic piston. The 110 kN loading plate was slowly acted upon by the motor driver. The reading values were transferred to the data acquisition unit with LVDT and load cell to the computer environment. This section is shown in Figure 1.



**Figure 1.** The test setup used in this study

**Results**

Load-displacement curves for stone column graphs having different characteristics were depicted in Figure 2. It was observed that the wrapped type stone columns are providing the best   load carrying capacity under the same deformation. Besides it is observed that, the center to center spacing of the stone columns are also an important factor in determining the load bearing capacity of the stone columns. At the end of the tests, the granular sand material around the columns were partially removed. As an example, the deformation in geogrid-wrapped stone columns at the end of a typical tests were shown in Figure 3.
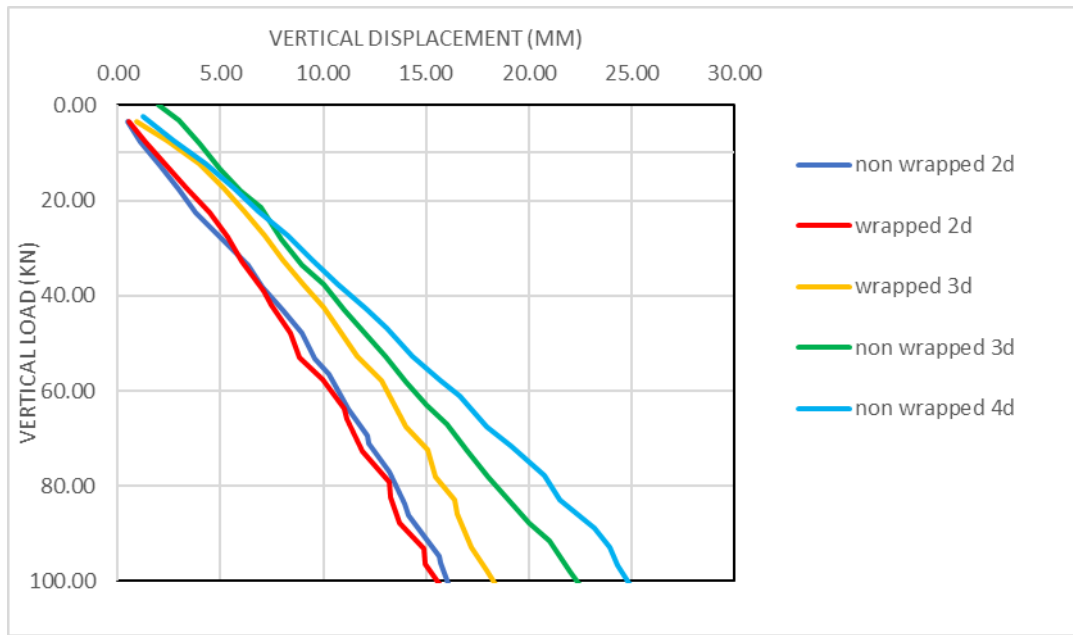
**Figure 2.** Load-displacement behavior for stone column groups having different characteristics



**Figure 3.** The bulging effect in geogrid-wrapped stone columns

## Conclusion

Results of the tests indicated that there is a significant improvement in the load carrying capacity of the stone column groups when a geogrid wrap is used along the column surface. Since the geogrid layer is serving a confining material, it decreases the typical budging type deformation of the stone columns. Eventually, under high loads, the geogrids are also yielding and the bulging type deformation occurs. Considering a vertical load of 100 kN , it is observed that displacements up to 14.45 mm occurs for the unwrapped stone column groups having 2×D center to center spacing. For the wrapped stone column groups having 2×D center to center spacing, a displacement of

15.68 mm was observed under the same load. When the stone column groups having 3×D center to center spacing were compared for the unwrapped and wrapped type, it was observed that 22 mm deformation was occurring for the unwrapped whereas 18.2 mm deformation is occurring for the wrapped stone columns. This will translate into an additional load carrying capacity of 18%. The center to center spacing for the stone columns in the group is observed to be a very important parameter in the response and this effect is more pronounced for the unwrapped type stone column groups. A comparison of the unwrapped stone columns groups having 3×D and 4×D center to center spacing presents around 18 mm deformation for the first case and 25 mm deformation for the second case. This translates into 39% reduction in the load carrying capacity of the group.

**Acknowledgement**

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# Numerical modeling of geogrid reinforced stone column groups with Plaxis 3D

**Furkan Tüter** *1 , **Özgür Lütfi Ertugrul** 1

*1Mersin University, Civil Engineering Department, Mersin, Türkiye, furkan.tuter@gmail.com, ertugrul@mersin.edu.tr*

**Keywords**
Group effect
Plaxis3D
Geogrids
Settlement

**Abstract**
Unlike reinforced concrete bored piles, unreinforced stone columns may not be able to safely withstand high structural loads. In this study, stress-strain behavior of stone column groups under vertical loads and the effect of geosynthetic reinforcement will be examined. The physical and mechanical properties of the soil, columns and geogrids to be used in this study will be determined by considering the material parameters available in previous studies. Within the scope of the study, the bearing capacity and settlement of stone column groups placed under the raft foundation in different configurations will be discussed. In this context, loading tests will be carried out on standard and geogrid reinforced stone column groups to investigate the effect of geosynthetic coating reinforcement on settlement amounts and bearing capacities in the improved soil cell. As a result of the study, findings regarding the effect of geosynthetic reinforcement on the mechanical properties of group stone columns were reported. Based on the numerical analyses results, it is observed that the wrapped stone columns having 3×D center to center spacing can be taken as the optimum pattern for the site applications while decreasing the foundation deformations effectively. It is believed that the results of the study may pave the way to the development of a novel stone column manufacturing technique that can be more efficient in terms of both strength and economy.

## Introduction

In a recent study, the important functions of the stone columns are stated as the increase in the bearing capacity and shear resistance of soils, decrease in the amount of settlement, acceleration of the consolidation in cohesive soils and decrease in the liquefaction sensitivity in the cohesionless soils [1]. In a recent thesis study, it is stated that the interaction of the foundation and a single stone column in the group is important, that each stone column under the foundation has a different load-settlement behavior and that the stone column in the middle of the foundation will receive the most load. In this study, the test outputs for the stone columns under the group effect were compared with the numerical analysis results [2]. Gniel and Bouazza presented the results of small-scale model experiments to investigate the behavior of geogrid-wrapped stone columns in their study. In their study, a uniform clayey soil representing the natural ground is preferred as bedding material. In their study, length-column-diameter ratio, cell diameter-column diameter ratio, aggregate particle diameter-column diameter and aggregate diameter-geogrid cell void ratio were under concern. The behavior of stone columns under the group effect is simulated with the unit cell model [3]. Castro and Karstunen, in their study, utilized finite element technique for modeling stone column behavior [4]. According to Isaac and Girish, stone columns reduce the settlement of the soil on which it is applied and increases the bearing capacity. In addition, it helps to increase the consolidation speed of the clayey soils and prevents large settlements that will occur later [5].

Within this study, numerical analyses were performed to investigate the efficiency of stone column groups using three-dimensional finite element modeling technique. Actual geometries for site applications were considered in the numerical simulations. Based on the results of the analyses performed for the standard and reinforced stone column groups using Plaxis 3D program, the effect of geogrid wraps on the settlement amounts and bearing capacities of the improved soil are investigated within this concept.

**Material and Method**

In Plaxis3D modeling software, the cross-sectional diameter (D) of the stone columns was taken as 1 meter, which is commonly used in conventional site applications. The center to center spacing of the columns were considered as the variable parameter and taken as 2×D, 3×D, 4×D. Within the analyses unwrapped and wrapped stone column models were modeled. For the bedding material, and stone columns, analyses were performed according to the Mohr-Coulomb hypothesis, based on the data obtained from previous studies. The foundation that will transfer the loads coming from the superstructure to the ground is defined as a very rigid. The model is divided into finite elements by mesh method as shown in Figure 1. Since there is no groundwater level for the considered problem, pore water pressure and groundwater level are not defined in the model. Soil mesh points just below the foundation were chosen for the comparison of the nodal points. The surcharge load is defined to represent the loads that may come from the superstructure. Since the modeled raft foundation is very rigid and does not deform, a uniformly distributed load has been defined according to represent the loads that come from the superstructure. The vertical stress coming from the superstructure were taken as 297 kN/m$^2$ corresponding to the stress value measured in the laboratory tests. The finite element model used in this study is shown in Figure 2.
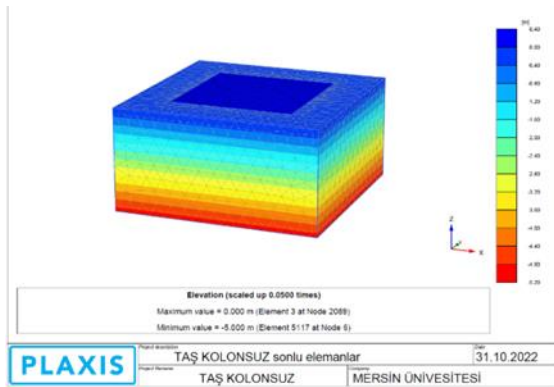


**Figure 1.** Plaxis3D finite element mesh for the bedding material
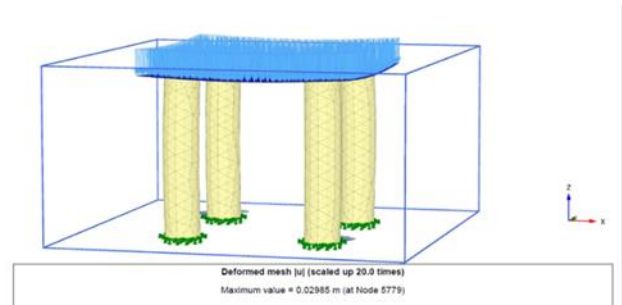


**Figure 2.** Plaxis3D finite element model for the stone columns and the raft foundation (loading were also depicted)

**Results**

Three-dimensional finite element model and the stress conditions are shown in Figure 3. The maximum displacement value for the model without stone columns was found as 33.25 mm. A displacement value of 28.71 mm occurred in the loading of the unwrapped stone column model at 2×D center to center spacing. The maximum displacement value of the unwrapped stone column model for 2×D center to center spacing under loading was 29.84 mm. The maximum displacement value of the wrapped 2D stone column model is found as 24.06 mm.

The horizontal displacement values in two different axes were found 1.567×10$^{-3}$ mm and 1.585×10$^{-3}$ mm. The horizontal displacement contours for the investigated model are shown in Figure 4. The maximum displacement value of the wrapped stone column model under loading was 24.56 mm, whereas the horizontal displacement values were around 1.8×10$^{-3}$ mm. Maximum displacement value for the unwrapped column groups with 4×D center to center spacing under loading is obtained as 29.85 mm. The maximum displacement value of the column groups with 4×D center to center spacing under loading is 24.9 mm, the horizontal maximum displacement values were around 1.95×10$^{-3}$ mm.

**Conclusion**

In three-dimensional finite element analyses, it was observed that an improvement of approximately 13.5 percent occurred between unwrapped stone column groups at 2×D center to center spacing and the no stone column case. For the analyses performed on unwrapped stone column groups at 3×D center to center spacing, an improvement of approximately 10.01 percent occurred when compared to no stone column case. An improvement of approximately 27.5 percent was noted between the wrapped stone column groups at 2×D center to center spacing and the no stone column case. The improvement ratio was approximately 26 percent for the wrapped stone column groups at 3×D center to center spacing. The improvement ratio was approximately 10 percent for the unwrapped stone column groups at 4×D center to center spacing whereas it is 25% for the wrapped stone column groups at 4×D center to center spacing

Based on the numerical analyses results, it is observed that the wrapped stone columns having 3×D center to center spacing can be taken as the optimum range for the applications. Although additional improvement can be achieved for wrapped stone column groups at 2×D center to center spacing, the group interaction effects and the

construction problems may be more pronounced. Hence it can be considered that wrapped stone columns at 3×D center to center spacing can provide optimal load bearing capacity. Results indicate that no significant improvement in deformation reduction capacity between unwrapped columns at 3×D and 4×D center to center spacing.
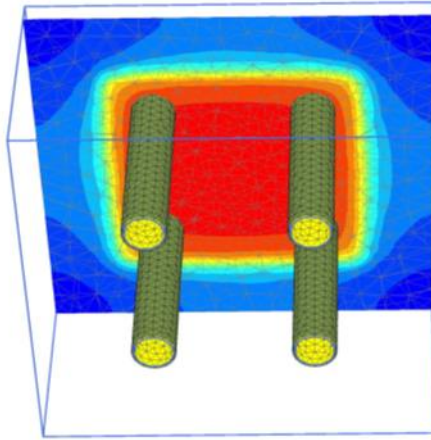


**Figure 3.** Finite Element Analysis Model and stress conditions
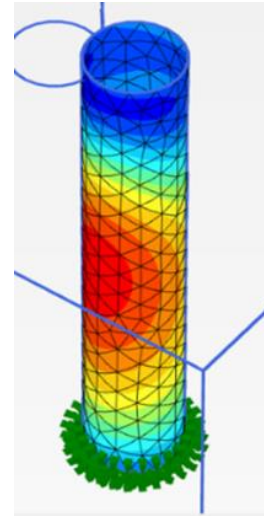


**Figure 4.** Horizontal displacement model

**Table 1.** Comparison of the deformation values for different stone column configurations

| | Cohesionless bedding material | Non wrapped model 2×D spacing | Non wrapped model 2×D spacing | Wrapped model 2×D spacing | Wrapped model 3×D spacing | Non wrapped model 4×D spacing | Wrapped model 4×D spacing |
|---|---|---|---|---|---|---|---|
| Displacement (mm) | 33.2 | 28.35 | 29.84 | 24.06 | 24.56 | 29.85 | 24.9 |
| Bearing Capacity Increase Rate | | 0.14 | 0.101 | 0.275 | 0.26 | 0.1009 | 0.25 |

**Acknowledgement**

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# A physical modeling study on the load -deformation behavior of geosynthetic reinforced stone columns

**Sadi Berkay Dural** *1 , **Özgür Lütfi Ertugrul** 1

*1Mersin University, Civil Engineering Department, Mersin, Türkiye, sadiberkaydural@gmail.com, ertugrul@mersin.edu.tr*

**Keywords**
Stone Column
Ground improvement
Geotextile
Geogrid

**Abstract**
The stone column applications have emerged in Europe as a soil improvement method half a decade ago. This method can be applied on all kinds of soils, and it is generally preferred in places where soft and medium clays are present and soft soil layers are not very deep. Within this study, physical tests were performed on small scale single stone column models. As a result of the performed tests, it was observed that the settlement amount of the stone column decreased significantly when the stone column is surrounded by geotextiles and/or geogrids. It was observed that settlement of a shallow foundation supported by geotextile reinforced stone columns may reach up to 36%.

## Introduction

Although soil improvement methods are emerged long time ago, well established applications are frequently observed in the last few decades. The rapid development of machine technology a and the studies on engineering solutions paved the way for the frequent use of soil improvement techniques. In recent years, because of industrial and infrastructure developments in urban and metropolitan areas and also significant rises in land prices, researchers have been looking for soft soil reclamation techniques that were previously considered to be too expensive to develop [1]. The construction of structures, such as a building, storage tanks, warehouse, etc., on weak soils usually involves excessive settlement or stability problems [2]. The main goal of soil improvement methods is to improve the weak and soft soils with low bearing capacity, high compressibility and high liquefaction potential to fulfill the project requirements of a civil engineering structure. As a result of soil improvement methods, bearing capacity, tensile strength, deformation modulus and shear strength of the problematic soils increase. Besides, liquefaction and settlement potential as well as hydraulic permeability values decrease. In addition, consolidation settlements of the clayey soils are accelerated, swelling and shrinkage potential is controlled.

Stone columns are produced by filling the boreholes drilled in the soft ground using coarse aggregate, which has more strength compared to the soft ground. The material is further compacted with the help of a probe to increase the deformation modulus of the stone columns. This probe can vary in diameters ranging from 30cm to 46 cm. Compaction is applied in layers of 0.4m-1,2m thickness during forming the column height. With the installation of stone columns, the volume of the ground is replaced with coarse aggregate filling material between percentage values of 15-35% [3].

One of the biggest problems on the widespread use of stone column method, which is an economical and environmentally friendly soil improvement technique, is the bulging of the cylindrical stone column under high structural loads. This bulging leads to the intermixing of column materials with the neighboring soil [4]. When this problem occurs, stone columns cannot sufficiently resist to the deformations under high building loads and therefore deform over time and lose their effectiveness under loading. Although it has similar properties to reinforced concrete bored piles under the foundation in general, the lateral soil pressures on the upper portions of the stone columns increase, especially with the high loads, causing the stone column to expand.

**Material and Method**

For ordinary stone columns which are not reinforced with geotextiles or geogrids, the horizontal support of the soil around the column must be equal to the horizontal pressure exerted on the column surface in order to prevent bulging. The effectiveness of the load carried by stone columns essentially depends on the lateral stress exerted by the surrounding soft soil [2]. In a stone column wrapped along the shaft with geotextiles or geogrids, although the lateral support of the surrounding soil may be much less, the confining effect of the geogrid provides additional support. This support basically arises from the friction force between the geotextiles and the stone column material. The geosynthetic encased stone column technique has gained wide acceptance as a means of increasing the load carrying capacity of ordinary stone columns installed in soft ground [5].

In this study, the similar size stone column model was fabricated and tested in a rigid sand box specially manufactured for this study. The prepared steel sand tank with the dimensions of 1000×1000×600 mm was filled with sand material up to a height of 500 mm. The sand filling process was made in 5 lifts of 100 mm height and by applying equal compactive effort at each lift.



**Figure 1.** Steel sand tank used in the physical tests

For the unwrapped stone column production process, bedding sand was filled up to a height of 500 mm and placed properly by the help of the fixed guide installed at the corners of the sand box. The filling process of the tank was made in five stages and each stage were compacted by dropping a fixed plate from 500 mm height 25 times. The compression process was applied every 100 mm and the tank surface was reached. Stone column material was also filled into the prepared guides, together with bedding sand, and compacted at every 100 mm lift.

For stone columns prepared together with geogrid or geotextile material, first geotextile and geogrid material were placed inside the guide pipe, and then the same processes were applied similarly to unwrapped stone columns.

**Table 1.** Geogrid properties used in the tests

| Raw Material | Polypropylene |
|---|---|
| Grid | Bi-axial |
| Tensile Strength, KN/m (EN ISO 10319) | 10/10 |
| Aperture Size, mm (ID/IDD) | 40×40 |
| Ph Resistance | 2-13 |

**Table 2.** Geotextile properties used in the tests

| Items | G-300 | G-1000 |
|---|---|---|
| Raw Material | Polypropylene | Polypropylene |
| Unit Area, gr/m$^2$ (EN ISO 9864) | 300 | 1000 |
| Thickness, mm (EN ISO 9863-1) | 2,5 | 6,7 |
| Tensile Strength, KN/m (EN ISO 10319) | 17/19 | 47/49 |
| Strain Failure, % (EN ISO 10319) | 50 | 50 |
| Statics Puncture Resistance, N (EN ISO 12236) | 3000 | 8000 |
| Dynamic Puncture Resistance, mm (EN ISO 13433) | 16 | 0,3 |

The prepared test setups were placed in the custom-made hydraulic loading press. The hydraulic system is controlled with a special load controller in order to adjust the displacement rate of the load piston. The foundation plate is positioned so that the stone column is located at the center of the plate. The load cell assembly is attached to the foundation plate and the deformation potentiometer is fixed to the plate. 11 kN loading was applied on the rigid plate with the help of a motor driver, and the load/deformation pattern of the investigated model is model through a high-resolution multi-channel data acquisition system.

**Results**

Based on the physical test results, the soil improvement provided by the unwrapped and wrapped stone columns were compared and the effect of geogrid wrap on the deformation improvement performance obtained with the stone columns were evaluated.

For the analyses performed in a bedding sand with a relative density value of 40%, the deformations that occurred during the vertical loading are monitored with the help of the displacement meter connected to the foundation plate. The data acquired with the computer environment and load-deformations graphs are plotted in Figure 2.
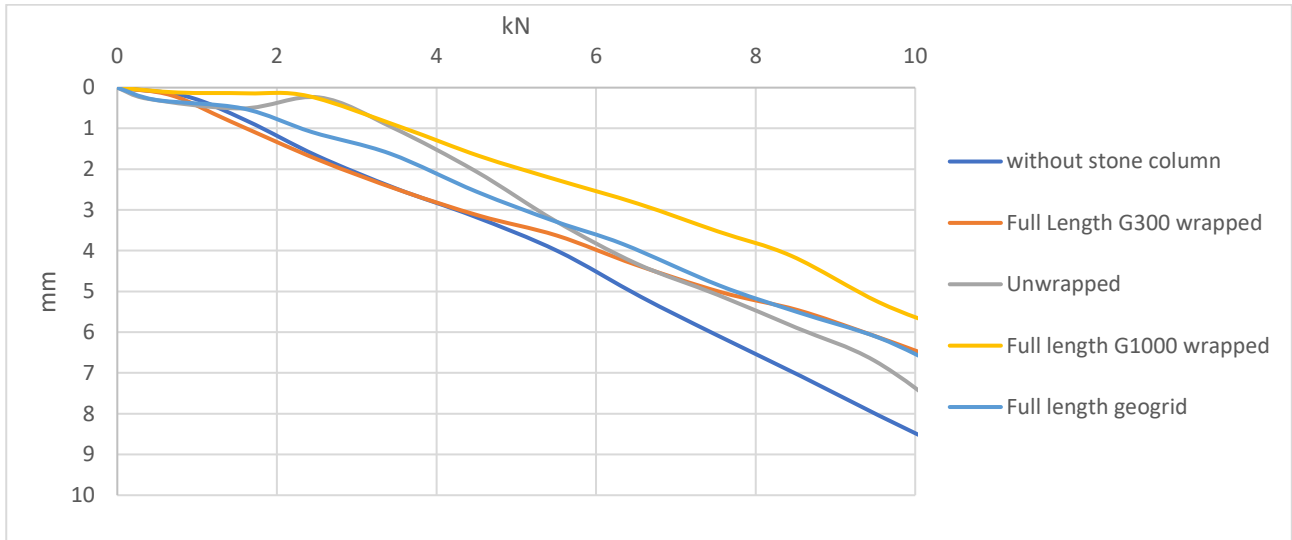


**Figure 2.** Comparison of the load-deformation characteristics for various stone column configurations

According to the results of the physical tests, for loading values up to 10-11 kN, the G1000 geotextile wrapped, G300 geotextile wrapped, geogrid wrapped, unwrapped stone column models provide the best deformation reduction efficiency values, respectively. To get a visual image of the stone column after loading, the sand bedding was partially excavated without damaging the stone column body. The deformation of the wrapped stone column after loading is shown in Figure 3. In general, it is seen that the deformations that occur on the stone column is concentrated on the upper portion up to a depth of two times the column diameter.

**Table 3.** Peak deformation values for the various tests

| | |
|---|---|
| No stone column | 9.00 mm |
| Ordinary Stone Column | 8.16 mm |
| Geogrid | 6.96 mm |
| G300 | 6.82 mm |
| G1000 | 5.98 mm |



**Figure 3.** Deformed shape of the geotextile wrapped (G-300) stone column model after loading

**Conclusion**

As a result of the physical tests, it was observed that the unwrapped stone columns can improve the settlement amount of the loose bedding material by 10.29%. When vertical geotextile wrapping is present around the stone column surface, settlements decrease by an amount 17.24% in the geogrid wrapped model, 19.65% in the G300 geotextile wrapped model and 36.45% in the G1000 geotextile wrapped model. Contrary to typical reinforced concrete bored piles, stone columns generally fail to the low confining stresses coming from the soft and loose soils. In order to overcome this problem, geotextile or geogrid wrapping can be a good alternative for soil improvement. It has also been observed that the bulging occurs under high vertical loads at the upper portion of the soil up to 2D-3D distance from the surface.

**Acknowledgement**

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# Numerical analysis of the geosynthetic reinforced stone columns with Plaxis2D finite element code

**Sadi Berkay Dural** *[1] , **Özgür Lütfi Ertugrul** [1]

*[1]Mersin University, Civil Engineering Department, Mersin, Türkiye, sadiberkaydural@gmail.com, ertugrul@mersin.edu.tr*

**Keywords**
Stone column
Finite element method
Geotextiles
Geogrids

**Abstract**
Stone columns applications are becoming widespread as a ground improvement method owing to their economical and efficient use. Contrary to typical reinforced concrete bored piles, stone columns generally fail to the low confining stresses coming from the soft and loose soils. In order to overcome this problem, geotextile or geogrid wrapping can be a good alternative for soil improvement. Within this study, results of numerical analyses of the stone columns performed with finite element technique were reported. For the simulations, unwrapped and geosynthetic wrapped stone columns were modeled. According to the results of the numerical analyses, the amount of lateral expansional deformation of the stone column under vertical load was 24.76 mm, while this value decreased by 6.82% in the geogrid-wrapped model, 12.29% in the G300-wrapped model and 34.20% in the G1000 geotextile-wrapped model. These results indicate the geotextile and geogrid type reinforcement provides significant contribution to the load bearing capacity of the stone columns.

## Introduction

Stone columns are widely used for reducing settlements of soft soils under vertical loads which may be induced by embankments and building loads. The stone column method is among the most efficient improvement techniques for soft foundation soils, both in terms of cost and installation time. This method has been extensively used in projects involving embankments founded on soft soils, with columns generally containing sand or gravel [1]. One of the major shortcomings of the stone columns when compared to the reinforced concrete bored piles is their failure risk due to low confining stresses. It is well known that stone columns lose their bearing capacity as a result of lateral deformations caused by these loads. Covering the stone column perimeter with geosynthetic materials produces alternative solutions to limit the lateral displacements that occur. Geosynthetic materials are generally polymer-based. Geotextiles include geogrids, geocells, geocomposites and geomembranes.

The greatest properties of geotextiles are flexibility and durability. A special type of geomaterial is known as geogrids [2]. These materials can be used as a wrapping material around the stone column body in order to provide confining support. This additional support can increase the load bearing potential of the stone columns while decreasing the deformations. Stone columns, encasement of stone columns in geogrid affects the distribution of lateral stress by improving the strain–stress behaviour and also reduces the ultimate settlement in certain loading conditions. Therefore, geogrid-encased stone columns can be used as a ground improvement technique for very soft soils [3]. The geosynthetic-encased stone column was first proposed by Van Impe (1989) and extensively studied by many researchers [4]. According to Miranda the main advantages of encased columns compared to ordinary columns are the extra lateral support provided by the geotextile encasement, and stopping fine particles of the soft soil squeezing inside the column avoiding clogging [5].

**Material and Method**

Within this study, numerical analyses were performed with PLAXIS 2D software. The simulations were performed by using the geometrical dimensions of the physical test which is performed to investigate the load bearing capacity of geotextile wrapped stone columns. In the analyses, due to symmetry, axisymmetric model was considered. Material properties which are used in the analyses were selected by using the typical values available in the literature for stone column material and bedding sand which is present along the stone column. A rigid raft foundation is modeled in the analyses. The foundation modeled in the analyses have the dimensions of 200×200×15 mm. Finite element mesh used in the modeling process is shown in Figure 1.
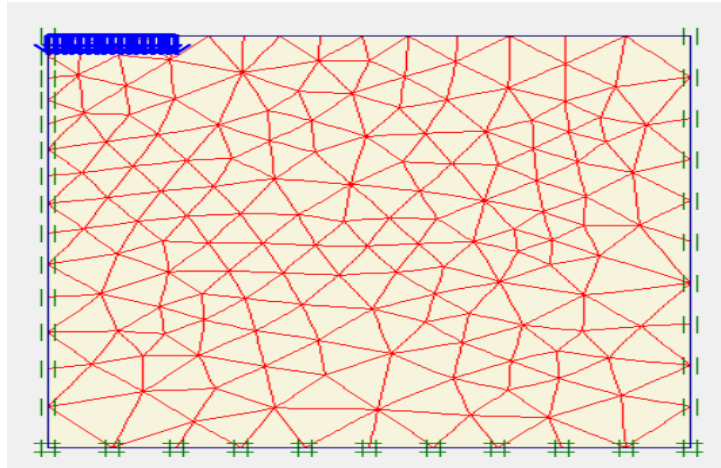


**Figure 1.** Finite element mesh used in the numerical analyses

Since the experiment was conducted on dry sand, groundwater pressure was not taken into account. The initial state of stress in the soil is produced by Ko procedure defined in the software. Vertical loading is applied as a prescribed dynamic displacement since the loading is applied gradually in the actual physical model tests. The loading of the foundation is depicted in Figure 2.
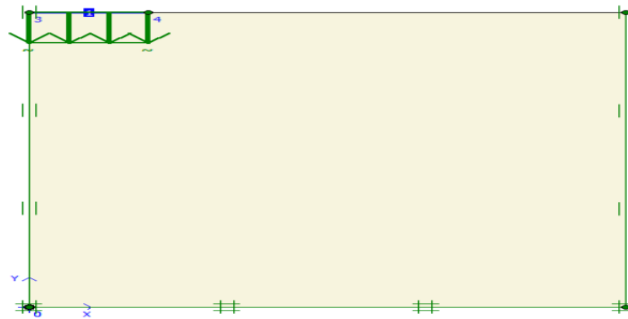


**Figure 2.** Plaxis2D dynamic loading pattern

**Results**

The behavior of the unwrapped stone columns and the geosynthetic reinforced stone columns were compared based on the data obtained from finite element analyses. The contribution of the geogrid and geotextile materials on the load bearing capacity of the single stone columns was evaluated with the help of the data obtained. The resulting load -displacement graphs are shown in Figure 3 for different stone column configurations.

The analyzes were continued until the failure of the stone column. Ultimate bearing capacities for unimproved and the improved soil models are given in the table below in MPa.

**Table 1.** Bearing capacity values

| | |
|---|---|
| Without stone column | 0.524 Mpa |
| Unreinforced Stone Column | 0.956 Mpa |
| Geogrid | 0.964 Mpa |
| G300 | 0.961 Mpa |
| G1000 | 0.989 Mpa |
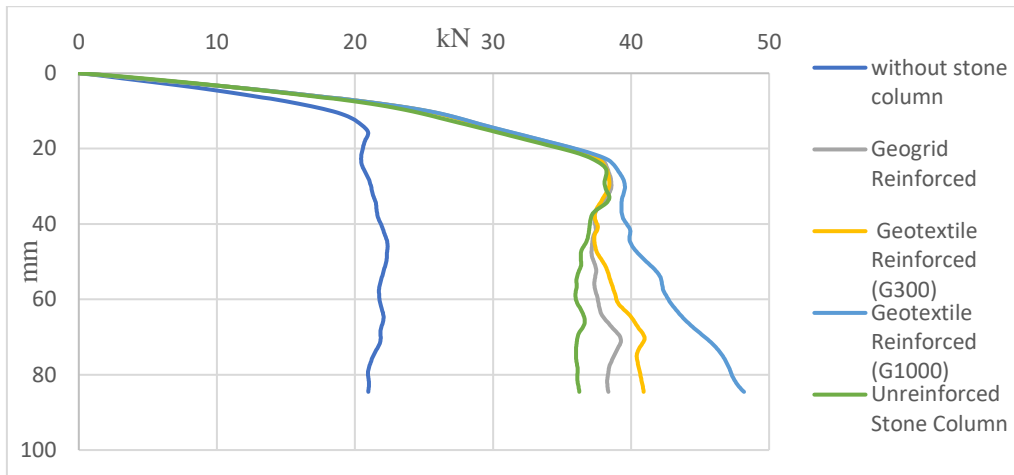
**Figure 3.** Comparison of the load - displacement behavior for different stone column configurations

According to the results obtained, it has been observed that the ultimate bearing capacity of the foundation soil increases when a stone column is installed. The confining effect of the geogrids and the geotextiles provides further capacity for the load bearing of the foundation soils. The presence of the stone columns also provides significant reduction for the foundation settlements. Finite element outputs indicate that the expansion of the column towards the sides occurred in the upper 2D and 3D portion of the stone column.

Modeling results indicate that the column expanded to the sides, and the sand around the column was compressed and swelled upwards with the effect of the loading. The average horizontal displacement values along the column surface, which have decreased due to the wrapping material applied around the column in this horizontal direction, are shown in Table 2.

**Table 2.** Horizontal displacement values.

| | |
|---|---|
| Without stone column | 28.23 mm |
| Unreinforced Stone Column | 24.76 mm |
| Geogrid | 23.18 mm |
| G300 | 22.05 mm |
| G1000 | 18.47 mm |

**Conclusion**

According to the results of finite element analyses, the bearing capacity of the soil increases with the installation of the stone columns and it reaches to even higher values with the use of geotextile wrapping around the stone column body. The analyses data indicates that the stone column reaches its ultimate capacity at around 0.524 MPa. For the analyses where stone columns are present, ultimate bearing capacity reaches to a peak value of 0.956 MPa for the unreinforced stone column, 0.961 MPa in the stone column wrapped with G300 geotextile, 0.989 MPa in the stone column wrapped with G1000 geotextile and 0.964 MPa in the geogrid reinforce stone column.

The lateral expansional deformations of the stone column is also compared in this study. While the amount of lateral deformation on the column surface was 24.76 mm in the unwrapped stone column, this value decreased by 6.82% in the geogrid-wrapped system, 12.29% in the G300 geotextile-wrapped stone column, and 34.20% in the G1000 geotextile-wrapped stone column.

**Acknowledgement**

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# Effect of nano-CaCO₃ on the physical properties of fly ash mortars

**Gani Eren Ererdem** *1 , **Cahit Bilim** 1

*1Mersin University, Civil Engineering Department, Mersin, Türkiye, gererdem@gmail.com, cbilim@mersin.edu.tr*

**Keywords**
Fly Ash
Cement
Mortar
Nanoparticle
Durability

**Abstract**
In this study, the effects of nano-CaCO₃ addition to mortars with fly ash at different rates on mortar properties were investigated. For this purpose, blended cement mixtures were prepared by using F class fly ash at 15%, 30% and 45% replacement level with CEM I 42.5 Portland cement in weight basis. A total of 12 different mortar compositions were prepared by adding nano-CaCO₃ at 1% and 2% by weight of the binder material in the mortar mixtures. In the preparation of the mortars, the water/binder ratio was kept constant as 0.5 and the sand/binder ratio was 3. The samples produced were kept in the curing pool at 21±1 °C for water curing until the 28th day; unit weight, water absorption and porosity tests were performed to examine the physical properties of the samples. As a result of the experimental studies, the addition of 1% and 2% nano-CaCO₃ was very useful in filling the voids in the mortar and significantly improved the physical properties of the mortars.

## Introduction

The high rates of $CO_2$ emission and consumption of natural resources and energy in the cement production process bring some disadvantages. One of the solutions to this problem is to try to reduce the use of cement.

Fly ash, which is the industrial waste of thermal power plants that generates electricity, can be used in cement systems due to its physical and chemical properties and easy accessibility.

On the other hand, it is known that the use of mineral additives in the cement and concrete industry causes some performance losses such as late setting time and low early strength.

Nanotechnology is seen as one of the promising fields in order to solve the problems encountered as a result of increasing the use of mineral additives in cement-based materials. The use of nanoparticles, which are a product of nanotechnological developments and started to be used in many areas, in cement systems is a relatively new study subject, and there is no study in the literature examining the effects of nano-CaCO₃ addition on the strength and durability properties of mortars with fly ash at different rates.

## Material and Method

Within the scope of experimental studies, CEM I 42.5 R Portland cement in accordance with TS EN 197-1 (2012) standard was used [1].

As seen in Table 1, fly ash contained more than 70% ($SiO_2 + Al_2O_3 + Fe_2O_3$) and less than 10% CaO. For this reason, fly ash used in this study was low lime F class fly ash according to ASTM C 618 (2014) standard [2], but siliceous V class fly ash according to TS EN 197-1 (2012) standard [1].

Nano-CaCO₃, which was used in experimental studies, was supplied as powdered commercial materials from Nanografi Nanotechnology A.Ş., a company based in METU Teknokent Ankara. The product properties and elemental analyze of nano-CaCO₃ are given in Table 2 and Table 3.

**Table 1.** Chemical and physical properties of the fly ash used

| Chemical and Physical Properties | Results |
|---|---|
| $SiO_2$, % | 55.94 |
| $Al_2O_3$, % | 19.85 |
| $Fe_2O_3$, % | 10.11 |
| $SiO_2+Al_2O_3+Fe_2O_3$, % | 85.9 |
| CaO, % | 4.78 |
| $Na_2O$, % | 1.20 |
| $SO_3$, % | 0.46 |
| $Cl^-$, % | 0.066 |
| Free CaO, % | 0.327 |
| Ignition Loss, % | 1.17 |
| Particle Density, $kg/m^3$ | 2355 |
| Activity Index, % (28 days) | 78.45 |
| Fineness, % (> 45μm) | 13 |

**Table 2.** Product properties of nano-$CaCO_3$

| Product Properties | Purity, % | Size, nm | Density, $g/cm^3$ |
|---|---|---|---|
| Results | 99.9 | < 200 | 2.93 |

**Table 3.** Element analysis of nano-$CaCO_3$

| Element Analysis, % | MgO | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | Degree of Activity |
|---|---|---|---|---|---|
| Results | < 0.35 | < 0.1 | < 0.1 | < 0.1 | 99.9 |

As mortar aggregate in experimental studies; CEN standard sand with a density of 2.56 $g/cm^3$ was used. Sand was produced by Limak Çimento Sanayi ve Tic. A.Ş. in accordance with TS EN 196-1 (2016) standard in 1350 g packages in Trakya Cement Factory [3].

A high rate of water reducer and superplasticizer in accordance with TS EN 934-2 (2013) standard was used in the mixtures [4]. It is recommended to use 0.20 – 2.50 kg additives for 100 kg cement in the product data sheet. Table 4 shows 12 different cement groups studied.

**Table 4.** 12 different cement groups studied

| Group No. | Notation | Content |
|---|---|---|
| 1 | OPC | 100% Portland Cement |
| 2 | OPC-1NC | OPC + 1% Nano-$CaCO_3$ |
| 3 | OPC-2NC | OPC + 2% Nano-$CaCO_3$ |
| 4 | 15FA | 15% Fly Ash + 85% OPC |
| 5 | 30FA | 30% Fly Ash + 70% OPC |
| 6 | 45FA | 45% Fly Ash + 55% OPC |
| 7 | 15FA-1NC | (15% Fly Ash + 85% OPC) + 1% Nano-$CaCO_3$ |
| 8 | 30FA-1NC | (30% Fly Ash + 70% OPC) + 1% Nano-$CaCO_3$ |
| 9 | 45FA-1NC | (45% Fly Ash + 55% OPC) + 1% Nano-$CaCO_3$ |
| 10 | 15FA-2NC | (15% Fly Ash + 85% OPC) + 2% Nano-$CaCO_3$ |
| 11 | 30FA-2NC | (30% Fly Ash + 70% OPC) + 2% Nano-$CaCO_3$ |
| 12 | 45FA-2NC | (45% Fly Ash + 55% OPC) + 2% Nano-$CaCO_3$ |

The unit weight test was carried out on prismatic mortar samples measuring 40x40x160 mm. The 28-day-old samples, which were left to dry in an oven at 100 °C for one day, were weighed on a precision scale, and their unit volume weights were found by dividing their geometric dimensions.

The water absorption and porosity tests were carried out on 28-day-old prismatic samples with the dimensions of 40x40x160 mm and a water/binder ratio of 0.5. The samples, which were saturated with water in the curing pool at 21±1 °C, were weighed with the help of Archimedes balance. With this method, the weights of the samples in the water were determined, their outer surfaces were dried and their saturated surface dry weights were determined. The dry weights of the samples, which were kept in a laboratory oven at 100 °C for one day, were determined. Finally, the water absorption and porosity ratios of the samples were calculated.

**Results and Discussion**

When the unit weight test results in Table 5 are examined, nano-$CaCO_3$ reduced the values in all groups. It was observed that this situation was caused by the density difference between the cement and the nanoparticles.

**Table 5.** Unit weight test results

| Group No. | Notation | Unit Weight (kg/m³) 28th day |
|---|---|---|
| 1 | OPC | 2095 |
| 2 | OPC-1NC | 2030 |
| 3 | OPC-2NC | 2003 |
| 4 | 15FA | 2078 |
| 5 | 30FA | 2050 |
| 6 | 45FA | 2005 |
| 7 | 15FA-1NC | 2033 |
| 8 | 30FA-1NC | 2027 |
| 9 | 45FA-1NC | 1994 |
| 10 | 15FA-2NC | 2018 |
| 11 | 30FA-2NC | 2007 |
| 12 | 45FA-2NC | 1988 |

Looking at the data in Table 6, nano-$CaCO_3$ reduced the porosity of the mortars and thus the water absorption. This situation also shows us that nanoparticles have a potential as a space filling material.

**Table 6.** Water absorption and porosity test results

| Group No. | Notation | Water Absorption, % 28th day | Porosity, % 28th day |
|---|---|---|---|
| 1 | OPC | 8.77 | 17.41 |
| 2 | OPC-1NC | 8.55 | 17.32 |
| 3 | OPC-2NC | 8.38 | 16.89 |
| 4 | 15FA | 8.39 | 16.89 |
| 5 | 30FA | 8.00 | 16.51 |
| 6 | 45FA | 7.95 | 16.34 |
| 7 | 15FA-1NC | 8.29 | 16.54 |
| 8 | 30FA-1NC | 7.94 | 16.02 |
| 9 | 45FA-1NC | 7.84 | 15.89 |
| 10 | 15FA-2NC | 8.14 | 15.94 |
| 11 | 30FA-2NC | 7.88 | 15.84 |
| 12 | 45FA-2NC | 7.83 | 15.43 |

**Conclusion**

Unit weight test results showed that nano-$CaCO_3$ addition decreased unit weight values in all mortars. As the nano-$CaCO_3$ addition increased, the decrease in unit weight values continued. The addition of nano-$CaCO_3$ decreased the water absorption and porosity ratios in all mortar groups. As the nano-$CaCO_3$ addition increased, its contribution to the decrease in water absorption and porosity continued.

**Acknowledgement**

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# U-Th enrichment in Arıklı ignimbirites: A multivariate statistical analysis

## Cihan Yalçın *1 , Önder Belgin 2

*1Ministry of Industry and Technology, World Bank Project Implementation Unit, Ankara, Türkiye, cihan.yalcin@sanayi.gov.tr*
*2Ministry of Industry and Technology, General Directorate of Strategic Research and Productivity. Ankara, Türkiye onder.belgin@sanayi.gov.tr*

| Keywords | Abstract |
|---|---|
| U-Th<br>İgnimbirite<br>Statistic<br>Factor analysis<br>Geochemical | There are various geological issues that can be resolved using multivariate statistical analysis techniques. Based on the findings of geochemical research, mineralization zones have particularly recently been examined. In this study, enriched U-Th anomalies in Arıklı ignimbrites' fault zones were statistically assessed. In the area with the highest radioactive enrichment, descriptive data of the major oxide and trace element concentrations were found. As a result, it was determined that MnO had the lowest average abundance and that Ba had the highest average abundance among the elements Then a factor analysis was carried out. The research produced 7 factors that were identified. Many of the chemical concentrations ($SiO_2$, $Al_2O_3$, $Fe_2O_3$, MgO, CaO, $K_2O$, $TiO_2$, MnO, LOI, As, Cu, Ga, Rb, and Zr) elements are classified under factor 1. $P_2O_5$, Nb, Sr, Th, and Y are classed under factor 2 along with U-Th elements. As a result, other majo oxide and trace element contents worked in concert to enrich radioactive material. |

## Introduction

In geological research, as well as in many other professional disciplines, multivariate statistical methods are used to detect important clues [1]. Many researchers have attempted to identify analytical and statistical explanations for properly implementing the geochemical analysis results [2]. These explanations employ a variety of mathematical techniques, including both traditional [3-4] and modern (such as fractal/multifractal analysis) [5-6]. To highlight geological relationships, studies based on statistical parameters, mineralization, correlation, and anomalies are presented [7-8].

High natural radiation values were also reached in the fault zones around Örencik and Feyzullah Tepe, northwest of Arıklı. Magnesite breccias located in the northwest of Arıklı are formed by the effect of hydrothermal waters and there are U up to 700 ppm and Th greater than 1000 ppm in this fault zone [9]. In and around Arıklı, bayleite and ningyoite have a U enrichment in chemical composition, according to Günaydın's [9] explanation.

Öztürk et al., [10] examined microthermometric measurements from magnesite observed in these fault zones and determined that (Th, oC) was between 282-348 oC and % NaCl salinity equivalents were between 4.2-8.0. They also set forth that the solution system of liquid inclusions is in the form of $H_2O$-$MgCl_2$-$CaCl_2$ and the density of liquids is between 0.58-0.74 g/cm3. Yalçın et al. [11] used GIS applications and thematic maps to show the geochemical distribution of U and Th enrichment in this region.

This paper was using a multivariate statistical analysis of the geochemical contents of 30 samples taken in the northwest of Arıklı, where Öztürk et al. [10] found the greatest radioactive results.

## Material and Method

The results of the previous geochemical analysis were used in this investigation to determine the descriptive statistics. Finally, factor analysis was used to calculate factor loads. In Microsoft Excel, these computations and analyses were conducted.

### Multivariate Statistical Analysis

In the study, multivariate statistical analysis techniques were used to investigate the chemical composition of 30 samples. Table 1 provides descriptive statistics for chemical data. As a result, it was determined that MnO had the lowest average abundance and that Ba had the highest average abundance among the elements.

**Table 1.** Descriptive statistics of geochemical data

| Variant | min | mean | max | sd | skewness | kurtosis |
|---|---|---|---|---|---|---|
| $SiO_2$ | 2.00 | 46.69 | 95.70 | 25.77 | -0.56 | 2.12 |
| $Al_2O_3$ | 0.11 | 10.50 | 19.96 | 6.20 | -0.52 | 1.88 |
| $Fe_2O_3$ | 0.22 | 3.38 | 11.27 | 2.59 | 0.74 | 3.42 |
| MgO | 0.00 | 10.21 | 40.10 | 13.78 | 1.17 | 2.79 |
| CaO | 0.00 | 5.13 | 30.57 | 7.24 | 2.35 | 8.37 |
| $Na_2O$ | 0.00 | 0.48 | 3.91 | 0.76 | 2.91 | 12.95 |
| $K_2O$ | 0.00 | 5.25 | 15.40 | 4.55 | 0.55 | 2.39 |
| $TiO_2$ | 0.01 | 0.45 | 1.28 | 0.34 | 0.33 | 2.16 |
| $P_2O_5$ | 0.00 | 0.18 | 0.93 | 0.22 | 2.29 | 7.93 |
| MnO | 0.01 | 0.07 | 0.18 | 0.05 | 0.80 | 2.83 |
| $Cr_2O_3$ | 0.00 | 0.08 | 0.45 | 0.13 | 1.69 | 4.52 |
| $SO_3$ | 0.00 | 0.11 | 0.60 | 0.17 | 1.72 | 4.62 |
| LOI | 0.00 | 17.20 | 49.02 | 18.60 | 0.82 | 1.87 |
| As | 0.00 | 184.25 | 727.00 | 170.02 | 1.62 | 5.74 |
| Ba | 0.00 | 643.44 | 5039.00 | 837.44 | 4.11 | 22.40 |
| Ce | 0.00 | 94.72 | 1491.00 | 269.25 | 4.14 | 21.40 |
| Cl | 0.00 | 187.94 | 2874.00 | 474.27 | 5.26 | 30.26 |
| Co | 0.00 | 4.28 | 68.00 | 12.43 | 4.15 | 20.86 |
| Cu | 0.00 | 31.94 | 91.00 | 17.86 | 0.55 | 5.03 |
| Ga | 0.00 | 8.03 | 40.00 | 12.50 | 1.24 | 3.27 |
| Nb | 0.00 | 6.22 | 62.00 | 11.34 | 3.45 | 17.37 |
| Ni | 0.00 | 93.72 | 409.00 | 106.01 | 1.14 | 3.38 |
| Pb | 0.00 | 11.81 | 75.00 | 23.22 | 1.56 | 3.74 |
| Rb | 0.00 | 125.11 | 395.00 | 104.78 | 0.59 | 2.65 |
| Sr | 19.00 | 364.11 | 2977.00 | 544.29 | 3.38 | 16.05 |
| Th | 0.00 | 376.39 | 11813.00 | 1962.99 | 5.72 | 33.86 |
| U | 0.00 | 47.64 | 1640.00 | 273.19 | 5.73 | 33.92 |
| V | 0.00 | 22.61 | 458.00 | 82.30 | 4.48 | 23.35 |
| Y | 0.00 | 25.67 | 864.00 | 143.80 | 5.74 | 33.95 |
| Zn | 0.00 | 17.64 | 88.00 | 25.68 | 1.27 | 3.44 |
| Zr | 0.00 | 151.92 | 523.00 | 119.74 | 0.78 | 3.81 |

The variations between the samples were discovered using factor analysis. Following this investigation, 7 factors were identified. Table 2 displays the variance explanation ratios together with the determined eigenvalues of the factors. Table 3 lists the factor loading values for the elements connected to the determined factors. The elements' inclusion in the factors is shown by the values in bold.

$SiO_2$, $Al_2O_3$, $Fe_2O_3$, MgO, CaO, $K_2O$, $TiO_2$, MnO, LOI, As, Cu, Ga, Rb, and Zr elements are classified under factor 1; $P_2O_5$, Nb, Sr, Th, U, and Y elements are classified under factor 2; $Na_2O$, Pb, and V elements are classified under factor 3; $SO_3$, Ba, and Ce elements are classified under factor 4; Co element is classified under factor 5. Ni and Zn elements are the last to be included under factor 6; factor 7 also includes $Cr_2O_3$ and Cl elements.

**Conclusion**

In this study, statistical techniques were also used to explain the geochemical behavior of the geochemically prospected U-Th enrichment with other major oxides and trace elements.

**Table 2.** Eigenvalues of the Factors obtained

| Factor | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| **Factor 1** | 10.079 | 4.809 | 0.328 | 0.328 |
| **Factor 2** | 5.269 | 1.842 | 0.172 | 0.500 |
| **Factor 3** | 3.428 | 1.294 | 0.112 | 0.611 |
| **Factor 4** | 2.134 | 0.195 | 0.070 | 0.681 |
| **Factor 5** | 1.939 | 0.232 | 0.063 | 0.744 |
| **Factor 6** | 1.707 | 0.378 | 0.056 | 0.800 |
| **Factor 7** | 1.329 | 0.378 | 0.043 | 0.843 |

**Table 3.** Factor load values

| Variant | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | **0.7973** | -0.064 | -0.078 | -0.1065 | -0.5452 | -0.0558 | -0.0865 |
| $Al_2O_3$ | **0.8952** | 0.0285 | -0.0643 | 0.1049 | -0.1049 | 0.0478 | -0.161 |
| $Fe_2O_3$ | **0.8023** | 0.2191 | 0.4695 | 0.092 | 0.1077 | -0.0863 | 0.0132 |
| $MgO$ | **-0.8327** | -0.2273 | 0.055 | 0.0241 | 0.3759 | 0.0771 | 0.1187 |
| $CaO$ | **-0.6118** | 0.4963 | 0.083 | 0.1631 | 0.2257 | -0.1084 | -0.0387 |
| $Na_2O$ | 0.4242 | 0.1166 | **0.7402** | 0.2023 | 0.1919 | 0.3059 | -0.0888 |
| $K_2O$ | **0.8316** | 0.1592 | -0.3625 | -0.2295 | 0.0696 | -0.022 | 0.0364 |
| $TiO_2$ | **0.85** | 0.2139 | 0.3096 | 0.0424 | 0.1139 | -0.1339 | 0.0551 |
| $P_2O_5$ | 0.1846 | **0.7755** | 0.419 | -0.1987 | 0.0464 | 0.021 | 0.2323 |
| $MnO$ | **0.5672** | 0.2724 | 0.2737 | -0.015 | 0.2968 | -0.3685 | 0.1336 |
| $Cr_2O_3$ | 0.2613 | -0.0428 | -0.2266 | 0.3566 | -0.3436 | 0.0695 | **0.6752** |
| $SO_3$ | 0.4136 | 0.1232 | -0.0875 | **0.752** | 0.0628 | 0.117 | -0.1894 |
| LOI | **-0.9019** | -0.0519 | 0.0422 | 0.0562 | 0.3829 | 0.0517 | 0.087 |
| As | **0.559** | 0.306 | -0.3948 | -0.3787 | 0.4203 | 0.0672 | 0.0442 |
| Ba | 0.3929 | 0.2145 | 0.0745 | **0.5817** | 0.0859 | -0.0242 | -0.3412 |
| Ce | 0.3941 | 0.1616 | -0.4148 | **-0.45** | 0.3784 | -0.1187 | 0.1348 |
| Cl | 0.1594 | 0.0117 | -0.3897 | 0.3344 | -0.0098 | 0.4423 | **0.4664** |
| Co | -0.165 | 0.2727 | 0.0355 | -0.3189 | **-0.6059** | -0.0591 | -0.1297 |
| Cu | **0.6962** | 0.038 | 0.4286 | 0.0541 | 0.0423 | 0.1394 | 0.2289 |
| Ga | **0.4571** | 0.1195 | -0.2868 | 0.0799 | 0.2938 | -0.3812 | -0.2936 |
| Nb | -0.0545 | **0.905** | -0.2036 | 0.0937 | -0.169 | 0.0555 | 0.0294 |
| Ni | 0.4793 | 0.11 | 0.2352 | 0.0055 | -0.1074 | **-0.6309** | 0.2811 |
| Pb | 0.2694 | 0.4514 | **-0.5777** | -0.1204 | 0.2525 | 0.3768 | -0.0193 |
| Rb | **0.8187** | 0.2221 | -0.3469 | -0.0777 | 0.0276 | 0.1028 | -0.0555 |
| Sr | -0.6516 | **0.6768** | 0.0886 | 0.1532 | 0.1105 | -0.0094 | 0.0029 |
| Th | -0.4371 | **0.8717** | -0.0168 | -0.0145 | -0.1441 | 0.0122 | -0.0354 |
| U | -0.4234 | **0.8742** | -0.0136 | -0.0126 | -0.1549 | 0.004 | -0.036 |
| V | 0.3029 | 0.1325 | **0.7324** | -0.2403 | 0.1541 | 0.3257 | 0.1445 |
| Y | -0.406 | **0.8834** | -0.0112 | 0.0017 | -0.161 | -0.0006 | -0.0363 |
| Zn | 0.2345 | -0.071 | 0.3727 | -0.4316 | -0.1364 | **0.5551** | -0.2605 |
| Zr | **0.6908** | 0.1154 | -0.3371 | 0.2021 | 0.0353 | 0.2368 | -0.1066 |

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# REE and trace element geochemistry of vein type Pb-Zn Deposits: Dadağlı (Kahramanmaraş)

**Yusuf Barbaros Akben**[1] , **Cihan Yalçın** [*2] , **Yusuf Uras**[1]

[1]*Kahramanmaraş Sütçü İmam University, Department of Geological Engineering, Türkiye, bakben@gmail.com*
[2]*Ministry of Industry and Technology, World Bank Project Implementation Unit, Ankara, Türkiye cihan.yalcin@sanayi.gov.tr*

**Keywords**
Pb-Zn
Epigenetic
Trace element
REE
Dadağlı

**Abstract**
Prior to Neothetys' closure, it may be observed in the Kahramanmaraş region in conjunction with the Taurus Orogenic Belt and Arabian Plate units. One of these bands, the marginal fold belt of the Arabian plate, is where the Dadağlı Pb-Zn mineralization is also observed. The oldest lithology in this area is made up of units from the Seydişehir formation. This unit is overlained in an angular unconformity of Mesozoic carbonates. In the fractures and fissures of carbonate rocks to the north of Dadağlı, there are vein type and epigenetic Pb-Zn mineralizations. Galenite, sphalerite, barite, goethite, pyrite, cerusite, smitzonite, quartz, and calcite are formed as gangues throughout paragenesis. Zn ranges from 77.19 to 1200.10% and Ag ranges from 6.20 to 59.17% in the ore zone samples that were used for the trace element analyses. Some of the samples that were compiled include a significant amount of Sc. The ore zone has low concentrations of these elements, according to REE analyses. When compared to heavy rare earth elements (HREE), it may be claimed that light rare earth elements (LREE) are richer. The Dadağlı Pb-Zn mineralization's characteristics are revealed by the obtained geochemical concentrations.

## Introduction

Arabian plate lithologies and units from the Taurus Orogenic Belt came together in the Kahramanmaras region with the closure of the Neotethys Ocean [1]. Due to the presence of rocks with various tectonic characteristics, Rigo De Righi and Cortesini [2] and Gül [3] divided the tectonostratigraphic units in this region into orogenic belts. According to Hanilçi et al. [4], the Pb deposits found in carbonate rocks in Turkey are a product of the Alpine-Himalayan Orogenic Systems. This orogenic belt has the effect of bringing several tectonic belt lithologies together in Turkey. Dadağlı Pb-Zn mineralization is found in the Arabian Platform's marginal fold belt, which is south of the Taurus Orogenic Belt (Figure 1).

Cansu and Öztürk [5] revealed that barite mineralization occurs in Paleozoic-aged sedimentary rocks in this area, and ore paragenesis also contains galenite and sphalerite. According to the study done by Akben et al. [6], this area has Pb-Zn mineralization linked to barite and quartz veins.

The alteration geochemistry of the Pb-Zn mineralization in this area was disclosed by Uras and Yalçın [7]. Yalçın [8-9] reported that galenite and smithsonite are found as gangue minerals in vein type barite mineralizations in the zones in the same region. According to Uras and Yalçın [7], the lead mineralization found to the north of Dadağlı was associated with carbonate rocks, and the PbO content reached a high of 60%. The common alteration types, according to the alteration geochemical diagrams and microscopy analyses, include carbonation and sericitization [7].

This paper reveals the trace and REE concentrations of this region's mineralization zone.

**Material and Method**

At the Geochemistry Research Laboratory of Istanbul Technical University, 10 samples were evaluated using the ICP-MS method on a BRUKER S8 TIGER model instrument for trace and REE analysis in the ore zone (Table 1-2).
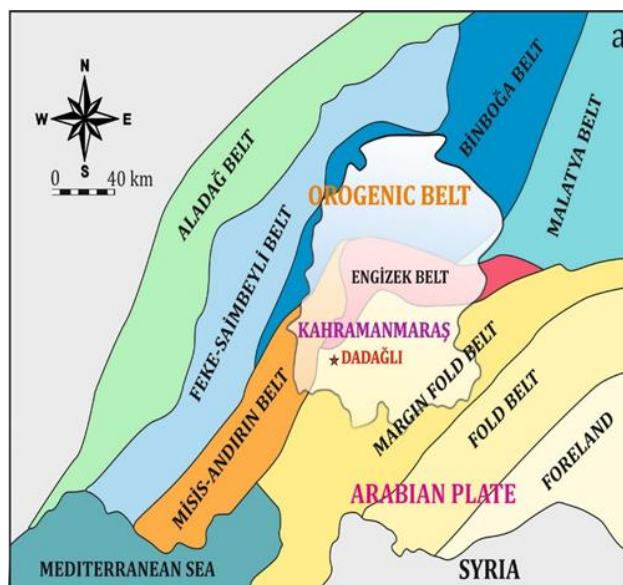


**Figure 1.** Tectonic location of the study area [3]

**Mineralization and Geochemistry**

In the dolomitic limestones to the north of Dadağlı vein-type Pb-Zn mineralizations can be observed (Figure 2a, b). Galena, sphalerite, pyrite, and quartz are still present in the mineralization with epigenetic formation, along with calcite, smithsonite, and quartz, respectively.

In the ore zone, Zn ranges from 77.19 to 1200.10% and Ag ranges from 6.20 to 59.17%, as shown in the Table 1. Some of the samples that were collected include a great deal of Sc. Hg ranges from 20.67 to 415.78%, whereas Sr ranges from 169.33 to 677.39% (average: 4.15%).

**Table 1.** Trace element concentrations of the samples

| TRACE ELEMENT (PPM) | DK-1 | DK-2 | DK-3 | DK-4 | DK-5 | DK-6 | DK-7 | DK-8 | DK-9 | DK-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sc | ND | ND | 40.44 | 9.51 | ND | 26.00 | 26.20 | 12.00 | 14.20 | 3.56 |
| V | 855.70 | 554.98 | 975.78 | 241.80 | 1307.08 | 90.76 | 130.20 | 145.60 | 230.48 | 268.20 |
| Co | 106.38 | 90.64 | 302.48 | 632.18 | 39.21 | 394.56 | 320.20 | 39.21 | 68.20 | 80.20 |
| Ni | 51.86 | 54.38 | 460.32 | 3691.15 | 38.05 | 485.68 | 32.20 | 50.30 | 200.30 | 180.30 |
| Cu | 9.95 | 105.60 | 89.55 | 363.92 | 113.80 | 666.73 | 220.40 | 128.30 | 340.30 | 120.60 |
| Zn | 77.19 | 127.31 | 768.70 | 93.70 | 86.26 | 1018.28 | 120.30 | 150.30 | 1200.10 | 980.50 |
| Rb | 59.55 | 97.22 | 79.67 | 125.45 | 29.26 | 72.71 | 34.60 | 58.20 | 68.20 | 76.15 |
| Sr | 266.35 | 677.39 | 672.18 | 776.16 | 328.47 | 169.33 | 268.90 | 320.20 | 468.48 | 530.78 |
| Zr | 315.06 | 308.49 | 618.38 | 536.12 | 98.55 | 769.74 | 120.45 | 150.80 | 96.00 | 98.00 |
| Mo | 6.25 | 6.05 | 16.78 | 11.58 | 1.31 | 20.48 | 5.20 | 6.20 | 4.58 | 15.20 |
| Ag | 20.46 | 20.39 | 59.17 | 37.69 | 6.20 | 55.20 | 32.40 | 17.40 | 20.10 | 40.30 |
| Cd | 1.31 | 31.47 | 44.71 | 26.01 | 7.86 | 6.62 | 16.80 | 7.45 | 3.23 | 4.30 |
| Sn | 5.58 | 49.00 | 82.83 | 53.35 | 7.60 | 6.42 | 18.70 | 25.30 | 4.30 | 5.20 |
| Sb | 20.20 | 33.02 | 74.96 | 48.31 | 9.99 | 39.14 | 23.25 | 26.40 | 35.40 | 38.90 |
| Nd | 64.99 | ND | ND | 39.76 | ND | 404.16 | ND | 32.30 | ND | 56.30 |
| W | 176.17 | 85.79 | ND | ND | 198.22 | ND | ND | ND | ND | ND |
| Hg | 29.32 | 241.90 | 178.29 | 415.78 | 20.67 | 395.15 | 250.30 | 310.20 | 178.20 | 86.78 |

**Conclusion**

The results of the study suggest that REE's Pb-Zn mineralization is poor (Table 2). Moreover, it implies that Heavy Rare Earth elements are rarer than Light Rare Earth elements (LREE) (HREE).

**Table 2.** REE concentrations of the samples

| REE (PPM) | DK-1 | DK-2 | DK-3 | DK-4 | DK-5 | DK-6 | DK-7 | DK-8 | DK-9 | DK-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ce | 10.41 | 12.10 | 10.06 | 9.62 | 5.52 | 31.37 | 26.80 | 17.40 | 18.80 | 23.30 |
| Cs | 0.85 | 3.41 | 0.92 | 4.08 | 0.93 | 0.35 | 2.10 | 3.23 | 0.90 | 0.46 |
| Dy | 0.48 | 0.99 | 0.73 | 0.68 | 0.86 | 0.81 | 0.30 | 0.29 | 0.68 | 0.82 |
| Er | 0.37 | 0.49 | 0.44 | 0.28 | 0.46 | 0.48 | 0.30 | 0.38 | 0.40 | 0.46 |
| Eu | 0.61 | 7.88 | 2.16 | 5.81 | 1.02 | 0.64 | 2.30 | 3.20 | 1.80 | 1.90 |
| Ga | 3.83 | 5.37 | 3.79 | 6.56 | 2.94 | 2.47 | 4.20 | 3.60 | 2.20 | 2.10 |
| Gd | 0.73 | 1.01 | 1.13 | 0.74 | 1.15 | 1.47 | 1.24 | 1.14 | 1.46 | 1.19 |
| Ho | 0.07 | 0.12 | 0.13 | 0.11 | 0.15 | 0.15 | 0.12 | 0.15 | 0.10 | 0.11 |
| In | ND | ND | 0.06 | ND | 0.01 | 0.01 | ND | ND | 0.01 | ND |
| La | 7.84 | 8.41 | 9.14 | 7.18 | 4.34 | 22.11 | 16.29 | 15.82 | 6.20 | 11.20 |
| Lu | 0.02 | 0.06 | 0.11 | 0.07 | 0.04 | 0.04 | 0.04 | 0.06 | 0.10 | 0.05 |
| Nd | 4.62 | 6.42 | 8.22 | 5.51 | 4.53 | 12.55 | 11.20 | 8.97 | 4.20 | 6.20 |
| Pr | 1.21 | 1.73 | 2.10 | 1.35 | 1.13 | 3.61 | 2.80 | 2.40 | 1.60 | 1.80 |
| Rb | 16.55 | 43.33 | 15.89 | 53.92 | 16.27 | 13.68 | 12.67 | 11.65 | 22.30 | 12.50 |
| Sm | 1.29 | 12.80 | 3.70 | 9.46 | 2.11 | 1.99 | 1.89 | 1.68 | 2.30 | 7.20 |
| Tb | 0.04 | 0.15 | 0.17 | 0.14 | 0.17 | 0.18 | 0.18 | 0.17 | 0.16 | 0.16 |
| Tl | 5.16 | 5.01 | 13.59 | 10.72 | 0.93 | 15.62 | 13.24 | 11.40 | 4.80 | 8.90 |
| Tm | 0.01 | 0.05 | 0.07 | 0.07 | 0.09 | 0.04 | 0.07 | 0.06 | 0.08 | 0.09 |
| Y | 2.83 | 4.70 | 3.22 | 3.83 | 6.34 | 4.94 | 2.90 | 3.68 | 4.80 | 5.20 |
| Yb | 0.14 | 0.35 | 0.52 | 0.33 | 0.40 | 0.29 | 0.36 | 0.38 | 0.36 | 0.34 |

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# Isotope geochemistry of Koçaşlı Barite mineralization

**Volkan Karasu[1]** , **Cihan Yalçın [2]** , **Yusuf Uras[3]**

[1]Mersin University, Department of Geological Engineering, Mersin, volkankarasu24@gmail.com
[2]Ministry of Industry and Technology, World Bank Project Implementation Unit, Ankara, cihan.yalcin@sanayi.gov.tr
[3]Kahramanmaraş Sütçü İmam University, Department of Geological Engineering, Kahramanmaraş, yuras@ksu.edu.tr

**Keywords**
Barite
Isotope
Geochemistry
Seawater
Koçaşlı

**Abstract**
Precambrian-Mesozoic dated rocks are seen combined along the Taurus Orogenic Belt owing to the closure of the Neotethys ocean's branches. In this area, there are significant barite deposits related to carbonate rocks. The mineralization of Koçaşlı (Gülnar, Mersin) barite may be observed in Devonian carbonates located in the Central Taurus Mountains. The slope and dip are toward 60°SW, and the ore is orientated N10°W. The ore zone has a thickness of 7 meters and an average length of 15 meters. The initial analyses of the barite in this area were done using stable oxygen, sulfur, and $^{87}Sr/^{86}Sr$ isotopes respectively. The Koçaşlı barite samples' $^{34}S$ values are quite high compared to the isotope composition in modern sea water, indicating that they are enriched in the heavy isotope $^{34}S$. The amount of $^{18}O$ isotope found in barites shares similarities with the sulfates observed in seawater from the Devonian period. The $^{87}Sr/^{86}Sr$ ratios of the barite samples examined for the study are higher than the isotopic composition of modern seawater. These isotope values for the barite sample point to a considerable contribution from the continental crust and a rich source of $^{87}Rb$. Results from isotope analysis demonstrate that mineralization in this area is majorly caused by sedimentary processes.

## Introduction

Barite ($BaSO_4$), an intense mineral, is a crucial industrial raw material. Barite also lacks magnetic properties despite the fact that it can withstand high pressure and heat without losing its chemical properties. It is a crucial mineral in heavy concrete applications because of these qualities. Barite is still implicated in the paragenesis of Pb, Zn, Cu, and Au deposits in low, medium, and high sulfidation classes [1–2], while being mostly observed in marine environments [3-4].

The Alpine and Hercynian Orogenies contributed to the formation of Turkey's significant barite deposits [5]. Barite mineralization hence occurred in major tectonic belts. The Taurus Orogenic Belt is reported to contain important mineral deposits in carbonate rocks [6–7]. This belt is made up of units where tectonic slices are persistent and is divided into three segments by the Western, Central, and Eastern Taurus Mountains [8]. In these units, there are many barite mineralizations related to carbonate rocks.

The Koçaşlı (Gülnar, Mersin) region of the Central Taurus Mountains has tectonic slices that are a part of the Geyikdağı Unit [9]. In the Ovacık and Araca Tectonic Slices, Upper Devonian-aged limestones have been enriched with barite [10]. BaO concentrations range from 64.76 to 67.09%, while $SO_3$ is the only substantial oxide. In terms of SrO composition, barites with an average of 0.39% are comparable to sedimentary deposits [10]. This paper analyses the isotope geochemistry information of the barite deposit in this area.

## Material and Method

Stable oxygen, sulfur, and $^{87}Sr/^{86}Sr$ isotope analyses were completed (Table 1) in order to demonstrate that barite deposits formed. Barite isotope analyses of $^{18}O$ and $^{34}S$ were carried out at Washington State University in

the United States, while $^{87}Sr/^{86}Sr$ isotope analyses of the same specimens were carried out at the Central Laboratory R&D Training and Measurement Center of the Middle East Technical University (Ankara).

**Table 1.** Oxygen, Sulphur, and 87Sr/86Sr isotope contents of barites

| SAMPLE | MINERAL | $\delta^{18}O_{SMOW}$ | $\delta^{34}S_{VCDT}$ | $^{87}Sr/^{86}Sr$ |
|--------|---------|-----------------------|------------------------|-------------------|
| KO-4 | Barite | 14.61 | 32.07 | 0.710618 |
| KO-2 | Barite | 14.95 | 31.90 | 0.710623 |
| **AVERAGE** | | **14.78** | **31.99** | **0.710621** |

**Mineralization and Isotope Geochemistry**

The Devonian-aged limestone outcropping southeast of Koçaşlı district contains barite deposits. The ore is oriented N10°W, while the slope and dip are towards 60°SW. The ore zone has an average length of 15 meters and a thickness of 7 meters. Iron is abundant in this ore zone's upper levels [10].

In comparison to the $SO_4^{2-}$ ($^{34}S$ =21 ‰) isotope composition in modern sea water, the Koçaşlı barite samples' $^{34}S$ values are quite high, indicating that they are enriched in the heavy isotope $^{34}S$. In heavy sulfur-enriched diagenetic processes, some microorganisms (Bacterial Sulphate Reduction BSR) reduce $SO_4^2$ to such high quantities that barite precipitates from such fluids. It can be argued that diagenetic processes and microorganisms play a significant role in the creation of regional barites in this regard. The amount of $^{18}O$ isotope detected in barites has characteristics similar those of the sulfates observed in Devonian seawater.

From the Precambrian to the present, there have been significant variations in the marine sulfate's $\delta^{34}S$ and $\delta^{18}O$ compositions. Figure 1 displays the results of this investigation in terms of these values.
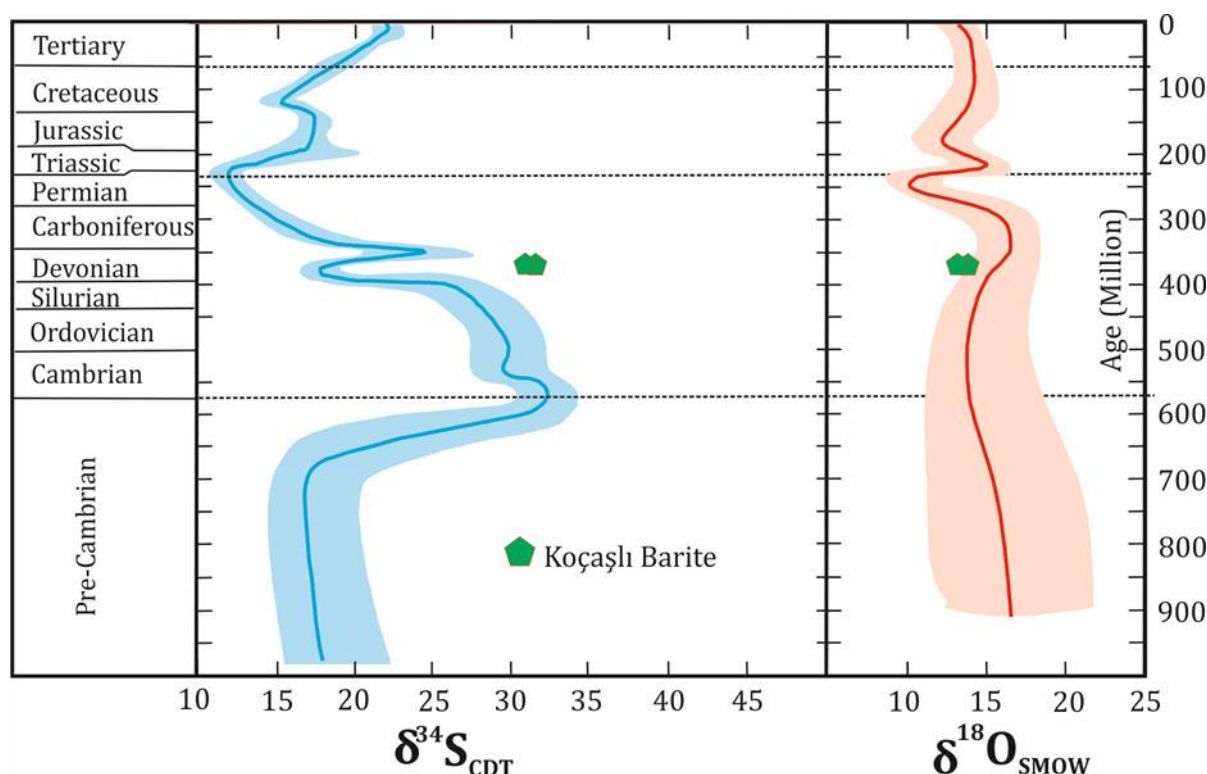


**Figure 1.** The $\delta^{34}S$ and $\delta^{18}O$ isotopic composition of marine sulphate and Koçaşlı barites examined in the study in different geological periods from the Precambrian to the present [11]

The barite samples analyzed as part of the study have higher $^{87}Sr/^{86}Sr$ ratios than the isotopic composition of modern seawater. These barite sample isotope values indicate a rich source of $^{87}Rb$, implying a significant contribution from the continental crust.

Figure 2 compares the isotope values of barite samples to values from hydrothermal, diagenetic, and terrigenous (terrigen) sources. The graphic shows that Koçaşlı barites have characteristics in common with diagenetic and cold seep barites. Additionally, it is evident that the mineralization is overly influenced by the terrigenous material.
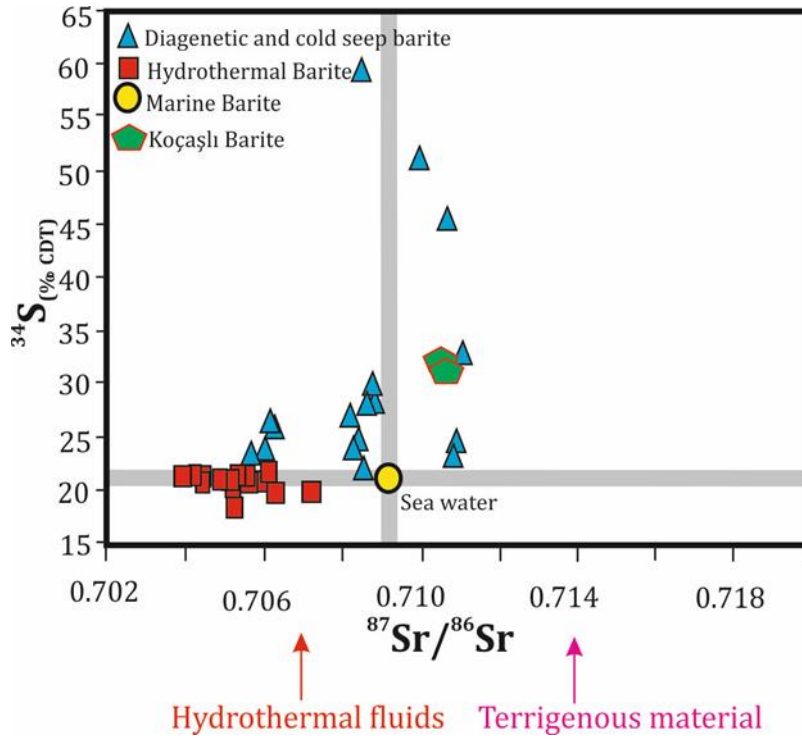
**Figure 2.** $^{87}$Sr/$^{86}$Sr and $\delta^{34}$S isotopic composition of barites formed in different processes [12]

**Conclusion**

The isotope analyses revealed that Koçaşlı barite mineralization was mostly formed by sedimentary processes. The oxygen isotopes of the barites, which are extremely sulfur-rich, have been found to represent the seawater sulfates from the Devonian period.

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# Industrial internet of things (IIoT) in energy sector

**Çetin Önder İncekara** *[1]

[1]BOTAŞ, Dr., Arazi Edinim Şube Müdürü, BOTAŞ Genel Müdürlüğü, Bilkent, Ankara, Türkiye, cetinincekara@gmail.com

**Keywords**
Industry 4.0
Internet of Things-IoT
Energy Sector
Fuzzy Logic
Machine Learning
Artificial Intelligence

**Abstract**
Internet of Things -IoT- represents a new production reality. Since 2000 the usage of IoT has been steadily increased in almost every sector, i.e., industry, business, entrepreneurs. The information derived from the data gathered from the new devices connected to the internet, i.e. IoT, can be used to develop new services, improve productivity and efficiency, improve decision making in real time, resolve critical problems and create innovative experiences. "Industry 4.0" concept has the flexibility to achieve interoperability between the different industrial engineering systems. Industrial Internet of Things (IIoT) is used to transfer the data from systems that monitor and control the industrial equipments to data processing systems that cloud computing has shown to be important tools for meeting processing requirements by using Wi-Fi, radio, satellite or cellular networks. IoT technologies offer greater availability of information throughout the chain of value, allowing for amortization of better tools for decision making. Using sensor devices in energy sector offers automated execution of the processes and the usage of Machine Learning (ML) and Artificial Intelligence (AI) in energy industry allow systems to communicate with each other, making their own decisions. IIoT enables real-time quality monitoring, which helps identify the nonconformities within the processes and energy production sector easily.

## Introduction

Over the previous decade, the Internet of Things (IoT) revolution has had a significant impact on manufacturing, energy, agriculture, transportation, and other industrial sectors. The Industrial IoT (IIoT) is an industry-specific variant of the IoT, which provides an impressive potential for businesses via connected machines, sensors, and applications. It is one of the most exciting technologies now reshaping industrial enterprises, prompting them to modernize their processes, system intelligence, and facilities in order to cope with emerging disruptive technologies. IIoT improves manufacturing efficiency, safety, scalability, production time, and profitability in the industrial sector.

The worth of the Internet of Things (IoT) market in the energy sector is expected to grow at the Compound Annual Growth Rate (CAGR) of 11.8% over the period of 2021-2025. This embarks a significant impact of using IoT-powered solutions to make the energy sector better and more advanced. The use of sensors has enabled real-time monitoring of productivity, simplified applications, and have remote control over the energy consumption patterns. Major factors that drive the growth of IoT in the energy sector include data management and the advantage of using IoT-based agile systems. The inclusion of IoT helps reduce the challenges and allow the management to evolve through all possible issues coming their way. IoT applications in the energy sector focus on improving asset and industrial efficiency create enhanced revenue generation, and effective resource utilization.

The emerging "Industry 4.0" concept is an umbrella term for a new industrial paradigm which embraces a set of future industrial developments including cyber-physical systems (CPS), the Internet of things (IoT), the Internet of services (IoS), robotics, big data, cloud manufacturing and augmented reality. Industrial processes need most

tasks to be conducted locally due to time delays and security constraints, and structured data needs to be communicated over the internet.

Transforming the energy sector with IoT technology is an innovative way to promote improved productivity and recognize/arrange the consumption patterns to cut-short the excessive energy usage. In the energy sector, IoT devices have been able to create intelligent networks, i.e., smart grids, through the collection, transmission and use of large quantities of data. In this way, it integrates in an intelligent manner all of the assets connected to the network, optimizing operation and increasing the flexibility of the systems.

**Material and Method**

In the study; an integrated Fuzzy AHP- Fuzzy TOPSIS- Fuzzy VIKOR approaches are used to assess/evaluate Industrial Internet of Things (IIoT) in Energy Sector. In literature Fuzzy Multi Criteria Decision Making Methods (FMCDM) are used in different fields by many researchers [1-23] by using MATLAB program.

IIoT in Energy Sector, i.e., measuring scale, consists of 6 dimensions-main criteria and 29 evaluation factors-sub-criteria are evaluated by decision makers (DMs). A questionnaire was developed following the methodology proposed for the below methods, which was answered by 25 experts/DMs.

It uses sensor devices and gateway connectivity to derive actionable insights and use them to develop new and advanced services for enhanced productivity. It further improves real-time decision-making, complex operability, and overall experiences.

**1. Process Monitoring and Resource Optimization:** Using sensor devices in a power plant offers automated execution of the processes and render better services that are mostly error-free. IoT technology is a smart concept that also protects excessive resource utilization and helps maintain consistency. IoT allows smart process monitoring that gives every detail of the plant-process in the form of data.

**2. Advanced Analytics:** Sensor-based functioning of the power industry is bringing a revolutionary change. It uses advanced techniques to fulfill the business requirements and generate quality production. The industrialists are making the most out of using advanced analytics with their business. It uses sensor-enabled data to extract information from the assets and make better decisions than before. Data analytics helps the power sector to optimize generation and planning.

**3. New Opportunities:** IoT brings new business opportunities along with newer and advanced concepts. It involves sensor devices, gateway connectivity, and communication protocols that combine and form IoT architecture for multipurpose businesses. One can use IoT technology to avail business benefits and enable smart techniques for better productivity and growth. IoT is a futuristic technology, which empowers businesses through its real-time monitoring features, smart data management, and analytics.

**4 Intelligent Grid:** IoT provides a smart grid system to get control over the power flow or curb the energy consumption at significant levels. It further curtails the energy load to match the real-time generation or near real-time. IoT is an automated concept that offers a cost-effective approach to interconnect the users for effective power usage.

**5. Cost-savings and Data Management:** IoT in the energy sector is an advanced process that includes planning and energy management of the consumption patterns in multiple domains. It allows the managers to take complete control of energy data from scratch and optimize the process significantly. Using an IoT-powered solution in the energy sector utilizes sensor-based methods to establish the automated functioning of the industry.

**6. Sustainability:** All assets/machines/equipments have been made to talk to each other through IoT. The energy sector is the major driver of accountability that seeks smart ways to reduce environmental issues. IoT facilitates automated maintenance and reporting, optimization of smart grids, renewable energy generation, and measure carbon consumption in real-time. The technology is enabling sustainability around the industrial world through its smart techniques and is allowing the managers to make informed decisions for better business growth.

**Machine-to-machine (M2M) Communication**

Machine-to-machine (or M2M) is a broad term that describes any technology that allows networked devices, without human assistance, to exchange information and take action. Machine Learning (ML) and Artificial Intelligence (AI) allow systems to communicate with each other, making their own decisions. M2M technology was initially adopted in industrial and manufacturing settings. Initially, technologies like Supervisory Control and Data Acquisition (SCADA) or remote monitoring are used to control and manage data from the equipment remotely, especially in energy sector. However, M2M technology has been used in many other industries, including healthcare, insurance, and other businesses. M2M is also the foundation of the Internet of Things (IoT), allowing

effective communication among equipment/machines. IoT provides b/m advantages; improved operational efficiency, better product quality and services, detail-oriented decision-making, cost-efficiency and increased Return on Investment (ROI), unlimited scalability, remote machine monitoring, accurate asset tracking, reduced power consumption, packet-switch services, real-time monitoring, time tolerance and control, geo-fencing, continuous data transfer, predictive maintenance.

## Results

Sensor technology, big data and analytics are used to optimize operations, such as efficiently balancing supply and demand as customers connect to a smart grid. The usage of IoT in energy production helps to satisfy the energy demands in smart cities in an efficient way. However, a robust digital infrastructure is crucial for the roll-out of an architecture of connectivity and data.

After acquiring the fuzzy comparison matrices, importance weights of IIoT's dimensions; evaluation criteria is calculated by using Fuzzy method. According to the calculated criteria weights for IIoT's weights; the most important evaluation dimension/main-criteria is "Cost-savings and Data Management", the second important evaluation dimension is "Process Monitoring and Resource Optimization" and the third important evaluation dimension is "Advanced Analytics".

## Conclusion

Industry is taking advantage of ever more complex and sophisticated systems. Systems not designed to communicate across production lines often require integration with pre-existing devices. The challenge of interoperability is thus one of the main concerns in designing intelligent human-to-machine and machine-to-machine cooperation.

"Industry 4.0" concept has the flexibility to achieve interoperability between the different industrial engineering systems. To connect the different industrial equipment and systems, the same standards and safety levels are required. The "Industry 4.0" concept was born to apply the ideas of cyber-physical systems (CPSs) and IoT to industrial automation and to create smart products, smart production, and smart services. It involves cyber-physical systems, IoT, cognitive computing and cloud computing and supports what has been termed "smart factory". IoT technologies offer greater availability of information throughout the chain of value, allowing for amortization of better tools for decision making.

IIoT is used to transfer the data from systems that monitor and control the industrial equipment to data processing systems that cloud computing has shown to be important tools for meeting processing requirements by using Wi-Fi, radio, satellite or cellular networks.

In the study by using Fuzzy method; the calculated criteria weights for IIoT's weights are as follows: the most important evaluation dimension/main-criteria is "Cost-savings and Data Management", the second important evaluation dimension is "Process Monitoring and Resource Optimization" and the third important evaluation dimension is "Advanced Analytics".

IIoT provides the necessary connectivity, security, and manageability, while some of the existing devices cannot share data with the cloud. They should be modified to share their data. IIoT enables real-time quality monitoring, which helps identify the nonconformities within the processes and energy production sector easily. Many applications have already been implemented in the construction and the infrastructure fields. The net market value of deploying UAVs in support of construction and infrastructure inspection applications accounts for about 45% of the overall UAV market. UAVs are also used for the real-time inspection of power lines. Drones are used to detect trees and buildings close to power lines. They can also be deployed to monitor oil, natural gas and water pipe lines. UAV and IoT technologies are used for building inspections, oil and natural gas pipelines inspections in North America using the powerful machine learning to process the data collected. They provide asset inspection and data acquisition, advanced data processing with 2D and 3D images and detailed reports on the property inspected.

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# Clean water for developing countries

## Joudi Borghol *1 , Ayse Yeter Günal 1

*1Gaziantep University, Department of Civil Engineering, Türkiye, joudy.bourgol@outlook.com, agunal@gantep.edu.tr*

**Keywords**
Drinking
Pollutants
Percolation
Mongrel
Rain water gathering
Rain water aggregating

**Abstract**
Availability of safe drinking clean water, a pivotal natural resource, is still a remote dream to many around the world, and a lot of cities especially in developing countries. Efforts to develop efficient, economical, and techno- logically sound methods to manufacture clean water for developing countries have increased worldwide. We focus on solar disinfection, filtration, percolation, hybrid and mongrel filtration methods, treatment of harvested and collected rainwater, herbal water disinfection, and arsenic removal technologies. Simple, yet innovative water treatment devices ranging from use of plant xylem as filters, tera filters, and hand pumps to tippy taps and nozzle designed and prepared indigenously and locally are methods mentioned here. By characterizing the technical ways of major water disinfection methods relevant for developing countries on medium to small scales and balances and emphasizing their merits, demerits, economics, and scalability, we highlight the current scenario and smooth the way for further research and explore and development and scaling up of these processes. This survey concentrates on clean drinking water, especially for rustic populations in developing countries.

## Introduction

Water for drinking, or drinkable water, is of paramount importance. The availability of water globally varies to a large degree in different countries, and even if it is available, whether it is clean for human consuming is doubtful. This is especially true for developing countries, where incoming to neat and drinkable water is bounded. The present review scouts about clean water, especially with respect to drinking water [1]. The technologies available at present, their development, and emerging novel technologies are described with a focus on developing countries; we address the medium to small scale, as on the large scale, enough information is available. Clean water essentially means water that is appropriately pure and free from physical, chemical, and biological pollutants and may be used for purposes such as drinking, bathing, and cooking.

It is major that every human being has access to safe drinking water, as it is the right of every person. The microorganisms that are in unclean waters are of uncountable kinds of which bacteria, viruses, and protozoa are the wide kinds. Thus, drinking water should be clean from any of these harmful microorganisms. However, waterborne diseases are a major challenge globally. (WHO) estimates that nearly 1.6 million people die every year from diarrhea, and 90% of these are children younger than five years of age, mostly in developing countries. Therefore, controlling pollution on one hand and developing effective disinfection methods on the other are the two most important and serious approaches available to handle the crisis [1].

## Material and Method

Water may be polluted by a set of materials as it is explained in (Figure 1) depending on the source of the water body, the environmental factors, and human activity. Physical contaminants lead to turbidity of water causing to

the being of materials like clay, microorganisms, or soil runoff, and particles in water bodies may harbor microbes (pathogenic or nonpathogenic). Microbes get in into water bodies mainly in the form of, e.g., animal and human wastes or runoff from farms.
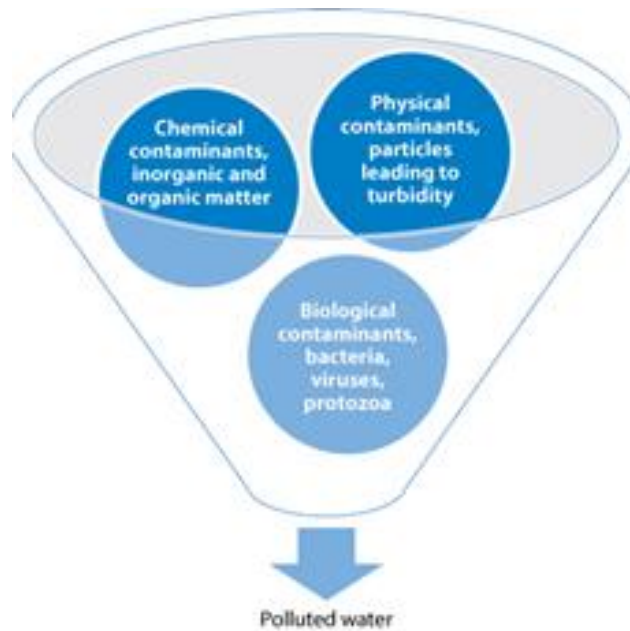


**Figure 1.** Common physical, chemical, and biological pollutants that pollute water

The inorganic contaminant arsenic is one major pollutant that causes skin, bladder, kidney, and liver disorders, lung cancer, and hyperkeratosis. Lead poisoning can be mortal, and small levels also can lead to intellectual defects in infants and young children [2]. It is believed that lead poisoning was the main reason for the breakdown of the Roman Empire because in ancient Rome, water pipes were made of lead.

The use of solar rays for water disinfection dates back many centuries. This simple yet effective method for water disinfection has huge possibility for implementations in developing countries given its low cost and zero energy requirements [4]. The technique's simplicity is depending on the capability of microorganisms present in contaminated water to directly ingest solar rays leading to its inactivation. In addition, sunlight is also known to burn molecules such as pigments and porphyrins present inside the cells, which in turn results in the formulation of reactive oxygen species like hydrogen peroxide that cause harm to the cell membrane, proteins, and DNA [3]. Thermal effects of solar disinfection, called solar pasteurization, are also included in the disinfection operation, during which the assimilation of solar infrared rays raises the temperature of water, leading to the inactivation of microbes.
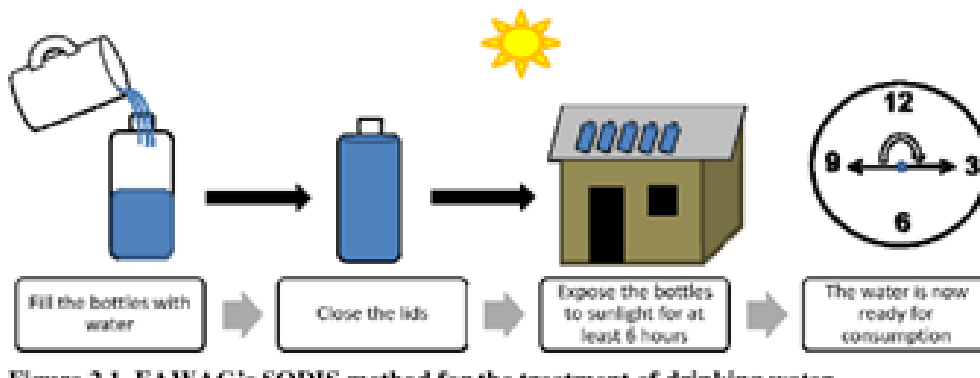


**Figure 2.** impact of water quality on solar disinfection

Rainwater gathering is used for collecting and storing rainwater from rooftops, land surfaces, runoffs, and catchments. The water becomes a household source for local uses, such as drinking and cooking, as well as for use in agriculture. In lowly polluted areas, catchment surfaces and metallic rooftops could be a source of pollutants such as inorganics and heavy metals, at least in the initial monsoon/rainy period. In addition, bacteria, viruses, and protozoans may earn access to the storage areas by way of fecal pollution resulting from birds and mammals. High levels of bacteria, such as 80.3% coliforms, 40.9% *E. coli*, and 28.8% enterococci, have been reported in harvested

and collected rainwater, thereby highlighting the necessity to disinfect gathered rainwater before to its consumption [5].

Disinfection of collected rainwater has been achieved by many methods, such as chlorination after its removal from the tank to minimize side reactions with inorganic matter settled at the tank bottom. Slow sand filtration is particularly useful to eliminate microbial contamination. For particulate matter, rapid sand filtration is one option, and metal membrane filters with ozonation and aeration on the feed side also serve well to remove most of the pathogens and explain rainwater to an acceptable quality [5].

**Conclusion**

Clean drinking water, a basic human right, continues to be a challenge worldwide owing to the humongous and myriad physical, chemical, and biological pollutants in water bodies, thereby affecting human lives.

Ongoing, continuous, and commendable efforts by the United Nations, World Health Organization including scientists, have resulted in remarkable improvement of the water scenario globally.

traditional techniques, such as filtration, hybrid filtration, and herbal water disinfection, are economical, easy to use, natural, and simple methods to gain clean drinking water in developing countries, especially in the form of point of use in households for turbidity removal or pathogen inactivation. Water treatment at the community level needs more focus and development [4].

collected rainwater is an excellent source of clean drinking water that not only conserves water but also is frail to simple and traditional disinfection techniques to render it pathogen free [3].

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