International Developments in Engineering &Technology

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Prof. Dr. Zeki ÇİZMECİOĞLU
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Güven Plus Group Inc. Publications: 29/2022
20 DECEMBER 2022

Publisher Certificate No: 52866
E-ISBN: 978-625-7367-36-3
Güven Plus Group Inc. Publications

Text and Language Editors
Assoc. Prof. Gökşen ARAS (Turkish – English)
Assist. Prof. L. Santhosh KUMAR (English)

Cover and Graphic Design
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Print-Binding
GÜVEN PLUS GROUP CONSULTANCY INC. PUBLICATIONS®
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PREFACE

In our world, while there are many negativities in the areas of nature, health, social, etc.; technological developments are becoming a necessity in the industry in general for the solution of these and other problems. Technological develop-ments, triggered by quality competition, desire for comfort, fear and anxiety, emerge as a fact that we face in many and difficult to follow. Academic studies conducted in this context; It is brought together with its interlocutors, sometimes in the form of open-access sites, and sometimes in the form of congresses, panels, periodicals and scientific books.

We wanted to have a finger in the pie with this academic book study called **"International Developments in Engineering &Technology"** which consists of different chapters and covers the researches of valuable academicians. This book; we pre-sent it to you, valuable scientists and industry employees through "Güven Plus Grup Inc. Publications" which a major part of its publications consisting of academic books, has gained a great reputation with its qualified activities in the na-tional and international arena. This book consists of many engineering subjects and experimental studies and applied academic subjects. In the book; You will find valuable research and experimental studies on many important subjects.

We believe that the book, which includes chapters dealing with many inter-esting topics of engineering technologies, will shed light on the academic studies of many researchers, and will find a valuable place in the catalogs of the Higher Education Institution, public libraries and personal archives.

We would like to express our gratitude to our esteemed editors, writers, referees and you, our dear readers, who have contributed to

the realization of this important work, which emerged as a result of the long-lasting and meticulous work. **December 2022**

Prof. Dr. Zeki ÇİZMECİOĞLU
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ÖNSÖZ

Dünyamızda doğa, sağlık, sosyal vb. alanlarda birçok olumsuzluk yaşanırken; bunların ve diğer problemlerin çözümüne yönelik olarak genel anlamda endüstride, teknolojik gelişmeler zorunluluk halini almaktadır. Kalite rekabeti, konfor arzusu, korku ve endişenin de tetiklediği teknolojik gelişmeler, takipte zorlanılacak derecede ve çok sayıda yüzleştiğimiz bir gerçek olarak karşımıza çıkmaktadır. Bu bağlamda yapılan akademik çalışmalar; kimi zaman açık erişimli siteler, kimi zaman da kongre, panel, süreli yayınlar ve bilimsel kitaplar şeklinde muhataplarıyla buluşturulmaktadır.

Biz de birbirinden kıymetli akademisyenlerin araştırmalarını kapsayan, farklı bölümlerden oluşan "**"International Developments in Engineering &Technology"** adını verdiğimiz bu akademik kitap çalışması ile çorbada tuzumuz olsun istedik. Bu kitabı; yayınlarının önemli bir bölümünü akademik kitaplardan oluşan, Ulusal ve Uluslararası alanda nitelikli faaliyetleriyle oldukça saygınlık kazanmış olan "Güven Plus Grup A.Ş. Yayınları" aracılığı ile siz değerli bilim insanları ve endüstri çalışanlarının hizmetine sunuyoruz.

Bu kitap, birçok mühendislik konuları ve deneysel çalışmalar ile uygulama yapılmış akademik konulardan meydana gelmiştir. Kitapta;

Birçok problemlerin çözümüne yönelik birçok önemli konuda değerli araştırma ve deneysel çalışmaları bulacaksınız.

Mühendislik teknolojilerinin birçok ilgi çekici konularına değinilen bölümlerin yer aldığı kitabın, çok sayıda araştırmacının akademik çalışmalarına ışık tutacağına, Yükseköğretim Kurumu kataloglarında, kamu kütüphanelerinde ve kişisel arşivlerde oldukça değerli bir yer bulacağına inanıyoruz.

Uzun zaman alan ve büyük bir titizlikle yapılan çalışmaların sonucu olarak ortaya çıkan bu önemli eserin gerçekleşmesinde emeği geçen saygıdeğer editörlerimize, yazarlarımıza, hakemlerimize ve kitabımızı edinen siz sevgili okurlarımıza teşekkürlerimizi sunarız. **Aralık 2022**

Prof. Dr. Zeki ÇİZMECİOĞLU
Prof. Dr. Tareq MUNEER
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ENVIRONMENTALLY SUSTAINABLE TRANSPORT: WHAT KIND OF A FUTURE AWAITS US?

Mahmut Esad ERGİN[1], Mustafa ILICALI[2]

Abstract: In 2030, population of the world is expected to become aorund 8,5 billion. As the population of the world increases, the urbanization rate rises. According to researches, 6 out of 10 people live in cities which means more than 50% of people reside in cities. The increase in urbanization also causes a significant increase in demand for urban infrastructure. In this context, the greatest increase in demand is experienced in the demand for mobility. However, due to the enormous financial benefits that transportation brings while also having an impact on environmental systems, as a result the relationship between transportation and environment can be considered as paradoxical. Within the scope of this study, the energy need, the type of fuel used in transportation and the damage caused by fossil fuels to the enviornment, traffic congestion related fuel consumption and the time spent in traffic, the effect of transportation on global climate change (especially due to greenhouse gas emissions), transportation-related harmful gas emission and its effects on air quality in cities and traffic-related noise emissions on public health were evaluated. As a result, it can be said that if environmental sustainability in transportation cannot be achieved, an unlighted future awaits us and next generations.

Keywords: Sustainability, Public Health, Transportation, Environmental Impacts, Urbanization

INTRODUCTION

Population of the world increases steadily. On November 15, 2022, it is anticipated that there will be 8 billion people on the planet. According to the United Nations' most recent estimates, the world's population

may reach 8.5 billion in 2030, 9.7 billion in 2050, and 10.4 billion in 2100 (United Nations, 2022). While the population of the world increases, individuals seek for new habitats and lands to settle and live.

The majority of people worldwide lived in tiny settlements for the majority of human history. This has drastically changed during the previous few centuries, especially in the last few decades. People have moved in large numbers from rural to urban areas. Estimates of the number of people worldwide who reside in urban and rural areas are shown in Figure 1, based on data from the UN World Urbanization Prospects. Currently, metropolitan regions are home to more than 4.3 billion people. This means that more than half of the world's population—55 percent in 2017—lives in cities. It can be said that 6 out of 10 people live in cities. According to the UN, this historic occasion, when the population of urban areas surpassed that of rural areas, took place in 2007 (Ritchie & Roser, 2019) (Figure 1).

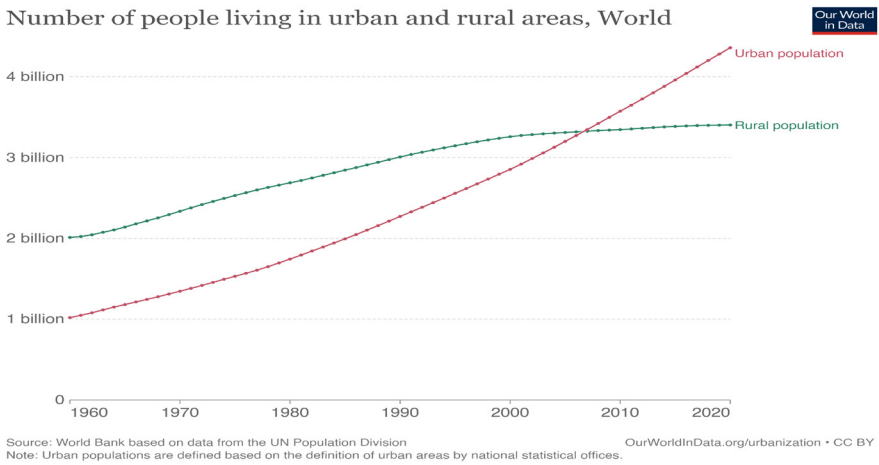

Figure 1. Number of Urbanized and Non-Urbanized People in the World[1]

According the above-given graph, it is clearly seen that the urbanized population of the world will increase and the demand for land and the services will increase as well.

A paradox exists in the link between transportation and the environment (Rodrigue, 2020). Although transportation has significant socioeconomic benefits, it also has an effect on the environment. Trans-

1 ourworldindata.org

port-related activities support the growing demands for passenger and freight mobility on the one hand, but they also have an influence on the environment that may not be favorable. Environmental factors also have an impact on how well transportation systems function and how much infrastructure is needed in terms of building and care (Rodrigue, 2020).

Urbanization is generally linked to invasion of the land and economic growth of the societies. World Economic Outlook (WEO) report (IMF, 2021) claims that Forecasts indicate that the global economy would expand by 6.0 percent in 2021 and 4.9 percent in 2022. The global outlook for 2021 has not altered from the April 2021 WEO. Urbanization is affected by economic growth. Numerous studies in the literature (Chenery & Taylor, 1968); (Henderson, 2003); (Chen, Zhang, Liu, & Zhang, 2014) demonstrate a significant relationship between urbanization and economic growth. A city's physical form and land use patterns may be fixed once it is constructed, resulting in unsustainable sprawl. By 2030, there will be 1.2 million km^2 of additional urban built-up area worldwide as a result of the development of urban land consumption outpacing population growth by as much as 50%. Cities account for two-thirds of worldwide energy consumption and more than 70% of greenhouse gas emissions, and such sprawl puts strain on land and natural resources, leading to unfavorable effects. Cities are becoming more and more crucial in the fight against climate change as they become more vulnerable to natural disasters and climate change. In regions where flooding depths of over 0.5 meters when major floods occur, over 76,400 km^2 of additional urbanized territory have been added since 1985; this is equivalent to around 50 times the area of Greater London. 1.81 billion people, or one in four people worldwide, reside in high-risk flood zones. 89% of the world's flood-exposed population live in emerging nations' highly populated and quickly urbanizing river plains and coasts, where exposure is particularly high (WorldBank, 2022).

The experience of urbanization and how urbanization rates vary between nations are influenced by societal traits.. As (Long, Zou, & Liu, 2009) stated Most Asian nations are experiencing significant urbanization, which leads to rural-to-urban migration and creates opportunities for industry. According to some (Chen & Bo, 2014), China's increasing

urbanization is fostering agglomeration economies and enhancing social mobility, which is opening up a wide range of options for those in lower social strata.

All in all, it is obvious that urbanization triggers economic growth and industrialization. One of the most effective systems of the urbanization is transportation system. The effectiveness of the transportation system also increases mobility and grows and develops in parallel with urbanization. Urbanization and transportation should be seen as parts of an inseparable whole. As urbanization increases, the demand for energy use also increases.

ENERGY NEEDS

Providing mobility for passengers and freight through transportation operations, which account for around 25% of global energy usage, is a substantial energy user. (Rodrigue, 2020). Additionally, as a result of the rise in private motorized modes and suburbanization, there is a corresponding rise in energy usage for transportation (Choi, Nakagawa, Matsunaka, Oba, & Yoon, 2013). This is of course an expected result. As the demand for mobility will create more trips, more energy will be needed. The amount of energy consumed within the scope of transportation is related to the level of development of the countries. For example, according to (Newman & Kenworthy, 1989), average fuel consumption in American cities exceeded that of Australian cities by over two times, European cities by four times, and Asian cities by 10 times.

In response to the growth of the world economy, energy consumption is rising everywhere. Figure 2 demonstrates how annual variations in global energy use have occurred. As a proportion of consumption from the prior year, the change is expressed. Global energy use has risen almost yearly for more than 50 years, it may be shown. The early 1980s and 2009 after the financial crisis are the outliers to this rule (Ritchie & Roser, 2019). Furthermore, in 2021, energy consumption decreased dramatically due to the Covid-19 countermeasures.

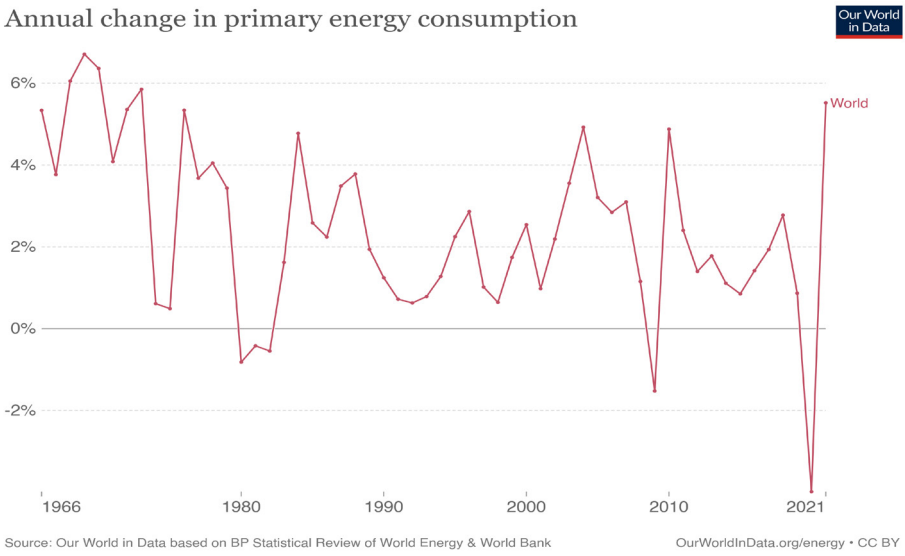

Figure 2. Changes in Primary Energy Use Annually

The growth of cities that is dependent on the vehicle is one of the key factors of high rate of energy consumption in terms of transportation. Dependence on automobiles is a term used to describe patterns of land use and transportation that encourage access to automobiles and offer inadequate alternatives. It implies that getting to services and activities for individuals without a car is challenging (Litman, 2019). Automobile-oriented urban areas encourage people to do motorized trips and this causes more energy conusumption. As it is known that one of the automobile-dependent countries is United States of America (USA). According to United States Energy Information Administration, transport uses 28% of the total energy use in 2021 (Figure 3). Moreover, Additionally, in 2021, the majority of the energy used by the U.S. transportation sector—about 90%—was derived from petroleum products. About 6% come up with by biofuels. 4% of it was made up of natural gas, the majority of which was utilized in compressors for natural gas pipelines. Less than 1% of the energy used in the transportation sector was attributed to the usage of electricity by mass transit systems (Figure 4) (EIA, 2022).

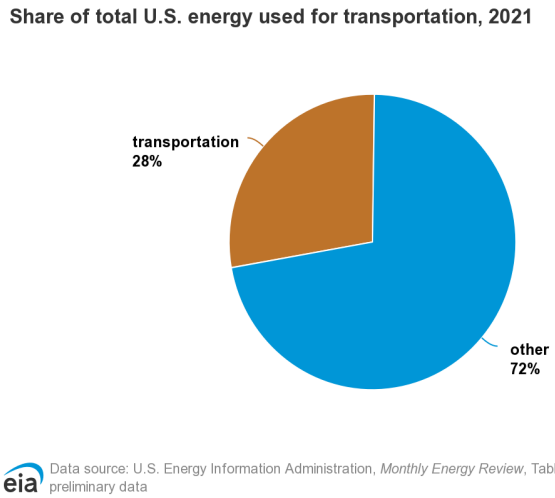

Figure 3. Share of Total U.S. Energy Used for Transportation, 2021

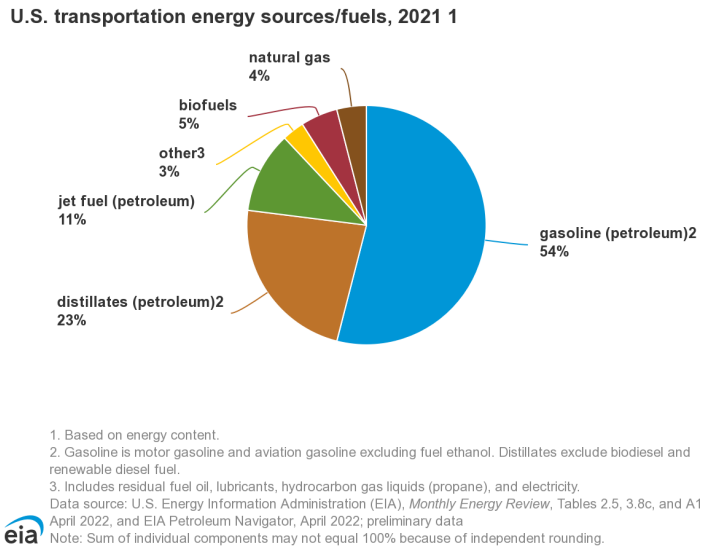

Figure 4. U.S. Transportation Energy Sources/Fuels, 2021

Furthermore, in Europe in 2020, Transports is the single largest end-use sector, accounting for 31.7% of total energy consumption. Fossil fu-

els account for the majority of the fuel utilized in the industry (ECEEE, 2022).

Energy consumption is directly related to transportation and economy. Economic development is connected with rising levels of energy consumption, with the quantity of work produced increasing as energy consumption increases (Rodrigue, 2020). Due to this strong relationship between energy and the economy, the increase or decrease in energy prices directly affects transportation and transportation-based energy consumption. We should consider transportation as a whole, not just passengers or regular users, and it should not be forgotten that one of the most important issues is freight transportation. Transportation is less of an economic burden the lower the energy costs per ton or passenger-kilometer. In a global economy, overcoming space needs a significant quantity of energy and is thus vulnerable to economies of scale. During the time that cargo has to be wrapped, sorted, and unbundled, vehicles and terminal equipment use energy (Rodrigue, 2020). As the development level and economic growth of countries increase, energy consumption also increases. While the USA was the country where energy was consumed the most for many years among others, there has been a significant shift in terms of energy consumption to China and India recently. There has been a decrease in the use of fossil fuels due to the use of clean energy sources in the USA and European Union members, especially with the steps taken within the scope of protecting the natural environment, such as "green consumption", which has been mostly adopted recently. However, the rise of China in particular continues. (Figure 5). Commercially traded fuels, including electricity-producing renewables, constitute primary energy which is shown in Figure 5.

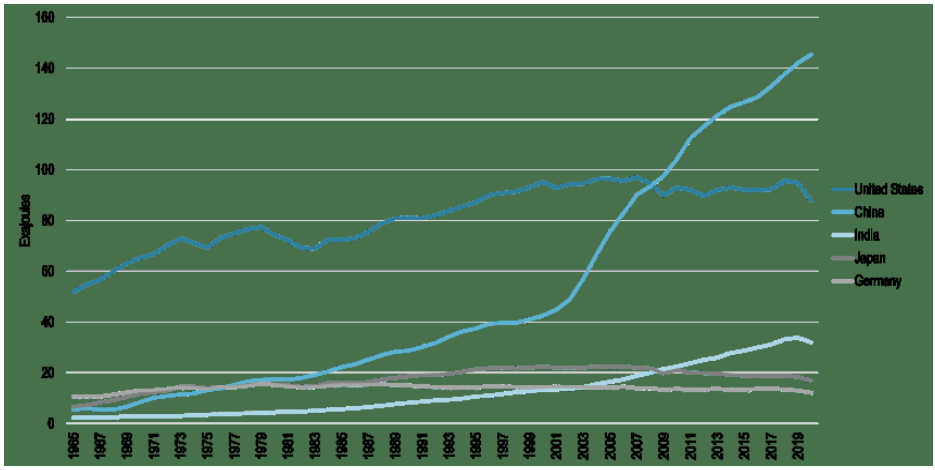

Figure 5. Primary Energy Consumption, 1965 - 2020

Especially in the last decades, due to the externalities of transportation, countries have started to determine approaches such as reducing their carbon footprint and vision zero. Efforts are being made to reduce externalities that threaten public health, such as climate change, air pollution, water pollution, and noise pollution by traffic. The concept of sustainability, which has been seen in almost every field recently, has been developed and the steps to be taken are defined and 17 sustainable development goals have been determined by the United Nations (U.N., 2015). The achievement of sustainable development goals in 2015 actually shows how late humankind is in taking these necessary steps.

There is a tendency for a rapid transition from fossil fuel use to electric vehicle use in transportation. The increase in the production and sales of electric vehicles and the declarations that the production of fossil fuel vehicles will be gradually reduced clearly express this situation. However, it is questionable how many cities are prepared to have electric vehicles on the road. In particular, it is not clear which method will be followed for the production of electrical energy, what kind of infrastructure the electrical energy will serve throughout the city, and what a budget investment and how long the construction-maintenance-repair work is required to make the infrastructure ready.

Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) are fuels that have started to be preferred frequently recently. These fuels are quite advantageous compared to fossil fuels in terms of gas emissions from vehicles on the road. LNG is kept at a very low temperature where it turns into a liquid (OECD, 2019). Countries invest on CNG and LNG infrastructure, especially in Europe. About 300 additional CNG stations have been built since 2020, an increase of 8,1%. At the same period, the number of LNG stations increased dramatically by 60%, going from roughly 250 to 400. The registration of similar LNG vehicles reflects this significant rise (NGVA Europe, 2021).

TRANSPORTATION IMPACTS on PUBLIC HEALTH

Transportation is one of the most important component of the economy and urban development. On the one hand, it contributes to economic and urban development, on the other hand, it threatens public health due to its high energy consumption and negative effects of the used fuels. The effect varies according to the type of fuel or energy source used by the vehicles. That is why; most studies are focused on new technologies that can use different and less harmful resources.

Environmental effects caused by transportation are generally classified as global climate change due to greenhouse gas emissions, harmful gas emissions, soil pollution due to land use, pollution of underground water resources, and noise emission. In addition to these classifications, traffic congestion increases the level of the above-mentioned effects. Due to the increase in waiting time in traffic, in addition to its environmental effects, it also increases the time spent by the users in traffic and also causes time costs.

Traffic Congestion

Traffic is seen one of the major problems in cities. Especially in crowded cities, mostly studies try to find optimal solution on roads and junctions in order to reduce travel time of the users. Due to the time-spent of vehicles on the road increases, harmful effects of traffic related emissions rises. It is possible to assess the significance of the harm

caused by traffic emissions by taking into account that areas with significant traffic are frequently locations with dense populations.

Istanbul tops the list of cities with the most crowded roads (Tomtom, 2022). According to official data, in Istanbul, which has a population of 15,840,900 (TUIK, 2022), and trips made by public transport are more than 8 million (IETT, 2022). In Istanbul, the average travel time for one direction is 50 minutes, and approximately 226 hours of extra time is spent in traffic in a year due to traffic congestion (Tomtom, 2022).

According to the data obtained from IETT for a sample day, the total number of trips made by public transportation vehicles in Istanbul on Thursday, 3.11.2022 is approximately 8 million. Considering the distribution among public transportation modes, the most trips are made by bus (43.4%), and the second most preferred mode of public transportation is the subway (33.3%). Metrobus, which carries more than 1 million passengers in both directions in a day, is seen as the most important component of the Istanbul public transportation system (12.5%). On the other hand, the share of maritime transport in Istanbul is only 2% (Table 1).

Table 1. Distribution of Public Transport trips by Modes

Report Date	09/11/2022	
Modes	No. of trips	Percentage
Ferryboat	195,989	2.4%
Bus	3,497,957	43.4%
Metrobus	1,007,430	12.5%
Marmaray (Turkish Republic State Railways)	653,763	8.1%
Metro (Istanbul Metropolitan Municipality)	2,682,490	33.3%
Nostalgic Tramway	922	0.0%
Tunnel	12,327	0.2%
TOTAL	8,050,878	

However, it is not known or shared by official institutions the shares of private vehicles, bicycles, or walking modes. Nevertheless, according to the data published by the European Environment Agency, 61.6% of the trips are made by private vehicles, 36.6% by bus and 1.7% by rail system. In Europe, likewise, the trips are made by private vehicles mostly which is around 80% (EEA, 2015).

Air Quality

The environmental impacts of transportation are not limited to greenhouse gases. At the same time, carbon monoxide, nitrogen oxide, silicon tetrafluoride, volatile compounds, heavy metals and particulate matter are also released by the transport sector. Toxic air pollutants appear to be associated with cancer, cardiovascular, respiratory and neurological diseases (Lee BJ, 2014).

Our cities are growing unplanned in many places due to the rapidly increasing world population. In cities that grow in a planned way, the highway connects every point of the settlement and creates the circulation system of the city. The way to avoid air pollution caused by traafic on roads is improven vehicle technology and switch to electric vehicles. There has been an increasing demand for electric vehicles in the world recently. Over 6.5 million electric vehicles were sold globally in 2021. Furthermore, by 2030, 55% of all new automobile sales in Europe will be entirely electric (Tridens, 2022).

Global Climate Change

Global climate change has started to attract the attention towards the end of the 20th century in particular. In general, the sectors contributing to climate change can be classified as built environment, power industry, other industries, agriculture, other sectors and transportation. It is calculated that the contribution of transportation to global climate change is around 25%. According to the estimates, if current conditions continue, this rate is expected to reach 50% by 2050 (UN, 2022). Figure 6 shows that the largest share of carbon dioxide emissions belongs to the energy sector. However, the contribution of transportation is around 22%.

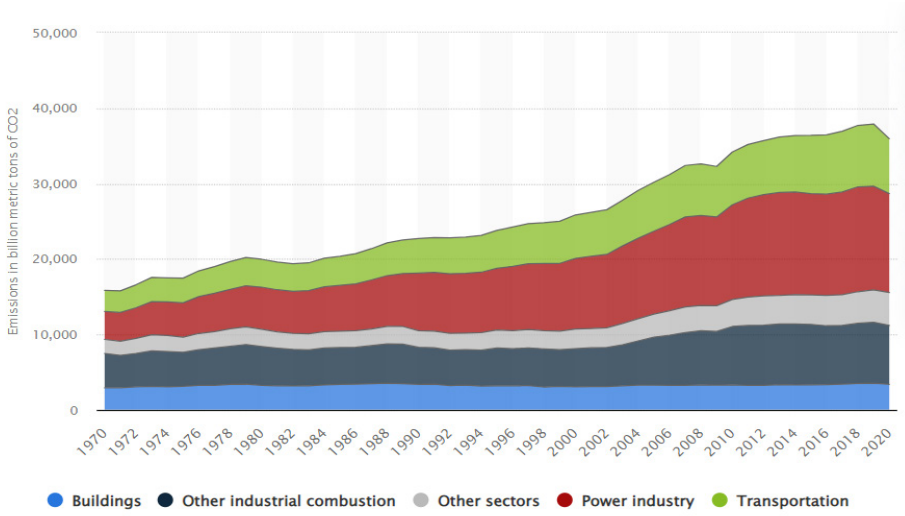

Figure 6. Worldwide Carbon Dioxide Emissions in 2020, Broken Down by Industry
Source: (Statista, 2022)

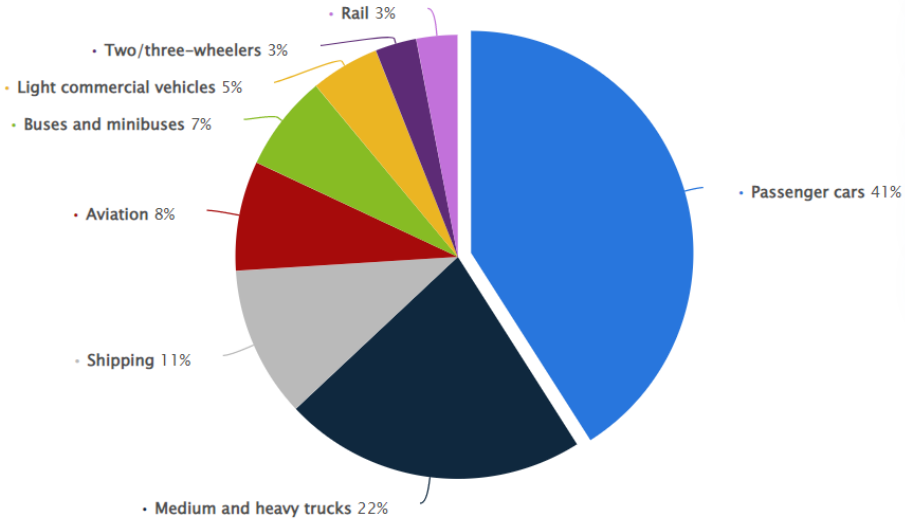

Figure 7. Distribution of Global Transportation Industry Carbon Dioxide Emissions in 2020
Source: (Statista, 2022)

The most contributor of the gas emissions that effect the rate of climate change is passenger car by 41%, and it is followed by medium and heavy trucks by 22%. As a result of Figure 7 one of the mostly preferred approach is reducing the number of passenger car on the traffic by sharing car applications.

Global climate change is one of the most important issues that threaten human life and change peoples' behavior and daily lifestyle. According to data published by the National Aeronautics and Space Administration (NASA), the global temperature is 1.01 degrees (NASA, 2022). However, according to NASA:

- Since the late 19th century, the planet's average surface temperature has increased by nearly 1 degree Celsius, and 2016 and 2020 are now tied as the hottest years on record.
- Most of this extra heat has been absorbed by the ocean, which has warmed by more than 0.33 degrees Celsius since 1969 in its upper 100 meters.
- The Antarctic and Greenland ice sheets have lost mass. According to data from NASA's Gravity Recovery and Climate Experiment, between 1993 and 2019, Greenland lost an average of 279 billion tons of ice each year, while Antarctica lost roughly 148 billion tons.
- In the last century, the sea level worldwide increased by around 20 cm. However, the rate during the past two decades has roughly doubled that of the previous century and is marginally increasing each year.
- Since 1950, the number of record high temperature occurrences in the US has been rising while the number of record low temperature occurrences has been falling.
- The acidity of ocean surface waters has grown by around 30% since the start of the Industrial Revolution. The reason for this rise is that people are releasing more carbon dioxide into the atmosphere, which causes more of it to be absorbed by the ocean.

The main contributor to the global warming is greenhouse gases. As EPA states that the loss of heat to space is slowed or prevented by par-

ticular gases in the atmosphere that absorb energy. They are referred to as "greenhouse gases." They operate as a blanket, insulating the ground from the outside temperature. The "greenhouse effect" is a term used to describe this natural and vital activity (EPA, 2022).

Noise

Environmental noise is one of the most important factors affecting the quality of life of people. The World Health Organization (WHO) estimates that 1-1.6 million healthy life-years are lost to traffic-related noise each year in Europe. Environmental noise is also linked to irritation, sleep disruption, cardiovascular illness, cognitive impairment, hearing impairment, and tinnitus (WHO, 2011). On the other hand, poor mental health has been linked to residential exposure to environmental noise (Li, Martino, Mansour, & Bentley, 2022). Additionally, exposure to noise levels of more than 70 dB from traffic revealed a higher risk of hearing loss (Wang, ve diğerleri, 2021). Figure 8 demonstrates that noise emissions are mostly generated by road transport as it is expected. Especially L_{den} level differences between road, and the rest is huge which means road-related noise affect individuals almost in each hour in a day.

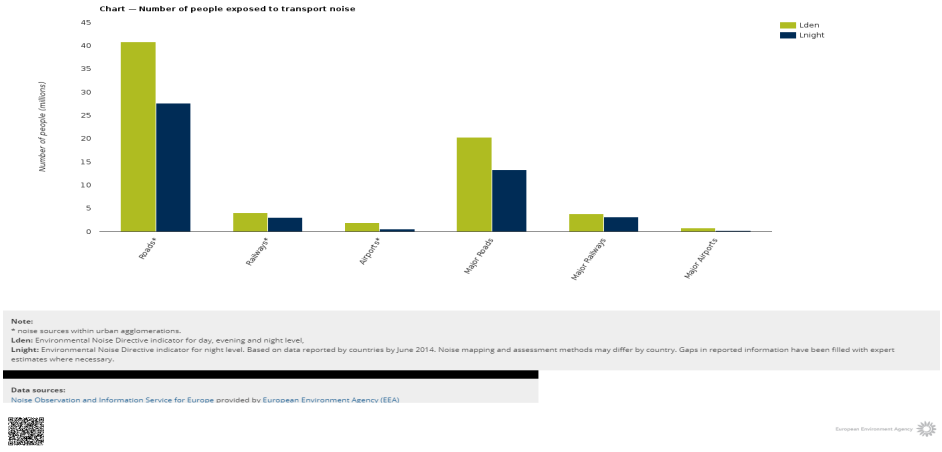

Figure 8. Number of Individuals Exposed to Noise From Transportation Source: (EEA, Number of People Exposed to Transport Noise, 2016)

The areas that need to be protected from the effects of noise on public health should be determined. Regulations are generally made by local or central administrations for the management of noise. In these regulations, the determined sensitive areas having priority to be protected from environmental noise are residences, educational areas and hospital buildings. Residential structures are especially protected in order to reduce the sleep disturbance effect of noise. In order to minimize the effects of noise such as loss of motivation, auditory and psychological factors, and heart diseases, measures to be taken at the receiver, between the receiver and the source, or at the source. These alternative solutions are investigated and implemented when it is necessary and demanded.

DISCUSSION

Transportation system can be defined as the circulatory system of cities and habitat. There is a close relationship between transportation and several significant variables, including urban economics, mobility, development areas, and quality of life in cities. Especially during the pandemic period, urban freight transportation has increased its place in urban life, with situations such as remote working and staying at home. Although the increase in urban passenger and freight mobility is important within the scope of urban mobility and vitality, this increase in the demand for mobility also threatens public health paradoxically.

Public health, regardless of the level of development of the countries and without being seen as a luxury, should be one of the top priority areas that local and central governments should allocate resources to. Therefore, at the beginning of the steps to be taken to increase the quality of life, the transformation of the transportation system within the framework of the concept of environmental sustainability is required. By transforming the fuel types to be used in the transportation system, air quality can be improved and its contribution to global climate change can be reduced. At the same time, the number of people exposed to high noise levels can be reduced by decreasing speed limits on the roads or noise barriers, or urban development areas can be determined in accordance with both gas and noise emission.

In particular, in developing countries, transportation plans and urban planning studies are often carried out separately and these plans are not made in an integrated manner. For this reason, concepts such as simultaneous and combined plans, 15 minute-cities, slow urban movement, or green transformation in transportation should be more easily implemented in cities, especially in the developing countries. In conclusion, if environmental sustainability in transportation cannot be achieved, it would be realism, not pessimism, to say that smogy future awaits us and next generations.

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EVALUATION OF DIFFERENT PLAN TYPES IN FACULTY BUILDINGS BY SPACE SYNTAX METHOD

Beyza Nur ÇALIŞKAN[1], Süheyla BÜYÜKŞAHİN[2]

Abstract: The spatial organization of the plan types used in the faculty buildings greatly affects the level of accessibility. In this context, it is aimed to examine the accessibility of four faculty buildings with L, U, complex and chaotic plan types. Within the scope of the study, space syntax analysis was performed and the integration, connectivity and mean depth parameters of the buildings were compared. With solutions such as increasing the number of interconnected blocks in buildings, breaking the linearity of corridors by branching, the integration value and connectivity of spaces decreases and their depth increases. This situation negatively affects accessibility. Solutions that make it difficult to access places have negative effects on spatial perception and user satisfaction, while reducing efficiency in education. For this reason, it is recommended to develop new spatial analysis techniques such as space syntax method in architectural design and to be included in planning by designers.

Keywords: Faculty Building, Plan Type, Space Syntax, Integration, Mean Depth

INTRODUCTION

The units where all undergraduate and graduate education and training activities are carried out in a university campus are located in the area called the academic region. The places used for educational purpos-

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es and the administrative spaces associated with them are mostly gathered in the buildings called faculties. The main function of universities is also carried out in these buildings. The basic departments that make up a faculty building are education, administrative and social units. The spatial organization is provided by the relations between these units. The circulation line, where the units come together and the connections between the spaces are provided, constitute the plan schemes. Specific plan schemes are often used for educational structures, but there are important differences between them. This difference in the organization of the space and the circulation line affects the accessibility of the spaces.

In this context, it is aimed to examine the accessibility of different plan types used for faculty buildings. Within the scope of the study, four plan types named as L, U, complex and chaotic were selected from simple to complex. Space syntax analysis was used as a method for the syntactic analysis of the plans. Integration, mean depth and connectivity parameters of the faculties were determined. The data were taken from the Syntax 2D program. Findings are expressed with visualized maps and numerical values. The average value of the parameters used in the analysis was evaluated comparatively in the form of a table.

SPATIAL ORGANIZATION İN EDUCATIONAL BUILDINGS

The basic unit of a faculty building is the educational units consisting of classrooms, lecture halls, workshops and studios where the formal process of education is carried out. These units are the basis of the spatial organization and the formation of the plan scheme. All other areas develop around these units. Administrative and common areas are directly related to educational units. Administrative units consist of the dean's office, department heads, teaching staff rooms and a meeting room. Common areas are conference and show halls, computer laboratories, library, canteen, cafeteria, etc. consists of eating, drinking and resting places. It is seen that these units are arranged in different blocks in the same building or on different floors in the same block.

The fact that educational structures have become more complex and contain more different types of fields has also led to a change in spatial

organization. This evolution gave rise to two different types of spatial organization as the combined classes were further divided into space. These are corridor type and central type organization (Figure 1). The corridor, which meets the circulation function in the corridor-type organization, provides access to the classrooms for students and lecturers. In the central type organization, the area in the center of the classrooms not only serves as a circulation function, but is also used as a socialization space (Pasalar, 2003).

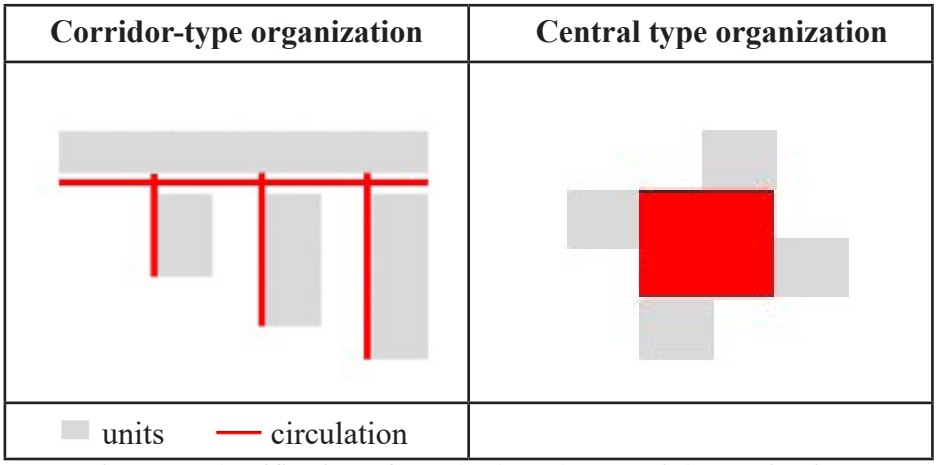
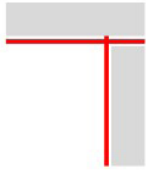
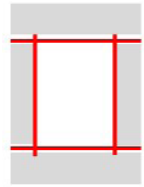
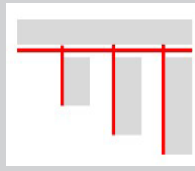
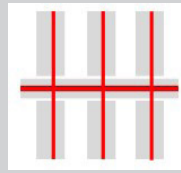
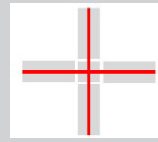
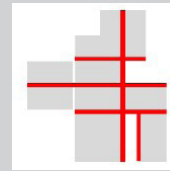


Figure 1. Classification of Pasalar based on spatial organization (Pasalar 2003)

As in the design of every type of building, certain spatial relationships and related schemas are formed in educational buildings. The element that plays a decisive role in the formation of plan schemes in educational buildings is circulation. Due to reasons such as the high number of students and the uniformity of the classrooms, mostly corridor-type spatial organizations are seen in the faculty buildings. According to Çalışkan (2021), there are ten different plan schemes as linear, U, L, T, courtyard, comb type, double comb type, complex, cross type and chaotic (Table 1).

Table 1. Plan Schemes of Faculty Buildings (Çalışkan, 2021)

Type	Linear Plan	L Plan	U Plan	Courtyard	Complex
Schematic representation					

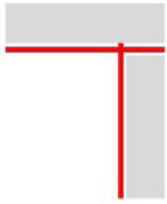
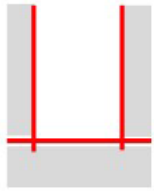
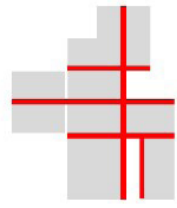
Type T Plan	Comb type	Double comb type	Crosstype	Chaotic
Schematic representation					

units
circulation

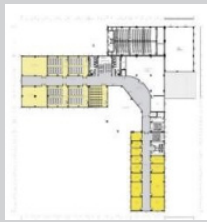
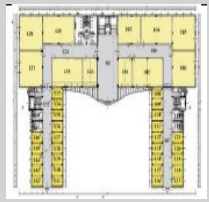
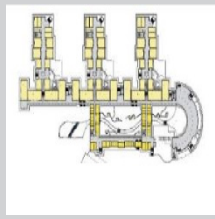
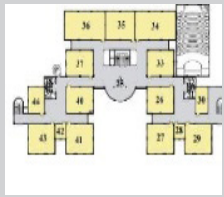
SCOPE & METHODOLOGY

Within the scope of the study, four different faculty buildings with L, U, complex and chaotic plan types from simple to complex, were selected on the Yozgat Bozok University campus (Table 2).

Table 2. Plan Types Selected Within the Scope of the Study

Type	L Plan	U Plan	Complex	Chaotic
Schematic representation				

Plans of sample buildings

Circulation
Common areas
Educational units
Academic staff rooms

L Plan Type

This building, which has an L-plan scheme, consists of two floors above ground level (Table 3). The entrance to the building is on the ground floor and the same entrance is used for students and academic staff. In the administrative section on the ground floor; There are administrative units such as the principal's room, assistant principals' rooms, secretary rooms, a meeting room and student affairs. In the common area, there are canteen, conference hall, gym and internet rooms. The first and second floor plans are the same, and each floor has an exhibition hall, eleven academic staff rooms and a meeting room. In the education section, there are seven classrooms, five of which are classrooms and two are laboratories.

Table 3. L Plan Type

Ground floor plan

First floor plan

Second floor plan

Circulation
Common areas Educational units Academic staff rooms

U Plan Type

This building, which has a U-plan scheme, consists of three floors above ground level (Table 4). The entrance to the building is on the ground floor and there are three different entrances, one student entrance and two administrative entrances. On the ground floor, there are twenty-six academic staff rooms, thirteen in the right arm and thirteen in the left arm. In the common area, there is a canteen, student club rooms, student affairs and a conference hall. In the administrative section on the right arm on the first floor; There are administrative units such as the principal's room, assistant principals' rooms, secretary rooms and meeting rooms, thirteen academic staff rooms on the left arm, and eleven classrooms above the common areas. On the second floor, there are twenty-six academic staff rooms, thirteen on the right arm and thirteen on the left arm, and eleven classrooms. On the third floor, there are six academic staff rooms, three on the right and three on the left, and eleven classrooms

Table 4. U Plan Type

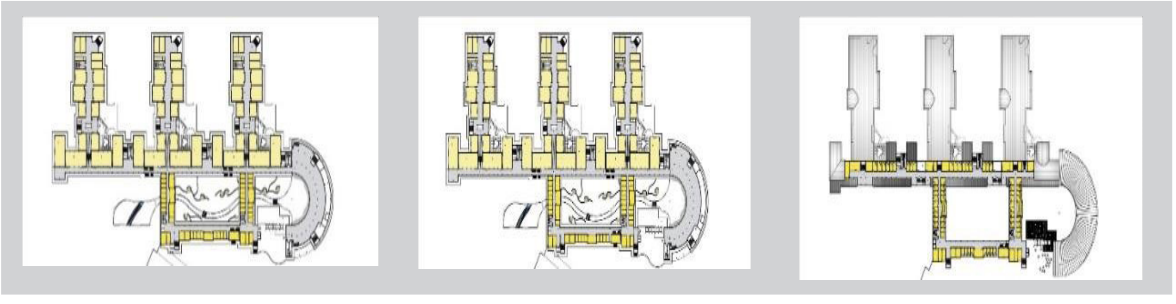
Ground floor plan First floor plan Second floor plan Third floor plan

Circulation Common areas Educational units Academic staff rooms

Complex Plan Type

This building, which has a complex plan scheme, consists of three different plan schemes (Table 5). The first diagram is the U diagram with the closed courtyard where the administrative section is located, the second diagram is the linear diagram with the education section, and the third diagram is the circular diagram with the open courtyard where the social section is located.

Table 5. Complex Plan Type



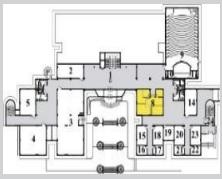
Ground floor plan First floor plan Second floor plan

Circulation Common areas Educational units Academic staff rooms

Chaotic Plan Type

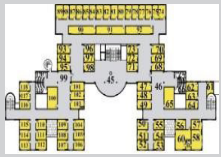
This building, which has a chaotic plan scheme, consists of three floors above ground level (Table 6). The entrance to the building is made in two ways, on the ground floor, as student entrance and academic staff entrance. On the ground floor, there are student affairs, conference hall, canteen and student club rooms. There are only fifteen classrooms on the first floor. On the second floor, there are the administrative section and fifty-five academic staff rooms, and on the third floor there are thirty-three academic staff rooms.

Table 6. Chaotic Plan Type

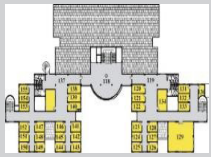


Ground floor plan

First floor plan



Second floor plan



Third floor plan

Circulation Common areas Educational units Academic staff rooms

Space Syntax Methodology

Space syntax; It is a system that analyzes spatial organization, first developed by the team created by Bill Hillier and Julienne Hanson. It is used in many fields such as architecture and urban planning as a method that expresses the relationship between spaces and the formula of coming together with numerical and graphical data.

Hillier and Hanson (1984) state that the spatial syntax theory basically aims to reach the following information about the relationship between space and space parts;

- To find the most basic structures of the system, and within this framework all the variations of human spatial organization are revealed,
- Representing these basic structures by some kind of signs or formulas to avoid repeated verbal expressions,

- To show how these basic structures are harmoniously related to each other,
- To show how these structures come together to form more complex structures.

The parameters of the space syntax method are divided into integration value, depth (mean depth), isovist area, isovist perimeter, circularity, connectivity. Each parameter is important in order to interpret the different features of the space. A high integration value, which indicates the distance to a place in the system from other places in the system, means that easy and direct access to that place is provided. The high depth value, which expresses the average depth of a space in the system to all other spaces, indicates that it is difficult to access that space. The connectivity value is the measurement of the number of adjacent spaces directly connected to the space. If a space is located in the central areas of the system, the number of partitions around it is high; This indicates a high connectivity value and also indicates that it is integrated within the system. On the other hand, as a space moves out of the system, the number of spaces it is connected to decreases, the connectivity value decreases, the integration decreases, and the depth increases. Integration graphs have a color scale from red to blue. Red indicates the most integrated, most connected, and least deep areas. On the contrary, blue shows the areas with the lowest integration and connectivity, and therefore the areas with the greatest depth. (Büyükşahin Sıramkaya 2015).

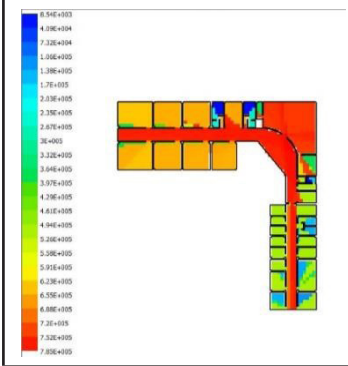
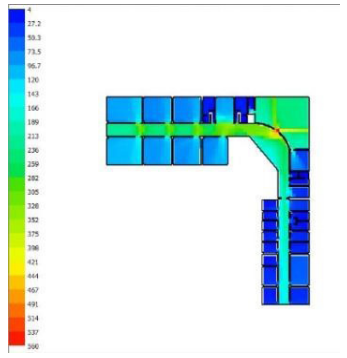
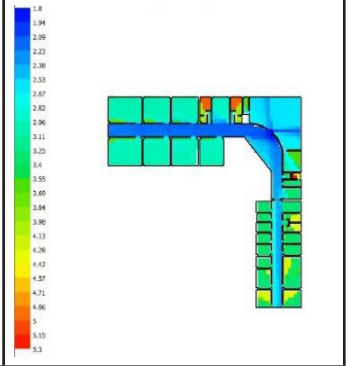
In accordance with the purpose of the study, space syntax parameters for accessibility research are limited to integration, depth and connectivity parameters. Data are taken from Syntax 2D software produced by the University of Michigan. Findings are expressed with visualized maps and numerical values. In order to interpret the data correctly, a comparative evaluation was made. The mean values of the parameters used in the analysis for each faculty were compared.

FINDINGS

When the graphics of the faculty with L plan type are examined;

In the integration graph; Intense red area has been detected in the corridors providing horizontal circulation and the floor hall, which is the intersection point of both linear blocks. The gym and the library, which open directly to the floor hall, appear in red as a place. The orange areas are used as classrooms, the green areas are used as academic staff rooms, and the blue areas are used as toilets. According to the map, it seems that the classrooms are more integrated than the rooms. In the connectivity graph; The fact that the value of the classrooms is higher than the rooms indicates that these spaces are more integrated and more accessible. In the depth graph; It is seen that the depth of the corridor of the rooms has increased compared to the corridor of the classroom, and its accessibility has decreased. According to the results of the syntactic analysis, the integration value is 1008, the connectivity value is determined as 174 and the mean depth value as 2937 (Table 7).

Table 7. Syntactic Graphics and Parameters of L Plan Type

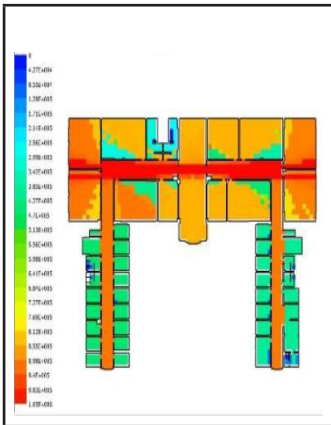
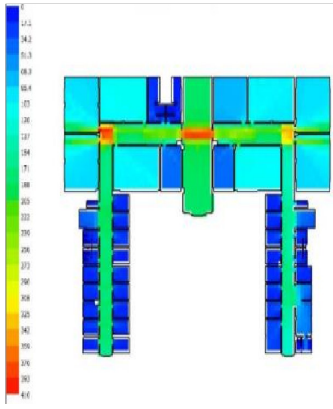
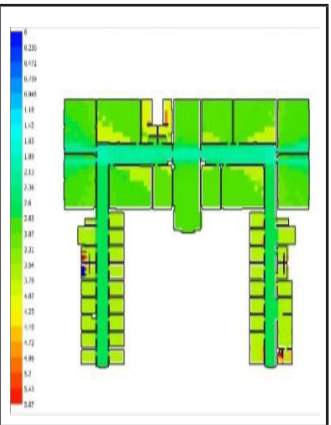
		
Integration: 1008	Connectivity: 174	Mean depth: 2937

When the graphics of the faculty with the U plan type are examined;

In the integration graph; The corridors of the middle block where the classrooms are located are red, and the corridors of the blocks where the academic staff rooms are located are orange. The fact that the rooms are green, the classrooms are orange, and the integration value of the rooms is lower than the classrooms, indicates that they are less accessible. In the connectivity graph; In the classroom block, the turning points where all

four classrooms are opened and the floor hall appear in red. This indicates that these spaces are more integrated than others. According to the results of the syntactic analysis, the integration value was 781, the connectivity value was 111, and the mean depth value was 2986 (Table 8).

Table 8. Syntactic Graphics and Parameters of U Plan Type

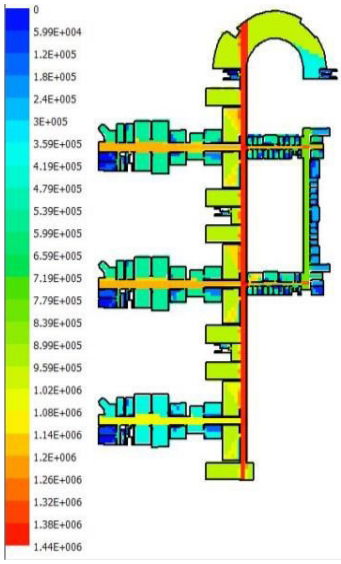
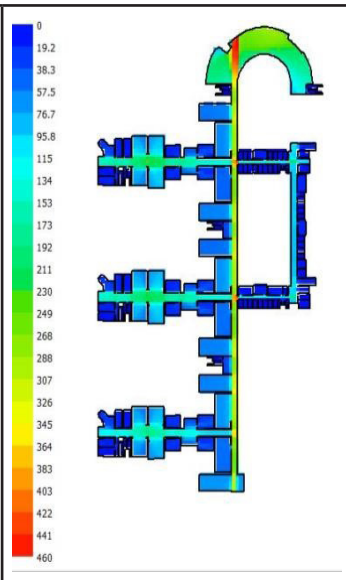
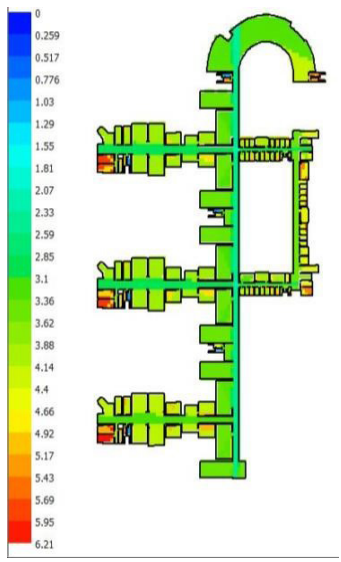
		
Integration: 781	Connectivity: 111	Mean depth: 2986

When the graphics of the faculty with a complex plan type are examined;

In the integration graph; The main corridor connecting the blocks is in red in the corridors that provide circulation, and the corridors in the blocks where the classrooms are located and the blocks where the academic staff rooms are located are in orange. This indicates that the main corridor is more integrated than the inner-block corridors. It is seen that the rooms far from the main corridor are in blue in the block where the 2 classrooms at the end of the education blocks and the U-plan type academic staff rooms are located. As you move away from the corridor, which is the most integrated space of the building, the integration value of the spaces decreases. In the connectivity graph; It is seen that the main corridor connecting the blocks and the corridors connecting the classrooms or the rooms within the block have a higher connection value compared to other spaces. This shows that the main corridor is more integrated and accessible compared to the others. In the depth graph;

The fact that the 2 classrooms at the end of the classroom blocks are red and high value indicates that the depth is too high and the accessibility is low. According to the results of the syntactic analysis, the integration value was 759, the connectivity value was 102, and the mean depth value was 3502 (Table 9).

Table 9. Syntactic Graphics and Parameters of Complex Plan Type

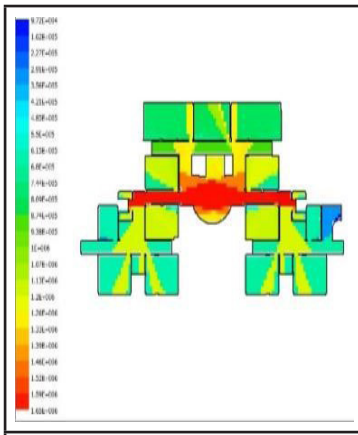
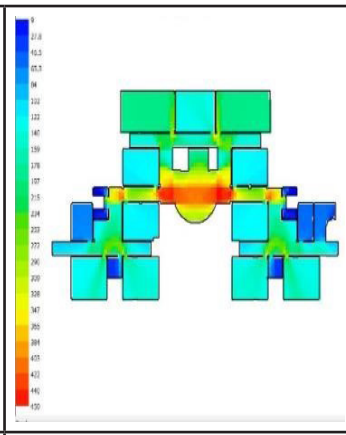
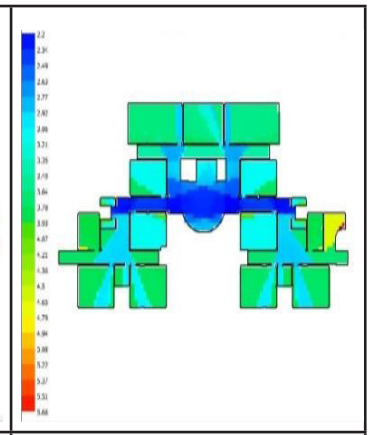
		
Integration: 759	Connectivity: 102	Mean depth: 3502

When the graphics of the faculty with the chaotic plan type are examined;

In the integration graph; it is seen that the floor hall is red and the corridors are yellow. In this case, the most integrated space of the building is the floor hall. In the connectivity graph; It shows that the floor hall is connected to more spaces than other spaces. Therefore, it proves that it is the most integrated space. The stairs, which are expected to be the most connected in a building, appear to be blue in this building. This indicates that the accessibility of the stairs is poor. In the depth graph; The most integrated and most connected floor hall depth value appears to be the least space. According to the results of the syntactic analysis, the

integration value was 622, the connectivity value was 132, and the mean depth value was 3307 (Table 10).

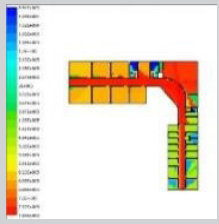
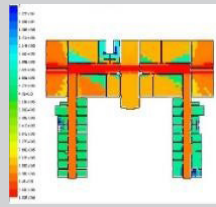
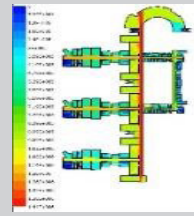
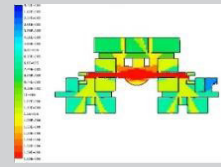
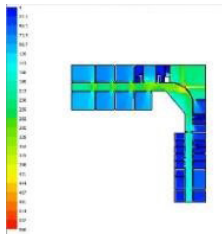
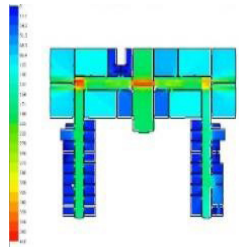
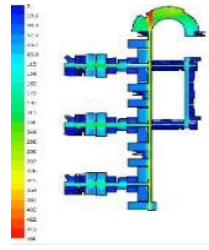
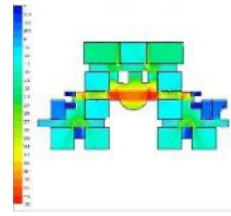
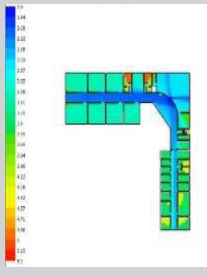
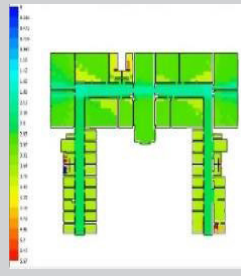
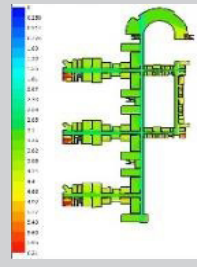
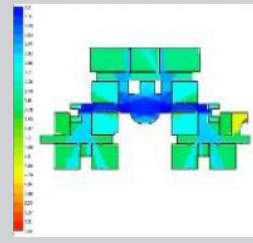
Table 10. Syntactic Graphics and Parameters of Chaotic Plan Type.

		
Integration: 622	Connectivity: 132	Mean depth: 3307

When a comparative evaluation is made (Table 11);

- According to the average integration values, the plan type with the highest value was determined as the L plan. The values decrease as U, complex and chaotic, respectively.
- According to the average connectivity values, the plan type with the highest value was determined as the L plan. The values decrease as chaotic, U and complex, respectively.
- The plan type with the lowest value according to the average depth values was determined as the L plan. The values increase as U, chaotic and complex, respectively.

Table 11. Comparative Space Syntax Analysis.

	L plan	U plan	Complex plan	Chaotic plan
Integration Analysis				
Graph				
Average value	1008	781	759	622
Connectivity Analysis				
Graph				
Average value	174	111	102	132
Mean Depth Analysis				
Graph				
Average value	2937	2986	3502	3307

CONCLUSION

Within the scope of the study aiming to examine the accessibility of the faculty buildings with different plan types, four faculty buildings with L, U, complex and chaotic plan types on the Yozgat Bozok University campus were examined.

The results obtained in the space syntax analysis are as follows;

As the number of interconnected blocks increases, the node point increases. This situation reduces the integration value, increases the depth value and negatively affects the accessibility. In the block where the classrooms are located, the depth of the classrooms connected to the corridor is low, while the depth of the classrooms accessed from another corridor connected to the corridor is high. This situation negatively affects the accessibility of the spaces that are indirectly accessed from the main corridor, as in the complex plan type. All classrooms of the same quality must be connected to a single corridor. In the use of corridors that do not have a certain linearity and order, the integration value is lower than other corridor types, as in the chaotic plan type. This situation negatively affects the relationship of corridors, which are the most connected spaces in buildings, with other spaces.

Finally, the spatial organization of the plan types used in the faculty buildings greatly affects the level of accessibility. Solutions that make it difficult to access places have negative effects on spatial perception and user satisfaction, while reducing efficiency in education. Considering the effect of design factors in increasing efficiency, it is suggested that new spatial analysis techniques such as space syntax method in architectural design should be developed and included in planning by designers for a quality educational building.

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AVAILABILITY OF RENEWABLE ENERGY SOURCES ON SHIPS

Kubilay BAYRAMOĞLU[1]

Abstract: Today, global and greenhouse effect warming has become one of the most important problems in terms of both the environment and human health. While the main components causing global warming are carbon emissions, the greenhouse effect is caused by nitrous oxide and sulphur oxide emissions. Heavy fuel oil and marine diesel oil used as fuel on ships. These fuels cause sulphur emissions due to the presence of sulphur in their structure. In addition, the use of marine diesel engines for two periods on ships and the combustion of fuels specified as fuel also cause the formation of carbon and nitrogen oxide emissions. Various regulations have been introduced by the International Maritime Organization (IMO) to reduce emissions from ships. These regulations are basically applied in three different ways to reduce harmful emissions in the exhaust gas. The first of these is to change the basic engine combustion parameters, the second is to capture harmful gases with chemical processes in the exhaust system and lastly, the use of alternative fuels and renewable energy sources. In this study, alternative energy sources that do not generate emissions such as wind, solar and fuel cells that are likely to be used on ships have been investigated. The potential of these energy sources to meet the Emission Limits enacted by IMO has been evaluated. As a result of the study, ships thrusted by the wind and their applications are presented comparatively. Solar energy, on the other hand, was put into practice for the first time as of 2000. Finally, the usability of fuel cells on ships was evaluated. Fuel cells are one of the most likely energy sources to be used for ship propulsion in the future, after the use of hydrogen.

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Thus, alternative renewable energy sources that can be used to reduce emissions in the future are presented comparatively.

Keywords: IMO-MARPOL, Ship Propulsion Systems, Fuel Cell, Emissions

INTRODUCTION

The fact that 90% of the world's transportation is provided by ships also brings the need to regulate the fuel and propulsion systems used on ships. Considering the development of ships and floating vessels in the last century, it is seen that there are significant changes in propulsion and fuel systems. It is known that especially the first floating vehicles were shipped with the wind and then evolved into internal combustion engines with steam. In the recent past, Heavy Fuel Oil (HFO) is used first, and then Marine Diesel Oil (MDO) fuel is used before the fossil fuels used (Yiğit, 2018).

As a result of the burning of fossil fuels on ships, different problems arise in terms of both environmental and human health. The one of the most important in the formation of these problems belongs to internal combustion engines, especially marine diesel engines that use heavy fuel oil. It is known that in the port areas where the ships dock, harmful gases originating from the marine diesel fuel used spread around 400 km. In addition, it is pointed out that approximately 60,000 cardiopulmonary deaths occur as a result of air pollution from ships. Emissions from ships are estimated to account for about 3% of global CO_2 emissions, about 20% of global NO_X emissions, and about 13% of global SO_X emissions. (Razy-Yanuv, arak, Noam ve Madar, 2022; Samosir, Markert ve Busse, 2017). Figure 1 Expresses the NO_X and SO_X emission rates of international transport according to variable sectors.

As can be seen from the graph given, a significant portion of global emissions is caused by ship based transportation. It has been stated above that these emissions may spread to rivers, ports and the surrounding environment. Disease costs, international transport $PM_{2.5}$ and ozone air pollution due to approximately 62,000 deaths and $156 billion in health problems annually (Razy-Yanuv ve diğerleri, 2022).

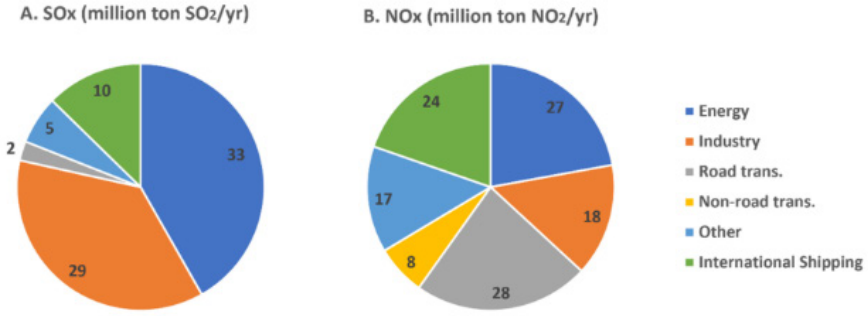


Figure 1. Annual Emission Amounts of Different Sectors

In order to reduce emissions from ships, the international maritime organization (IMO) has introduced different regulations. The first of these regulations aims to reduce NO_X emissions. In order to minimize NO_X emissions from ships, three new regulations were introduced by IMO, the first of which was January 1, 2000. Figure 2 represents the variation of NO_X emissions from ships with engine speed. (Chu Van, Ramirez, Rainey, Ristovski ve Brown, 2019)future marine fuel mix and ship emissions. IMO limited marine fuel sulphur content in both Sulphur Emission Control Areas (SECAs.

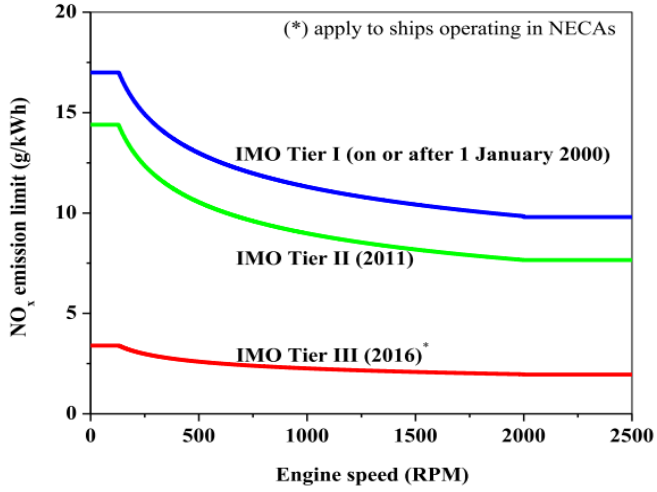


Figure 2. IMO NOX Emission Limitations

According to the NO_X regulation, which entered into force within the scope of IMO MARPOL Annex 6, the emission limits for Tier I are 17 g/kWh for two-stroke low-speed marine diesel engines, and this limitation has been reduced to 3.4 g/kWh with the new regulation introduced on January 1, 2016. With the regulations made, it is aimed to reduce the Tier III NO_X emission limitation by approximately 80% compared to the Tier I regulation. Table 1 expresses the variation of NO_X emissions from ships according to engine speed (Deng ve diğerleri, 2021).

Table 1. MARPOL Annex VI NO_X Emission Limitation

Tier	Date	NO_X, g/kWh		
		v<130	130≤v<2000	v≥2000
Tier I	2000	17.0	45 $v^{-0.2}$	9,8
Tier II	2011	14,4	44 $v^{-0.23}$	7.7
Tier III	2016	3,4	9 $v^{-0.2}$	1,96

The main purpose of reducing NO_X emissions is to reduce the greenhouse effect. As it is known, another harmful gas that causes the greenhouse effect is SO_X emissions. Water vapor in the air combines with NO_X and SO_X gases, causing acid rain (Bilgen ve Sarikaya, 2015) ecology and sustainable development implications are reviewed in this study. There is perfect relationship between environment, ecology and sustainable development. If a proper balance is maintained among these three aspects then exergy for the welfare of human being is obtained. Efficient energy use which requires exergy analysis is a key solution to the environmental problems. A primary aim of minimizing the environmental impact is to increase the efficiency and decrease the related overall environmental impacts such as global warming, ozone depletion, and acid rain. This study has been written with a view to draw attention and to examine the range of views for integration of exergy for environment, ecology and sustainable development. Much of the information presented in this study is basically to acquire an understanding of exergy relations with environment, ecology and sustainable development. This study will be useful for those involved in

exergy activities and planning.","author":[{"dropping-particle":"","family":"Bilgen","given":"Selçuk","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-particle":"","family":"Sarikaya","given":"Ikbal","non-dropping-particle":"","parse-names":false,"suffix":""}],"container-title":"Renewable and Sustainable Energy Reviews","id":"ITEM-1","issued":{"date-parts":[["2015"]]},"page":"1115-1131","title":"Exergy for environment, ecology and sustainable development","type":"article-journal","volume":"51"},"uris":["http://www.mendeley.com/documents/?uuid=f8f7cecc-72eb-491d-9c30-9cdb867e286c"]}],"mendeley":{"formattedCitation":"(Bilgen ve Sarikaya, 2015. In order to reduce SO_X emissions from ships, the first regulations were introduced in 2010 within the scope of IMO MARPOL (Peter ve Williams, 2010)to provide a background to the natural cycles of carbon and sulfur in the oceans, along with essential reference data; second, to outline the behaviour of the seawater carbonate buffer system and how it responds to additions of the combustion gases carbon and sulfur dioxides. The report then explores the response of the seawater system to these gases, as produced by combustion of marine fuel oil, and illustrates the impact of these gases in comparison with their natural cycles and other anthropogenic inputs. Finally, the consequences on the ocean chemistry of removing sulfur from fuel oil during refining, or leaving the fuel untreated are explored. Essential points coming out of this research are: (1. With the first regulations introduced, SOX emissions were allowed to be released at the rate of 1% in the Sulphur control areas (SECA). later, new regulations were introduced in 2015 and 2020, respectively (Cullinane ve Bergqvist, 2014). Figure 3 shows the SO_X emission limitations put into effect within the scope of IMO MARPOL by year.

With the regulations introduced, SO_X emission limits are now set at 0.1% in the SECA region and 0.5% in other regions. In order to ensure the restrictions imposed, either sulphur-free fuel or scrubber systems are used on the ships. In addition to the greenhouse gas effect, global warming is one of the main environmental problems encountered in recent years. In order to reduce CO_2 emissions from ships, which cause global warming, regulations have been introduced within the scope of MARPOL.

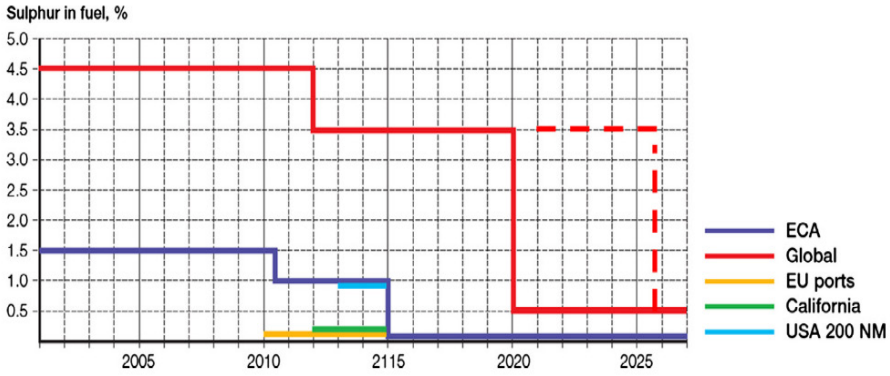


Figure 3. IMO SOX Emission Limitations

Regulations brought by IMO in order to reduce carbon emissions from ships came into force as of 2008. Maritime transport accounted for approximately 2.89% of greenhouse gases in 2018 (IMO, 2005). As of 2018, they have set new targets in order to reduce carbon emissions from ships. (Schroer, Panagakos ve Barfod, 2022). The first target is to reduce carbon emissions by approximately 40% in 2030 and approximately 70% in 2050 compared to 2008. These regulations have been brought under control by the EEDI brought by MARPOL. The targets for EEDI, which is planned to be reduced in 3 phases, are presented in Figure 4 (Zheng, Hu ve Dai, 2013).

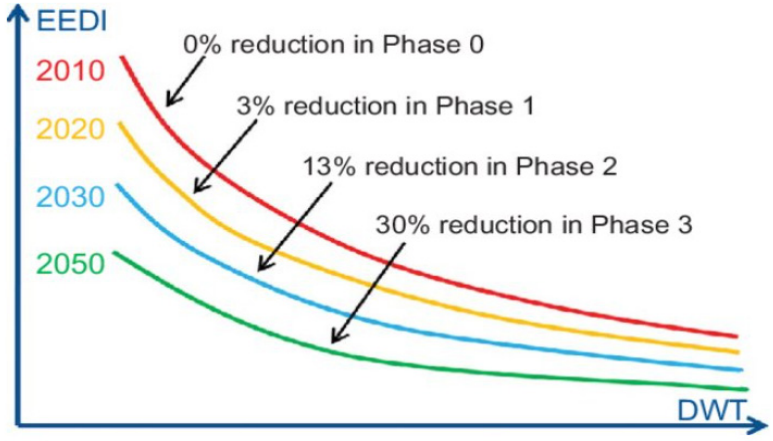


Figure 4. MARPOL EEDI Limitations

In order to reduce CO_2 emissions from ships that have been built, it is aimed to reduce them with the energy efficiency operational index (EEXI). There are several ways ships can comply with EEXI regulations. The newly built ships will be designed according to EEDI criteria by 2022. Thus, newly built ships comply with EEXI conditions. On the other hand, the EEXI and EEDI criteria basically limit the amount of carbon dioxide they can emit per unit load. Ships operating on current cruising can meet EEXI requirements with new parameters that will increase installation and ship power for energy efficiency. EEXI is based on EEDI calculation formulas that set legally binding CO_2 concentration targets for newly built ships. Under the EEXI, existing ships are required to meet technical efficiency standards based on EEDI targets for their ship types, which will come into effect in 2023. This means that by definition new construction ships delivered next year and beyond will already be compatible (Czermański ve diğerleri, 2022)the shipping sector has been incorporated into the global decarbonization process. At present, global shipping – as a whole – aims to reduce its emission levels by 40 % by 2030 in relation to the 2008 level. In reducing greenhouse gas emissions, regulations such as the MARPOL 73/78 Convention and Energy Efficiency Design Index as well as other monitoring and managing schemes already in operation (e.g., Ship Energy Efficiency Management Plan and Energy Efficiency Operational Indicator.

Other parameters used to reduce carbon emissions from ships are the ship energy efficiency management plan (SEEMP) and the Carbon Intensity Index (CII) (DNV, 2022). Figure 5 represents CII requirements by year.

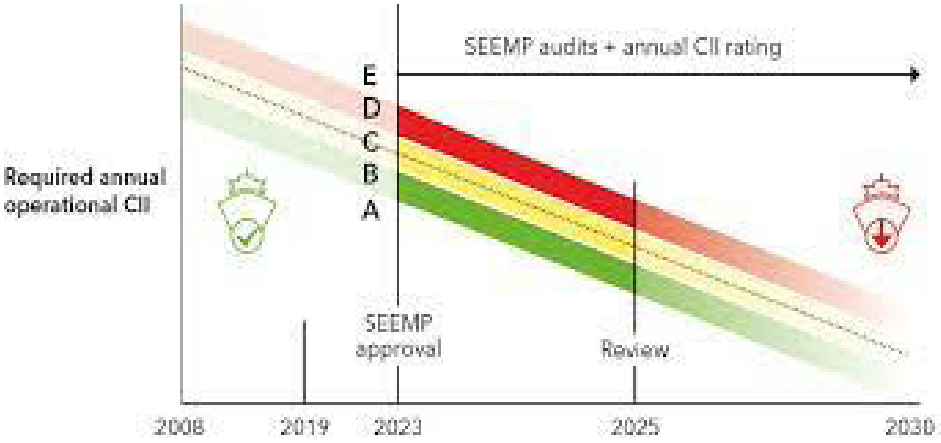


Figure 5. According to CII Requirements

Different techniques are applied in order to ensure the regulations introduced to reduce emissions from ships. The applied systems can be basically divided into three groups. The first of these is the change of diesel engine combustion parameters. Changes in combustion parameters such as injection of water into the combustion chamber, change of injection timing directly affect the exhaust emissions (Bayramoğlu ve Nuran, 2020)national and international organizations impose various restrictions to reduce emissions from diesel engines. Reducing emissions and improving performance in diesel engines are one of the most common areas of work. Improvement of performance and emission parameters is possible with changes in alternative fuels, engine geometry and fuel injection systems. In this study, the effects of different injection timing and injection duration on diesel engine performance and exhaust gas emissions have been investigated with computational fluid dynamics (CFD. The second method is to reduce the emissions in the exhaust gases by chemical processes as known aftertreatment systems. These processes reduce NO_X emissions in the exhaust gas by injecting urea into the exhaust system, such as SCR (Bayramoğlu ve Özmen, 2021). Reducing SO_X emissions is also provided by Scrubber systems (Brown, Kalata ve Schick, 2014)for example, it is estimated that by 2014 new rules will lead to a 71% reduction of sulfur dioxide emissions and 52% of nitrogen

oxide emissions as compared to 2005 level. Thus, medium-sized plants (100-500MW. Carbon emissions are reduced by carbon capture systems (Feenstra ve diğerleri, 2019)such as blue hydrogen or ammonia. However, that requires major modifications to the ships and the logistics of fuel distribution. As a transition solution, which can be implemented on much shorter term; this study presents the technical and economic evaluation for ship-based carbon capture (SBCC. The last technique is the use of renewable power systems and alternative fuels. In this study, the usability of renewable energy sources such as wind and sun used in ships will be evaluated.

EVALUATION of the USABILITY of WIND ENERGY on SHIPS

The increasing energy need with the industrial revolution has also increased the consumption of fossil resources significantly. This situation has brought about the release of greenhouse gas caused by fossil fuels and unwanted gases that cause global warming. (Akyol ve Yiğit, 2022).

However, wind was one of the first energy systems on ships. Wind, which was first used to propel ships instead of diesel engines, is now used to obtain electrical energy (Birol ve Demirgil, 2022). Different technologies such as wind turbine, kite system, Flettner rotor system, sailing system, electric power generation system are needed for the propulsion of ships (Kükner ve Kaplan, 2017). Wind turbines are explained by general wind energy and the potential to convert motion energy into electrical energy. The performance parameters of wind turbines, which can be horizontal and vertical axis in general terms, are generally high aerodynamic efficiency, more stable shaft torque, and rotor activation at lower speeds. Horizontal axis wind turbines have higher energy efficiency compared to vertical axis wind turbines. However, wind turbines that can be preferred to be used on ships are horizontal axis wind turbines due to their ease of installation and production. Besides, the fact that the center of gravity of vertical axis turbines is closer to the ship deck results in less inclination moment to affect the ship. Therefore, the transverse stability of the ship is less affected (Göksu, 2022). Figure 6 represents the basic wind turbine used in ships.

Figure 6. Wind Turbines Used on Ships

Another advantage of vertical axis turbines used on ships is that the turbine blades do not have to be positioned according to the angle of incidence of the wind. Since the wind is in the same direction as the movement of the ship, there is no need for a separate orientation. Vertical axis turbines, which eliminate the importance of the angle between the wind and the direction of advance of the ship, show superiority over all other wind assisted propulsion systems in terms of the angle of incidence of the wind. (Lele ve Rao, 2016).

Kite propulsion systems are one of the propulsion systems used on ships by utilizing wind energy. Kite propulsion systems are basically the systems that provide propulsion of the ship with the help of aerodynamic forces such as drag and lift forces that occur on the kite attached to the ship and free in the air. The starting point of these systems was basically to generate electricity on land. Today, it is one of the important systems used in ships. There are basically two types of parachute systems used to propel ships. The first of these is the transfer of the electrical energy obtained from the wind turbines installed on the flying kite system with a kite rope. Another type is that the movement of the kite turns the drum with the rope placed on the drum to which the kite is attached.

As a result of the rotation of the drum, the motion energy is converted into electrical energy and the movement of the ship is provided. Figure 7 represents the parachute system and its types on ships (Göksu, 2022).

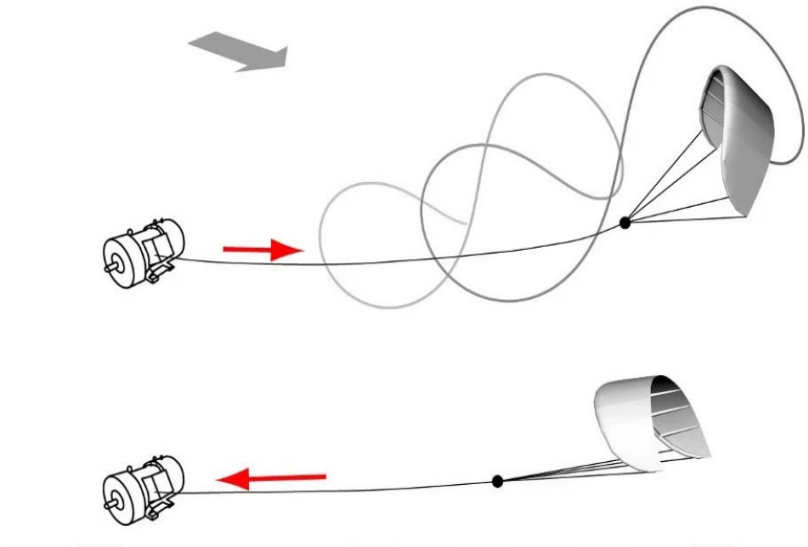


Figure 7. Electricity Generation by Kite System on Ships

With the Flettner rotor, aerodynamic forces are created by thrust, translation through a cylindrical system. As expressed in Figure 8, a circulation Γ will be created under a velocity U. This speed causes forces to occur on the cylinder. These forces will be basically the lift force and the drag force perpendicular to this force. The resulting drag force occurs in the same direction as the flow. With the Flettner rotor, only buoyancy is generated by viscous flow and this is known as the Magnus effect. The points P_1 and P_2 on the cylinder are the points where the velocity is zero. The velocity values at these two points are $o<|\Gamma|<4\Pi R|U|$ in which case it is zero. Beyond this situation, when $|\Gamma|>4\Pi R$, the recession will end (Carlton, 2012).

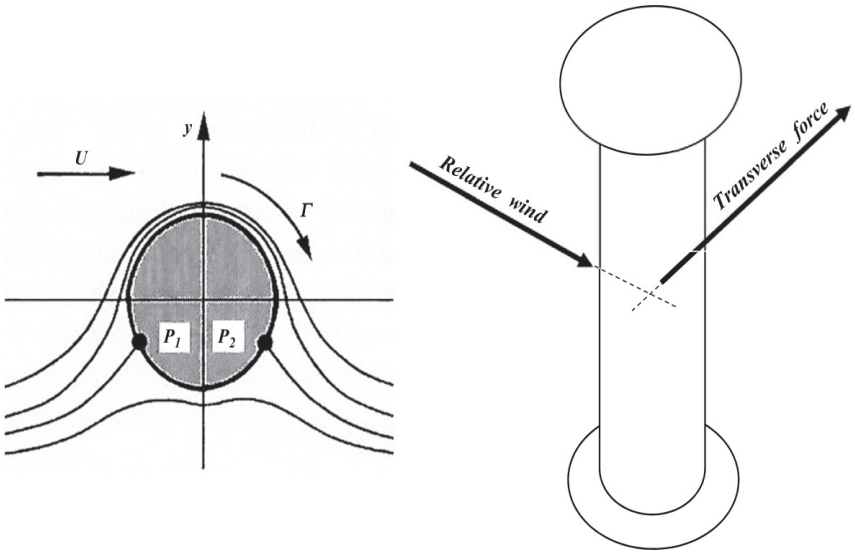


Figure 8. Magnus Effect and Flettner Rotor

It was proposed by Anton Flettner to propel the ship with long thin cylinders driven by engines and mounted vertically on a ship's deck to provide propulsion. To control flow with the Flettner rotor, larger diameter end plates than the rotor are fitted. Thus, it is aimed to limit aerodynamic losses and to provide an essentially two-dimensional flow regime on the cylinders. In 1926, two such rotors were fitted to the Buckau, a three-masted sailing vessel with the masts removed earlier. With this design, a high performance has been achieved with the Flettner rotor on the ship.

The rotors were 18 m long and 2.7 m in diameter, and the ship, renamed Bade-Baden, crossed the Atlantic Ocean. After this work, a cruise ship called Barbara, equipped with three rotors, was designed. These rotors, also equipped with end plates, were 17 m long and 4 m in diameter and were driven by a 27 kW motor at 150 rpm. This ship operated successfully for several years on the route from Hamburg to the Mediterranean and as a result the technical feasibility of the concept was thus demonstrated (Carlton, 2012).

When the potential of wind energy to meet the regulations introduced to reduce emissions from ships is examined, it is determined that although it does not cause emission formation, it reduces emissions per unit load in hybrid systems.

AVAILABILITY of SOLAR ENERGY on SHIPS

Solar, one of the renewable energy sources used in ships, was used in land facilities such as buildings and solar power plants. With the development of photovoltaic technology, solar energy gradually passed from land to the ocean and started to be used in ships. This trend started to accelerate especially from the beginning of the last century.

The first solar powered ship named "Sea Cleaner 400" was manufactured in Switzerland in 1997 using solar energy as the main power. The built boat was cruising from Lausanne to Saint-Sulpice in the Lake Geneva region of Switzerland. The boat was powered by an electric motor powered by 14 square meters of solar panels placed atop the ship. This boat provided a waterway transportation with emission-free solar energy for the first time in the world. Figure 9 shows the Sea Cleaner 400 solar powered boat (Grove Sea Cleaner, 2022).

Figure 9. Sea Cleaner 400 Solar Powered Boat

In 2000, a "Hybrid Power System" (HPS) named "Solar Sailor" was designed by Australian scientists using a commercial catamaran ferry. Solar, wind, fuel cells and fuel oil are used in the design. The built ship consisted of eight adjustable wings covered with solar panels that could also be used as wind sails. The passenger capacity of the ship built was approximately 100 passengers. The ship was the first commercial project in the region to model a solar-driven propulsion system. As shown in Figure 10, two solar blades stood on board, covered with many solar panels. With the project, the wings designed in the time periods when sunlight is absorbable can be used as power sails (Zhu, 2013).

Figure 10. Solar Sailor

The usability and availability of solar energy in marine vessels of different sizes and service classes have been studied by different researchers. Especially the types of solar cells used in solar systems, types of photovoltaic (PV) systems and their applicability to marine vessels were investigated. Firstly, it was designed and numerically simulated to determine the performance of a diesel engine and PV/diesel hybrid system on ships. Due to the fluctuation in solar radiation, a control method

has been developed to control the fluctuation in the PV output power with numerical studies. The system is designed as a hybrid system to increase the power of a 263-passenger capacity ferry with both an off-grid and grid-connected power system. The hybrid system was designed for a system consisting of PV, diesel and battery unit and analysed in terms of fuel consumption and energy consumption with parameters such as summer, winter, weekdays and weekends.

The study was used to provide lighting on the ship, and it is a study in which PV panels were used as an auxiliary energy source for the Nile River cruiser on the Cairo and Aswan voyages. In another study, the measurement path of the power load flow of the installed PV system was applied to a ship and the system performance was examined and presented. The possibility of PV power as a maritime auxiliary energy source operating in the Red Sea region is analysed for the economy and system efficiency of the system and for solving environmental problems. A hybrid energy system consisting of solar panels, diesel generators and an energy storage unit has been designed for a solar-driven full-size tanker traveling 100000 DWT from China to Yemen. The designed hybrid system was examined at variable loads and an optimization study was carried out for the installation of the system. A hybrid system has been designed on a naval vessel going from Dalian to Yemen to Aden in China. The designed hybrid system consists of a diesel generator, solar panel and battery unit. As a result of the study, the dimensioning of the hybrid system, cost, fuel and emission analyses were made. PV system design and properties were investigated experimentally on a sailing ship. In the study, the effect of the emissivity in motion is taken into account, and the internal gap optimization method for on-board PV generation is taken into account. Actual data of a hybrid energy system built on a large tanker ship from Dalian in China to Aden in Yemen have been calculated. Another study with solar propulsion systems was carried out in the Northwest Black Sea region, based on the data of ships sailing between Constanta and Odessa. In this study, the use of PV modules in commercial ships was investigated and the cost analysis of the developed system was carried out. A large-scale PV system connected to the main power grid of an ocean-going ship has been investigated.

As a result of the research, the performance parameters of the system were determined by the optimization method. A hybrid system consisting of PV, diesel and energy storage system was developed in three different simulation scenarios on a naval ship sailing from Shanghai to Sydney. In the developed system, the ripple characteristics of the PV output power were investigated using a mathematical method. A large-scale PV array has been created in a solar power system for a ship system. In order to obtain maximum power from the system, swarm optimization, which is one of the optimization techniques, is used. A model has been proposed to reduce total cost, fuel consumption and greenhouse gas emissions for emission limits that will satisfy IMO regulations on merchant ships. In the system model, variable management strategies are used for the hybrid system independent from the grid and connected to the grid. A hybrid system consisting of a four-stroke ship diesel generator, solar panels and an energy storage unit is designed. In the designed model, the development of the coordinated control method of a ship with a hybrid energy system was examined and the energy efficiency, emission reduction, fuel savings, payback period of the selected ship were examined. A PV-based hybrid system is designed on the ship, which is modelled on a tanker ship. Sizing and optimization of the hybrid system was carried out in 4 different scenarios in terms of cost and emission, and the results of the scenarios were evaluated comparatively. Finally, a battery storage unit with a hybrid grid-connected/independent PV system was designed in the energy system carried out on a Ro-Ro ship with a capacity of 500 vehicles. As a result of the experimental study, the one-year performance of the hybrid system was evaluated. In the evaluations, it is predicted that it will reduce fuel consumption by 4.02% and CO_2 emissions by 8.55%. Fluctuations in different sea structures, power fluctuations are under control, and studies are carried out to ensure optimum energy consumption under variable operating conditions (Karatuğ ve Durmuşoğlu, 2020)and adapting alternative energy systems to ship's main power grid is an effective method to both save energy and reduce the amount of emission gases. For this reason, the contribution of solar power, which is one of the effective alternative energy sources, to the marine vessels as a result of

adaptation to the ship's power system and the environmental impacts of application is evaluated within the scope of the study. A novel approach is demonstrated for the layout of solar arrays within a Ro-Ro type marine vessel navigated between Pendik/Turkey and Trieste/Italy during 2018, and the performance of the designed system is theoretically evaluated. According to followed methodology, 7.76% of energy efficiency is carried out and 7.38% of the fuel requirement of the stated vessel is met by the designed solar system. 0.312 tons of SOx, 3.942 tons of NOx, 232.393 tons of CO2, and 0.114 tons of PM are prevented from releasing to the atmosphere. Besides, the investment of the solar system is analyzed under three different economic indicators and is found to be economically profitable to implement on the ship.","author":[{"dropping-particle":"","family":"Karatuğ","given":"Çağlar","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-particle":"","family":"Durmuşoğlu","given":"Yalçın","non-dropping-particle":"","parse-names":false,"suffix":""}],"container-title":"Solar Energy","id":"ITEM-1","issued":{"date-parts":[["2020"]]},"page":"1259-1268","title":"Design of a solar photovoltaic system for a Ro-Ro ship and estimation of performance analysis: A case study","type":"article-journal","volume":"207"},"uris":["http://www.mendeley.com/documents/?uuid=f3634b61-c478-49b8-8908-45bb2637a402"]}],"mendeley":{"formattedCitation":"(Karatuğ ve Durmuşoğlu, 2020.

When the potential of solar energy to meet the regulations introduced to reduce emissions from ships is examined, it has been determined that although it does not cause emission formation, it reduces emissions per unit load in hybrid systems.

AVAILABILITY of FUEL CELL on SHIPS

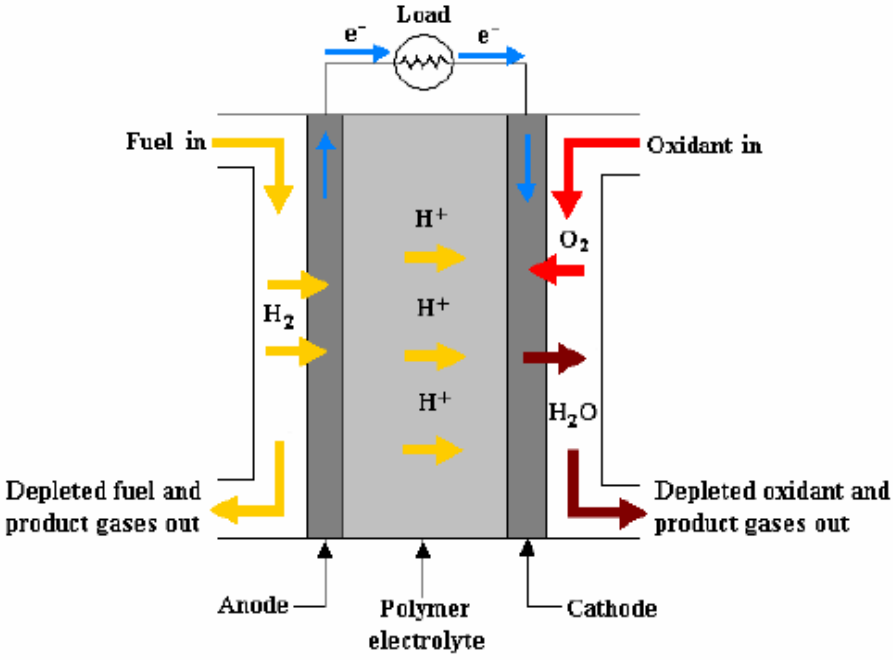
One of the energy sources that can be used on ships is fuel cells. Fuel cells produce electricity as a result of the reaction of hydrogen and oxygen obtained as a result of electrolysis in the membranes. Fuel cells are one of the most likely energy sources to be used in the future mainly due to their high efficiency, high power generation, low operating temperature and zero emissions. (Han, 2016). Fuel cell technologies are not only environmentally friendly and green, but also have unlimited ener-

gy resources compared to other energy sources (You, 2017). Equation 1 and Equation 2 express the chemical reactions that take place in fuel cell processes.

$$H_2 \rightarrow 4H^+ + 4e^- \quad (1)$$

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O \quad (2)$$

Fuel cells are a wide range of energy sources compared to traditional marine fuels and renewable energy sources. Fuel cells used in marine vehicles are used in different applications. These applications are mainly used in different applications such as fixed power generation, residential power generation, cogeneration and portable power.



Şekil 11. PEM Fuel Cell Technology

Fuel cells come in different types that are recognized by their operating temperature and electrolyte type. In addition, fuel cells are of great interest to scientists due to their low temperatures and high efficiency. PEM fuel cells have simple operations. Hydrogen and oxygen react electrochemically to produce electricity. Figure 11 shows the PEM assisted fuel cell technology.

On the other hand, Yilmaz and Nuran implement a fuel cell application for a boat design shown in Figure 12. In this study, they aimed to increase the awareness of the marine industry about the advantages of fuel cell technology (Nuran ve Yılmaz, 2016).

Figure 12. Fuel Cell Powered Boat

Basically, the use of fuel cell technologies in ships and the selection stages of the appropriate fuel cell are provided by estimating the power based on the resistance of the priority ships. After the calculation of the power based on the drain of the ships, the fuel cell is placed in the appropriate area. Basically, the flow chart given below is followed in the selection of fuel cells. (Bayramoğlu ve Yılmaz, 2017). Figure 13 express the flow chart for Fuel cell.

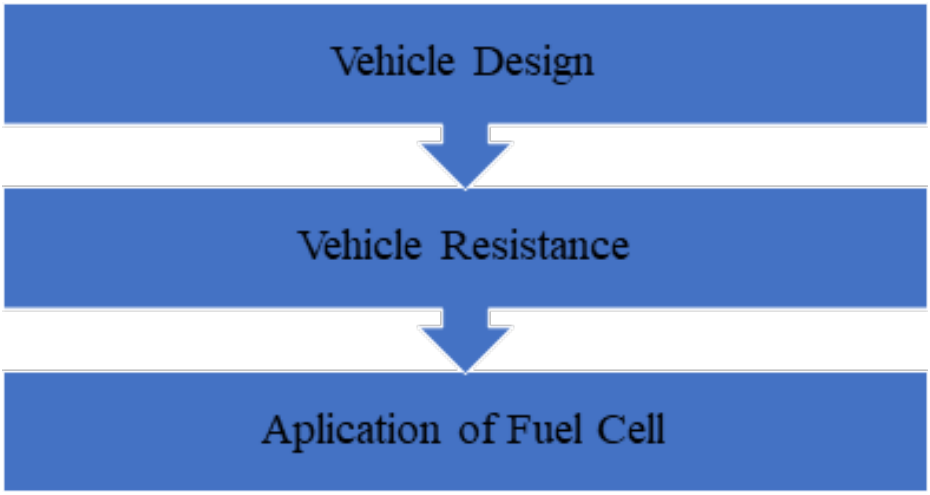


Figure 13. Fuel Cell Application System on Ships

CONCLUSIONS

The regulations brought in order to reduce the emissions from ships have brought along some regulations by ship owners and public institutions. In this study, the following regulations were taken into consideration.

- First of all, the regulations and affordability limits brought by IMO in order to reduce emissions from ships were evaluated.
- Wind energy and its potential to be used on ships are presented comparatively. Basically, wind turbines, parachute systems, flettner rotor and sail systems of wind driven propulsion systems used on ships. While the specified propulsion systems are not used alone, they are only used on ships as a support in the main propulsion system. When the potential of wind energy to meet the regulations introduced to reduce emissions from ships is examined, it is determined that although it does not cause emission formation, it reduces emissions per unit load in hybrid systems.
- Another energy system used in ships is solar driven systems. Solar energy is not one of the sources used for the propulsion

of ships, as is the case with wind energy. It is used only in the propulsion of ships as a support to the main propulsion system. In the study, basically the usage of the sun on ships and the examples of solar powered ships made in the literature were examined. When the potential of solar energy to meet the regulations introduced to reduce emissions from ships is examined, it has been determined that although it does not cause emission formation, it reduces emissions per unit load in hybrid systems.

- Fuel cells are one of the most likely energy sources to be used on ships in the future. Fuel cells are based on the principle that hydrogen and oxygen generate electricity in fuel cells. Fuel cells, which have different types, were first used under the sea, and can be used alone on ships since they do not emit emissions and have high energy generation potential. In addition, since it does not create emissions caused by traditional propulsion systems, it meets the regulations put into effect by IMO.

Considering the energy sources given above, the use of environmentally friendly alternative energy sources on ships is extremely important in terms of reducing emissions. However, it is not possible for these systems to be used alone on ships today due to their low energy potential. However, in the future, with more efficient systems, these energy sources can be used on ships alone from propulsion of ships.

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IMPORTANCE OF ETHICAL VALUES FOR PROFESSIONAL ENGINEERS AND ARCHITECTURES

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Abstract: Ethics is an important topic for engineers and architectures of every level and field. When you become a professional engineer or architecture, however, you are held to a higher standard. That is why one of the requirements for maintaining your professional engineers' and architectures' license is to meet a certain number of professional development in ethics. Ethical values provide the moral compass by which we live our lives and make decisions – 'doing the right thing' because it's the right thing to do. Education is a life time process beginning by birth. Family is the first phase of this process which was cultivated and carried out by the schooling and social settings in the later stages. Consisting of both academic and values education, it is one of the most powerful tools to change the world. Islam accepts 'knowledge' and taqwa, which can also be called the Islamic ethics, as the only criteria of superiority. It is well-regarded that ethics and fear of Allah contribute a lot to the society and those who possess these virtues and the Quran states that it is the ethics and taqwa (fear of Allah) that make human valuable. Justice, goodness, charity, good deeds, steadiness and right direction are defined as good ethics, which are praised and encouraged, whereas heresy, badness, immorality, wrong-doing, impiousness are rendered as bad morality and advised to keep away from.

Keywords: Ethic Values, Engineering, Architecture

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INTRODUCTION

Even the parts of the Code of Ethics for Professional Engineers that deal with honesty and integrity go back to safety issues. The things we help design, build, and maintain could result in a loss of life if we put profits, personal advancement, or anything else in front of people.

Another important reason to have a code of ethics for professional engineers and architectures is it sets a standard for professional behavior. You know you can expect another PE to behave with honesty and integrity since they adhere to the same creed as you. The public can also be assured you are not pulling a fast one or working for your own gain. The standard of professional behavior provides the people who you work with and for a foundation of trust that you are going to operate in the project's and public's best interest.

While the code of ethics seems fairly straightforward and clear cut, having courses about it are important for navigating your day-to-day. The professional development classes help guide you through real life cases that have come before the Board of Ethical Review, so you can see the nuances of the code and how it can be used to make better decisions

EDUCATION of ETHIC VALUES

There are various definitions of values education. But it can be summarized as 'the activities that aims to make the national, spiritual and universal values reflect in the behaviours of individual, in order to contribute and sustain the peace and harmony of the societies. (Torun, 2019)

The human experience in history has shown us that the knowledge is power and this is even as more valid and applicable as ever. It is known that knowledge is better gained and acquired through a proper education. Observance and internalization of the virtues such as good, beauty, integrity, justice, love, solidarity, respect and equality is regarded as the reflections of a good education. Education mainly targets the achievements of certain emotional and social skills as well as the development of some mental and language abilities. People learn the values of love and affection, respect, mercy and solidarity from their families through experience and transfer them to their individual lives. On the

other hand, there are values with social implications such as the sense of right, law, and justice, which keeps the societies stronger. Individuals learn them through their interactions with the society and in the schools. The key purpose of the values education is to make the behaviours of the individual transformed accordingly. Those who can improve and transform themselves would eventually change the society for better. Those who fail in their self-development and transformation shall not make a change within their families and the society in which they live. (Güneş, 2016)

Education is understood as a process of earning positive behavioural change for an individual, in addition to achieving some academic knowledge and skills. Such behavioural transformation process can be expressed as 'values education'. In Turkey, values education was used to be included within the curriculum of 'ethics education' until 1960. Since 1990's it was delivered within the context of 'character education'. What is called 'values education' in Turkey was provided and named as 'moral education' in the literature of other countries. (Yıldırım, S.G., Demirel, M., 2019, p.93)

In our history, values education was given a special significance under various titles. Schools have always been a significant centre for learning the social values in addition to their function to provide academic knowledge. In our culture, forty values have been mentioned for to adopt and acculturate the individuals. They are embedded in our education system and curriculums directly or indirectly. Some of them are 'rightness, cleanness, justice, responsibility, affection, tolerance, equality, hard-work, hospitality, being charitable, health, solidarity, integrity, respect for family unity, independence and respect for human rights and others.((Yıldırım, S.G., Demirel, M., 2019 , p.97)

The Ministry of Education included 'values education' in the primary and middle years school in 2005 and 2006 and stated that our valued are derived from our traditions, history and faiths and they reflect the key human charactetistics for what and who we are. These values are our strenghts and guidance in combating the challanges we are to face with. Today, in the Training Program of the Ministry of Education, there are ten (10) root values, namely, 'justice, integrity, friendship, self-dicip-

line, patience, respect, affection, patriotism, sense of responsibility and being charitable' (Ministry of Education, Curriculum and Program for Religious Education, 2020) .

As the moral values are linked with personal beliefs and convictions, the values education and religious educations appear to be integrated and at some point hard to be seperated each other. Therefore, some religious scholars assume that the ethical values shall be taught by themselves or those who have the knowledge of religion as well, based on the assumption that religion and morality are interlinked. Although religion is not the only source of values, it is regarded as the strongest makers and shapers of the values and religion assists substantially to transfer the knowledge of values into behaviours.

Values education constitutes an important part of the general education and helps people to socialize and integrate with the society. Character and personal development, increased sense of citizienship and moral development and advancement are named among the functions and objectives of education. In the past, there were some views suggesting that human values are intrinsic and by birth and therefore not subject to advancement and betterment. However, as opposed to this view, it is today accepted that values education play a critical role in the future success of the children and the attitudes, life perspective and general perceptions of children can improve through education. A good experience of schooling and well-designed and implemented values education sessions can help a lot to the children for betterment.

It can be therefore claimed that values education is as important as the academic education. Education is not limited to the activities, carried out in the schools within a disciplined plan and program and through reading studying books. Non-curricular activities outside the school are substantial parts of one's educational process. Educationists classify education as formal and informal education or public education. Values education can be located closely within both formal and informal education. The social setting of the individual in which he lives, bring in impact upon the individual attitudes and behaviours. Value education is very important to shape a child to become successful in the future. The attitude, behavior, and overall perception of the child change, and for

the good. There are many advantages to value education. Value education is very important to shape a child to become successful in the future. The attitude, behavior, and overall perception of the child change, and for the good. There are many advantages to value education.

Today, education is not just confined to books. It goes much beyond that. In today's world, what is most important is a child's holistic development. This is why parents focus on extracurricular activities and value education along with academics. It feels like moral values are almost disappearing in today's generation. To resolve this, value education is the best solution. Through Val-ed, as it is commonly known, we can develop the children into people with a strong character. Such children know how to utilize their knowledge for the advantage of mankind. Education is a strong weapon that can change the world. Here, education refers to both academic as well as moral value education. As much as academic education is important, value education is important too. It has the power to change the world.

Education is a lifelong process and one's personality development starts from school. Schools build the base for a student's future. This is why it is said that schools play a significant role in providing value education or moral education. All schools and even a few colleges have separate classes for value education. Val-ed aims at training the children to face the outer world with the right values and attitude. This is a process of the overall personality development of a student. Character development, personality development, citizenship development, and spiritual development form part of value education. Some people think values are an inborn character of a child and can never be developed. But, this is not true. A good school and value education sessions can change the character of a person drastically.

On a larger scale, value education is very important in the life of a person. It paves way for a brighter future. Educated and well-mannered people can survive in the rat race of the world better than ill-mannered persons. It also helps to get better job opportunities and maintain a good standard of living. Some of the main advantages of value education in life are

- Makes future better
- Serves as a backbone of society
- Changes perspective of a person
- Develops moral values and patience
- Helps in understanding things better and more precisely.

Engineers are the strong upholders of the nation. They deal in things that are as important as laying the foundation of a country. An Engineers work/art has a compelling impact on the society, let alone the people, leading them in doing an adept work with utmost commitment to self and to the society. The commitment and adeptness thus demands no carelessness as, many lives depend on their work. To get a clear picture, we can say that a bridge build with low quality raw material, might fall down, endangering thousands of people's life. This is wherein the deeds of righteousness emerge, the ability to act with lot of diligence and care. Working on ethics is thus an integral part of these deeds and acts**.** In the words of great Albert Einstein, "I do not believe in immortality, and I consider ethics to be an exclusive human concern with no superhuman authority behind it." Ethics are based on well-founded standards of right and wrong that prescribe what humans ought to do, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues, where engineers are no less. 'Engineering ethics' in this way finds its way up to the ladder of moral consciousness/self-righteousness.

THE aim of ETHICAL VALUES

Ethics are the moral principles and values that underpin human behaviour. Morals are concerned with what is 'right' or 'wrong'. Business ethics are, therefore, the moral principles that underpin business behaviour. Whether actions carried out by organisations and their employees are morally acceptable must, however, be judged in the context of the society and the times in which they operate.

An ethical business is one which applies a set of moral principles to all interactions with stakeholders, such as its treatment of employees, customers, suppliers and shareholders. Being ethical means a business goes beyond merely complying with laws and regulations, but makes

choices about what it is prepared to do, and what it will not. Therefore, an ethical business strategy may exclude behaviour, which is legal, but conflicts with the businesses ethical policy.

Setting ethical objectives is the process by which organisations apply ethical values to their targets and the actions by which they will achieve them. These ethical values should cover all the actions of the organisation from tactical to strategic.

ISLAMIC ETHICAL VALUES

In a literal sense, ethics means a discipline of custom and moral principles. The concept of ethics is perceived as the set of rules and behaviours that a member of profession is expected to observe and avoid during his/her conduct of that profession.[4] (TDK Dictionaries, 2022) Ethics can also be defined as a moral philosophy that studies the foundation of what moral is and the problems in relation to human conduct.

Those who need to live together in a social co-existence are expected to act in a way beneficial to social life and behave in compliance with the community's expectation for peace and security. As an essential requirement of social life, social order and trust need to be established in the societies and moral principles are accepted among those rules of social order. In Islamic teaching, it is Allah Almighty that defines what is good and bad and what moral values that a man should adopt and observe. In another word, according to Islam, whatever Allah asks people to do is good and beautiful and whatever He prohibits is wrong and ugly. Those who base the roots of morality on human and society prioritize the human and social interests. Those who build the morality on divine origin, in fact, claim that any virtuous act without taking into account any material and worldly benefit is much more ethical.

The main sources of Islam underlines that human is created by Allah in a perfect manner.(The Quran, Chapter Tin, 95/4; Bukhari, Adhan, 11; Muslim, Birr, 32.) Those who believe and perform righteous deeds are well-received before Allah, while those who do act as opposed to the purpose of creation or those who do not believe and perform right deeds

4 TDK Dictionaries, https://sozluk.gov.tr/ (09.12.2022)

are misled and will ultimately end in a big loss and disappointment.(The Quran, Chapter Tin, 95/4-6) The Quran states that all humankind is created from one man and woman and asserts ascending from the same lineage, all humans are equal, which means that there is no superiority among human based on the lineages, family and tribal bonds or the nation or on capital and good. Rather, the superiority can only be generated in relation to fear of respect to Allah (*'taqwa'*) and good morality.(The Quran, Chapter Hujurat 49/13.)

Islam accepts 'knowledge' and *taqwa*, which can also be called the Islamic ethics, as the only criteria of superiority. (The Quran, Chapter Zumar,39/9). It is well-regarded that ethics and fear of Allah contribute a lot to the society and those who possess these virtues and the Quran states that it is the ethics and *taqwa* (fear of Allah) that make human valuable. Justice, goodness, charity, good deeds, steadiness and right direction are defined as good ethics, which are praised and encouraged, whereas heresy, badness, immorality, wrong-doing, impiousness are rendered as bad morality and advised to keep away from.

While explaining the wisdoms behind the moral behaviours it suggests for humans, the Quran underlines the individual and public good. It upholds the concept of justice as necessary for societies to survive and sustain themselves, yet those wrong themselves aggression and injustice are doomed to get destroyed.(The Quran, Chapter Anbiya, 21/11)

In Islamic teaching, human beings are born with a capacity to do both good and bad. In a related verse, it is mentioned that the soul has the potential to guide one toward a good deed or a wrong-doing; one can achieve salvation only through purification of the soul but those who soil and follow its misleading instructions will harm itself. (The Quran, Chapter Ash-Shams, 91/7-10) But, humans lead their lives by their free will which can differentiate the good from bad. An ideal Muslim shall direct and demonstrate his/her good character and behaviours, first of all, toward Allah, his Creator, to himself/herself, family and all humanity. Therefore, human is upheld responsible for his/her actions, as s/he has the ability to control him/herself. According to Islam, one is to be rewarded or punished in this world and hereafter as a consequence

of his/her actions and choices. People can learn their responsibilities, rights and duties through a good education.

Our behaviours in individual and social life get somehow linked and associated with the ethics and values of the society in which we live in. Values are the common beliefs that would shape out the behaviours in individual and social areas. Such beliefs can encourage some behaviours on the one hand, but on the other hand, it can discourage and make one avoid certain actions. As our values are strongly linked with moral rules, one can argue that ethics is both a source for values but it is also an enabler for the implantation of the values in our lives. A value which finds no reference in ethics and morality has a little chance to survive and get observed by people.

Muslims paid attention to professional ethics since the very beginning in early period of Islam; and they have formed and built the concept on the principles of 'obtaining Allah's pleasure' and 'the need for some one to conduct his/her affairs in a perfect diligence and care' and 'the belief that one shall not violate the rights of other who live together with himself'. This understanding got eventually institutionalized through '*Ahilik*', a kind of guilds, in Ottoman and Seljuqi states in the history. The moral conducts of Muslims in merchandise and professional life had brough a positive impact on non-Muslim as well. (Kazıcı, Z., 1988) Such conducts of Muslims have led the Islamization of Anatolia and Balkans and conversion of Indonesia to Islam. (Coşkun, B., (2020)

The Islamic ethics and the rules of moral conducts in trade and professional life generate from the very sources of Islam, i.e the Quran and sunnah. The Prophet (pbuh) defined Islamic ethics with the concept of '*ihsan*' literally means beatification and bestowal. In Islamic terminology, it means 'to act and worship as if one sees Allah with no barrier'. This notion is reflected in the individual social and professional lives of Muslims.(Bukhârî, Ch. Tefsîr, 31/2.)

Islam offers a balanced view of life and demands people to regard the world and hereafter in a wholistic and integrated approach and live their lives accordingly. Human are given a free will and consequently held responsible for the choices he makes and this responsibility shall

not be limited to this world and s/he will be see the rewards and punishments in hereafter as well.

Islam does not tolerate laziness and inactivity in social and economic life and urges them to work. The Prophet said '***no one has ever achieved and eaten something better than what he earned with his hand and effort. The Allah's Prophet, Dawud, used to eat only from the earnings of his hand***'. (Bukhârî, Ch.Sales, 15).

He is required to be careful about halal (*permissible*) and haram (*prohibited*), to earn halal profits and observe the rightful due of everyone.

With the verse, '***Woe to those that deal in fraud***,*(The Quran, Ch. Mutaffifîn,v. 1-6.)*

Allah reminds the significance of 'rights of others' in the Quran, which also clearly orders ' ***Do whatever you do in a good way. Allah loves whose do (their job) in a good (beautiful) way*** .*(The Quran, Ch. Baqara, 2/195.)'* It requires the employers to pay the dues of employees in time and in full; to share some of his imcomes with the needy ones and be considerate about the people around him. Any fraudulent activity is made illegitimate in trade. Once, the Prophet saw a trader who was selling wet grain in the market, he told him that ' ***whoever deceives is not one of us***.*(Muslim, Ch. Iman, 164.)*

Islam teaches to be 'contented' and 'generous', while it disapproved 'greed and extravagance'. In the Quran, Allah says '**Those who, when they spend, are not extravagant and not niggardly, but hold a just (balance) between those (extremes**)(*The Quran, Ch. Furqan,25/ 67.)* and to share the wealth, knowledge, time and love is understood as generosity. In a related verse, Allah expresses that '*even though they are in poverty they prefer others over themselves; and whoever saves himself/herself from the covetousness,- they are the ones that achieve salvation and prosperity*'. When they spend, they neither go extravagant nor stinginess but they find a balanced midway'. Usury, bribery, stocking, speculation and manipulation in prices are strongly prohibited. With all these principles that Islam invites to be implanted in individual and social life, it aims at securing social peace and harmonization.

Islam is a religion that provides a complete way of living through its ethical standards and values provided in the Holy Quran. It has described moral values and ethics in a proper way and has emphasized the Muslims to follow them in order to please the Almighty Allah. The Creator of this world and the eternal one has allowed human beings to choose their living style according to their will. The reason behind this freedom is that Allah has described this worldly life as a test in the Holy Quran to earn a reward on the day of judgment according to the deeds.

Islam has provided fundamental rights to all the living things in the world. Therefore, these rights of all living things must be well observed according to the ethical principle and values of Islam. In the Holy Quran Almighty Allah says: "It is not righteousness that you turn your faces towards East or West; but it is righteousness to believe in God and the Last Day and the Angels, and the Book, and the Messengers; to spend of your substance, out of love for Him, for your kin, for orphans, for the needy, for the wayfarer, for those who ask; and for the freeing of captives; to be steadfast in prayer, and practice regular charity; to fulfill the contracts which you made; and to be firm and patient in pain (or suffering) and adversity and throughout all periods of panic. Such are the people of truth, the Allah-conscious".(Quran, 2:177)

The most glorifying example of practicing Islamic values and ethics is the Last Prophet of Allah, Prophet Muhammad (SAW). He (SAW) set standards and provided guidelines to the followers to practice in life. He (SAW) ended the ill customs and traditions found in the Arabic world and other regions regarding racism, killing of daughters, alcohol, fraud, interest, adultery and brutal killings. In the Holy Quran, Almighty Allah describes Prophet Muhammad (SAW) as,

"And indeed, you are of a great moral character."(Quran, 68:4)[5]

With contrast to other systems, the ethical system in Islam takes guidelines from the divine source of teachings "The Noble Quran" and Hadith of Prophet Muhammad (SAW). The ethical values set by Islam cannot be altered according to the will of human beings and the situation they are in. The system is working for thousands of years and it will

5 https://islamicreminder.org/values-and-ethics-in-islam

do the same until the day of judgment. This system cannot be affected by the cultural norms as Allah (SWT) is the one whose acceptance is most important when it comes to performing the deeds in this world.

In the Holy Quran, Almighty Allah has mentioned the following values that Muslims must practice in their lifetime.

- Almighty Allah is the only one to be worship.
- Parents must be dealt with kindness.
- Whenever a promise is made it, fulfill it.
- The poor and orphans are the responsibility of the society.
- Performing the religious duties set by Islam.
- Staying away from the deeds that are recommended as sin in Islam.
- Dear of Allah should be in the heart of everyone with the truth on the tongue.
- Killing a person is like killing the whole of humanity.
- Practice honesty in personal and professional life.

ENGINEERING and ARCHITECTURE PROFESSION

Engineers use the laws of nature to create and refine the artifacts of modern life. They seek, through ingenuity and invention, to fashion a more livable world. An architect is a person who plans, designs and oversees the construction of buildings. To practice architecture means to provide services in connection with the design of buildings and the space within the site surrounding the buildings that have human occupancy or use as their principal purpose.

"Most simply, the art of directing the great sources of power in nature for the use and the convenience of humans. In its modern form engineering involves people, money, materials, machines, and energy. It is differentiated from science because it is primarily concerned with how to direct to useful and economical ends the natural phenomena which scientists discover and formulate into acceptable theories. Engineering therefore requires above all the creative imagination to innovate useful applications of natural phenomena. It is always dissatisfied with present

methods and equipment. It seeks newer, cheaper, better means of using natural sources of energy and materials to improve the standard of living and to diminish toil.

Traditionally there were two divisions or disciplines, military engineering and civil engineering. As knowledge of natural phenomena grew and the potential civil applications became more complex, the civil engineering discipline tended to become more and more specialized. The practicing engineer began to restrict operations to narrower channels. For instance, civil engineering came to be concerned primarily with static structures, such as dams, bridges, and buildings, whereas mechanical engineering split off to concentrate on dynamic structures, such as machinery and engines. Similarly, mining engineering became concerned with the discovery of, and removal from, geological structures of metalliferous ore bodies, whereas metallurgical engineering involved extraction and refinement of the metals from the ores. From the practical applications of electricity and chemistry, electrical and chemical engineering arose.[6]

IMPORTANCE of ETHICAL VALUES in ARHITECTURE and ENGINEERING PROFESSION

How do the guidelines of Engineering Ethics actually work? We can say that Engineering Ethics are the primary obligation of any engineer to protect the safety, health and the welfare of the people. In a professional scenario, we are placed in a huge threshold of either doing what's safe for the people or blindly following the orders of the employer. This crossroad situation consequently gives rise to the discussion about 'Engineering Ethics'.

According to Martin At El, ''Engineering Ethics relates to the study of the moral issues and decisions confronting individuals and organizations involved in engineering". They are underlying in itself the questions about moral conduct, character, policies, relationships and corporations involved in technological activities. Now, where does need of studying Engineering Ethics originate? Considering that we all are li-

6 https://www.loc.gov/rr/scitech/SciRefGuides/eng-whatis.html

ving in an age of highly advanced technology and in this mind boggling and physically tiring race of reaching the vertex of success, we take such decisions that may not only have unintended consequences but are also adversely affecting the society.

Another reason is that while performing our professional duties, there may arise such situations which may lead to conflicts between our Personal and Professional interests. For instance, one is working in a reputed construction company where the material that company uses is of poor quality that could not be used for constructing of dams, then one is in a state of dilemma of 'what is to be done?', if the material is overlooked, thousands of lives would be in danger and if voice is raised against it, one may lose his/her job. The example reflects the situation of many people who have conflicts arising between personal and professional interests, and thus answering our question about why do we need to study engineering ethics.

Some of the Ethics which Engineers have to follow are listed below.

- Engineers, in the fulfillment of their professional duties, shall:
- Hold paramount the safety, health, and welfare of the public.
- Perform services only in areas of their competence.
- Issue public statements only in an objective and truthful manner.
- Act for each employer or client as faithful agents or trustees.
- Avoid deceptive acts.
- Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

These are the code of ethics which are more or less universally followed.

You as an Engineer! As an engineer, you may also have to make many decisions when you have to be clear about what is right and what is wrong, and it is here that the code of Ethics will guide you, you can also design your own code of ethics and follow it to fulfill your Professional responsibilities.

Shared below are the guidelines which will help you in taking right decisions:-

Test your decisions in the following manner:

- Is the decision good for all?
- Does it protect the health of the users or the public in general?
- Is it harming the environment?
- Is it energy efficient?
- Is it in the interest of the nation?
- Have you taken into consideration all the stakeholders as well as the people who are directly and indirectly affected by it?
- Is it able to justify prescribed standards and has efficiency?
- Is it affordable by a common man?

Actually, these codes make one feel really responsible and proud to be a professional, thus motivating towards the commitment one should have towards one's profession. This self-made code of ethics will provide the necessary moral support and guidelines, which will inspire you to work with great commitment and more effectively serve the public. It can also win you greater powers of self-regulation for the profession itself while lessening the demand for more government regulation.[7]

Engineering is transforming science into valuable products for human convenience. Engineering is something that engineers accomplish, and what they do has significant effects on others. Ethics in engineering then is the ability and duty of an engineer to judge his decisions from the context of the general wellbeing of the society. It studies moral issues that encounter engineers and engineering organizations when vital decisions are taken. Engineering research and practice demand that the task being performed contemplates all the pros and cons of a specific action and its implementation.

- Engineering is transforming science into useful products for human comfort.

7 https://byjusexamprep.com/ethics-and-values-in-engineering-profession-i-2b1ef000-d260-11e6-a244-93755fd0e51e#:~:text=ESE%202022%3A%20Ethics,October%2013th%2C%202017

- Engineering is something that engineers do, and what they do has profound effects on others.
- Ethics in engineering then is the ability as well as the responsibility of an engineer to judge his decisions from the context of the general wellbeing of the society.
- It is the study of moral issues that confront engineers and engineering organizations when some crucial decisions are taken. Engineering research and practice require that the task being performed considers all the pros and cons of a certain action and its implementation.

Ethical standards in engineering are influenced by many factors:

1. Engineering as experimentation for the good of mankind is a notable factor involving far-reaching consequence,
2. Ethical dilemmas make engineering decisions relatively difficult to make.
3. Risk and safety of citizens as social responsibility is a prime concern of an engineer,
4. Technological advancement can be very demanding on the engineering skill in the global context,
5. Moral values and responsible conduct will play a crucial role in decision making.

Ethics:

- Study of right or wrong.
- Good and evil.
- Obligations & rights.
- Social & Political deals.

Engineering Ethics:

- Study of the moral issues and decisions confronting individuals and organizations engaged in engineering/profession.

- Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in the technological activity.
- Moral standards/values and system of morals.

Need to study Ethics:

- To responsibly confront moral issues raised by technological activity.
- To recognize and resolve the moral dilemmas.
- To achieve moral autonomy

The scope of engineering ethics envelopes diverse activities like

- Engineering as a social experimentation
- Engineers responsibility for safety
- Role of engineers, managers, consultants etc.
- Rights of engineers
- Moral reasoning and ethical theories
- Responsibility to employers
- Global issues and concerns

Moral Vs Ethics

MORAL:

- Refers only to personal behavior.
- Refers to any aspect of human action.
- Social conventions about right or wrong conduct.

ETHICS:

- Involves defining, analyzing, evaluating, and resolving moral problems
- and developing moral criteria to guide human behavior.
- Critical reflection on what one does and why one does it.
- Refers only to professional behavior.

Method used to solve an Ethical problem:

- Recognizing a problem or its need.
- Gathering information and defining the problem to be solved or goal to be achieved.
- Generating alternative solutions or methods to achieve the goal.
- Evaluate benefits and costs of alternate solutions.
- Decision making & optimization.
- Implementing the best solution.

Senses of Engineering Ethics:

- An activity and area of inquiry.
- Ethical problems, issues, and controversies.
- Particular set of beliefs, attitudes and habits.
- Morally correct.

Need for Authority: Authority provides the framework in which learning can take place.

Criteria required for a Profession:

- Knowledge
- Organization
- Public Good

General criteria to become a Professional engineer:

- Attaining standards of achievement in education, job performance or creativity in engineering that distinguish engineers from engineering technicians and technologists.
- Accepting as part of their professional obligations as least the most basic moral responsibilities to the public as well as to their employers, clients, colleagues, and subordinates.

- **Integrity:** Integrity is the bridge between responsibility in private and professional life.[8]

CONCLUSION

In a 1947 Newsweek article headlined "The Man Who Started It All," Einstein was quoted as saying,

"Had I known that the Germans would not succeed in producing an atomic bomb, I wouldnever have lifted a finger."

- Ethics is an important topic for engineers and architectures of every level and field.
- Ethical values provide the moral compass by which we live our lives and make decisions – 'doing the right thing' because it's the right thing to do.
- Education is a life time process beginning by birth.
- Family is the first phase of this process which was cultivated and carried out by the schooling and social settings in the later stages.
- Consisting of both academic and values education, it is one of the most powerful tools to change the world.
- Islam accepts 'knowledge' and taqwa, which can also be called the Islamic ethics, as the only criteria of superiority.
- It is well-regarded that ethics and fear of Allah contribute a lot to the society and those who possess these virtues and the Quran states that it is the ethics and taqwa (fear of Allah) that make human valuable.
- Justice, goodness, charity, good deeds, steadiness and right direction are defined as good ethics, which are praised and encouraged, whereas heresy, badness, immorality, wrong-doing, impiousness are rendered as bad morality and advised to keep away from.

8 https://njspe.org/2018/05/17/ethics-professional-engineers/#:~:text=Why%20Are%20Ethics,YOUR%20ETHICS%20CREDITS%3F

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(31.12.2022)

GLOBAL CLIMATE CHANGE AND POSSIBLE IMPACTS ON THE MARINE ENVIRONMENT

Serpil SAVCI[1]

Abstract: Water is one of the most important resources for the sustainability of life. The use of natural resources, the tendency to consume and production have increased with the industrial revolution. This situation has increased greenhouse gas emissions. It has caused global climate change. The inorganic carbon composition of sea waters is in a certain balance. In particular, the increase in CO_2 emissions has changed the carbon chemistry of sea waters. The decrease in the pH of seawater has resulted in ocean acidification. This situation adversely affected the marine life. Since the creatures living in the aquatic environment are sensitive, they can be affected by the environmental conditions they are in very easily. It is known that the effects of global climate change are seen faster in the aquatic ecosystem than in the terrestrial ecosystem. Global warming affects the oceans through changes in oxygen content, water temperature, acidification and sea level rise. In addition, the effects of global warming on sea creatures, food chain, plankton and seagrass meadows were also examined. The oceans have climate regulatory roles. Oceans store carbon and heat from the atmosphere. Thus, they prevent sudden climate changes. They provide a regular climate. They have an active role in reducing the environmental effects of global warming. The melting of the ice sheet on Earth will bring about changes in salinity. As the temperature rises, evaporation will increase and weather events such as storms and typhoons will increase. Climate change will affect the economy and ecosystem of countries. It will increase the pressure in the aquaculture and fisheries sector. The temperature of sea and ocean waters will increase with

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global warming. The glaciers will melt with the effect of increasing temperatures. The rise in sea water level will cause a change in light. The creatures living in the depths of the sea will be adversely affected by this. This will affect the migration, spawning and feeding of sea creatures. In addition, coastal erosion will increase and the quality of the coasts will deteriorate. Seawater temperature changes will also affect water quality parameters. Deterioration of water quality will also impair the quality of white meat, which is a healthy protein. With the increase in water temperatures, bacterial infections will increase and the immune system of the fish will be affected. In this study, the effects of climate change on the marine ecosystem were evaluated. In addition, the effects of global warming on sea creatures, food chain, plankton and seagrass meadows were also examined.

Keywords: Global Warming, Marine Ecosystems, Aquatic Environment, Fisheries

INTRODUCTION

Global warming; it can be defined as the increase in temperature on the earth as a result of the greenhouse effect of gases such as excess carbon dioxide (CO_2), carbon monoxide (CO), halocarbons (17 groups containing fluorine, chlorine, bromine or iodine) and methane (CH_4) released into the atmosphere as a result of industrial activities (Wrona, 2006).

Climate change can be caused by humans as well as natural causes such as slight shifts in the earth's axis, temporal differences in solar activity, volcanic activities and continental drift (Gosling, 2013; Mol et al., 2012). Especially since the industrial revolution, depending on the rapid increase in the accumulation of greenhouse gases released into the atmosphere as a result of the burning of fossil fuels and industrial and anthropological activities, with the contribution of urbanization and deforestation, the greenhouse effect has intensified and the temperature increase in the lower troposphere has begun to reach dangerous levels (Kayhan et al, 2015).

Although interest in global warming did indeed increase in the 1980s, when research activities increased as the potential negative effects

of global warming became clear, the science of climate change can trace its origins back to the early 19th century (Frost et al., 2017).

Climate change is manifested by the warming and acidification of the oceans, sea level rise, and intensification of extreme weather events. It affects the dynamics of a large number of biodiversity from genes to ecosystems at temporal and spatial scales (Gissi et al., 2021). It affects the dynamics of a large number of biodiversity from genes to ecosystems at temporal and spatial scales.

In the last decade, anthropogenic climate change has been recognized as a global biodiversity threat, motivating extensive research on its biological effects (Wernberg, 2012). However, most research has focused on terrestrial ecosystems and detailed information on impacts on marine ecosystems lags behind (Takolander, 2017).

In this book chapter, global warming and its effects on the marine ecosystem are explained. In addition, how global warming affects fishing activities, seagrass meadows and phytoplankton is also emphasized. The effects on the Antarctic continent are explained especially on the basis of past and present water levels. The conditions of the creatures living on the Antarctic continent are also explained in this book chapter.

Marine Environment

Unfortunately, many marine ecosystems are declining as a result of climate change and human activities (Chinenye et al., 2021).

Human activities affect almost all of the oceans. Eroded sediments, nutrients and chemicals from agriculture and urbanization flow into basins and coastal oceans, causing pollution. Ecosystem changes, such as rising sea levels and reduced growth of coral reefs, can negatively impact coastal communities in relation to global warming (Cheal et al., 2017).

Marine species are key to sustaining primary and secondary productivity in the oceans (Horton, 2020). The warming of the oceans intensifies the oxygen depletion and can encourage the growth of harmful algal blooms that lead to the death of marine organisms (Chinenye, 2021).

Deep-sea species have adapted to certain consistent environmental conditions for over a millennium and are highly vulnerable to environmental change (Lincoln et al., 2022; Biltekin et al., 2021; Portner et al., 2008).

Any impact on marine life will become a problem for the production and quality of desalinated water, which will have a significant impact on the unique water resources of many countries (Al-Humaiqani and Al-Ghamdi, 2022).

In the seas of Turkey, changes in sea water temperature and water parameters have occurred as a result of climate changes due to global warming (Ömeroğlu Tapan et al., 2021).

Changes caused by global warming are above (Sağlam et al., 2008);

- *İnhibit the shell-forming abilities of organisms changes in ocean chemistry, such as acidification.*
- *Ocean cycles affecting population dynamics*
- *Cloud cover affecting light penetration to the ocean surface and changes in sea ice*

Therefore, reducing anthropogenic effects in seawater pH could affect entire marine ecosystems [(1)]. Figure 1 shows that sea ecosystem before acidification and Figure 2 shows that sea ecosystem after acidification.

Figure 1. Before Acidification

Figure 2. After Acidification[2]

Diseases on sea creatures will increase. Increase in sea water temperatures and acidification will affect fishing activities by decreasing fish abundance. Countries whose economy depends on aquaculture will be adversely affected by this situation. With climate change, the population of invasive species will increase, which will negatively affect biodiversity. It is also thought that invasive species will cause great damage to the economy. In addition to these, divers, holidaymakers and fishermen will encounter these species more and injuries may occur. Each of the climate zones in the world will be affected differently by global warming. Sea creatures will migrate to different places. The fishing industry will be adversely affected. In species that love cold waters, mass deaths will occur.

The increase in ocean temperature accelerates the metabolism and oxygen uptake of organisms, thus reducing oxygen concentrations in the water. This may ultimately make some parts of the ocean uninhabitable for marine life. For example, precipitation carries nutrients from

2 (1)https://ocean.si.edu/ocean-life/invertebrates/ocean-acidification. Access:26.07.2022. (2-3)http://cecilebrugere.com/?p=494. Access:25.07.2022.

agricultural fertilizers to the sea. The remainder comes predominantly from nitrogenous gases released when fossil fuels are burned. When this happens in the sea, it creates a condition known as algae overgrowth. Oxygen in the water is depleted due to the over respiration and death and decay of these aquatic plants. This results in a lack of oxygen and ultimately leads to the formation of "hypoxic areas", or dead areas, where aerobic life can no longer live. Even if the release of nutrients into European seas has now come to a halt, nutrient emissions from past years will continue to create dead zones if the seas are not restored for years to come[4].

ECOSYSTEMS

7,000 living species are displaced daily by ship ballast water, where 80% of the world trade is carried out by sea transport. Climate change has direct effects that change the growth, reproductive capacity, mortality and distribution of fish stocks, and indirect effects that change the productivity, structure and composition of marine ecosystems. Ocean or inland waters temperature, salinity, oxygen level, carbon/acid, water stress, water capacity, water flow, changes in sea level, changes in precipitation amount, time and discharge, ice and currents, changes in water currents, changes in oceanography, storm, hurricane and tsunamis, overuse and salinization of groundwater, amount of sediment, hypoxia, stratification, impact on marine and inland water ecosystems, damage to habitats, damage to coral reefs, primary production and plankton structures, algal bloom, shifting of species, extinction of local species, overfishing, Ciguatera and Puffer fish poisonings, increase in shellfish prelarva diseases, spread of vectorial diseases, increased risks of species invasion, vaccination of non-native aquatic species and the effects of pollution and environmental stressors with the increase in human population are the negative effects of climate change. Changes in temperature and salinity of the oceans due to the effect of climate, decrease in ice cover, increase in ocean surface density and vertical stratification will change the surface mixing, decrease oxygen transmission, change oxy-

gen concentrations, and low oxygen levels will expand. As a result, the primary and secondary production of eutrophic regions in oceans and[3]

lakes will decrease. The fact that algae biomass and nutrient reduction in lakes will reduce productivity also creates an uncertainty expectation (Diken, 2020).

Jellyfish become a problem when ecosystem cycles are disrupted. In the Mediterranean, swarms of jellyfish emerged as a result of rapid reproduction and growth of Jellyfish populations. It occurs every year and lasts longer. As the flocks expand, changes occur in regional ecosystems that seriously affect the fishing and tourism sectors. Flocks of jellyfish fill fishing nets across the Mediterranean, prey they damage their vehicles, fishermen make a living by fishing instead of having to clean jellyfish from the nets for hours. In the Gulf of Gabes in Tunisia, some fishermen reported catching more jellyfish than fish. Recently, a 10-ton trawler boat sank in Japan, unable to support the weight of giant jellyfish caught in nets.

Jellyfish can also be poisonous. Fishermen are often damaged by jellyfish while cleaning their nets. This has become a growing problem in tourism centers in the Mediterranean. A beach full of stinging jellyfish soon loses its appeal, and local communities suffer economic losses due to dwindling visitor numbers. Swarms of jellyfish threaten other industries: they can invade aquaculture cages and harm fish there, or even drain the cooling water inlets of power plants. They can clog and reduce energy production efficiency. Higher sea temperatures extend the lifespan of jellyfish swarms and some species are more likely to breed in the winter. Figure 3 shows Giant Barrel Jellyfish.

3 (4)https://www.eea.europa.eu/tr/isaretler/isaretler-2015/makaleler/iklim-degisikligi-ve-denizler#:~:text=%C4%B0klim%20de%C4%9Fi%C5%9Fikli%C4%9Fi%2C%20okyanuslar%C4%B1%20%C4%B1s%C4%B1tarak%20deniz,deniz%20biyo%C3%A7e%C5%9Fitlili%C4%9Finin%20kayb%C4%B1na%20yol%20a%C3%A7ar. Access:25.07.2022.

Figure 3. Giant Barrel Jellyfish [5]

High temperatures also make the Mediterranean more hospitable for invasive jellyfish from tropical waters. On the other hand, the increase in the amount of nitrogen and phosphate in the water (eutrophication) due to excessive use of fertilizers in agricultural activities carried out on land causes the proliferation of algae clusters and the formation of oxygen-free 'dead zones'.

Jellyfish are larval or immature in commercial fish species (even in species such as anchovies and sardines adults) eat the zooplankton or copepods they feed on, so the more jellyfish there are in the ecosystem, the less food is left for other fish that feed on plankton. On top of that, jellyfish eat fish eggs and larvae, preventing fish from reproducing and reducing the number of fish that reach adulthood. As fish larvae feed and also compete with fish for food, they will become the new super predators of the Mediterranean, which will become jellyfish[6].

FISHERY

Fish is an important source of essential vitamins and fatty acids, as well as being a valuable protein for human metabolism. In addition, global fishing benefits more than 56 million fishermen worldwide and directly and indirectly supports the livelihoods of 12% of the world's population (Talloni- Álvarez et al., 2019).

Climate change causes changes in the body size of marine species (Doney et al., 2021).

Species that do not tolerate high temperatures will either perish or migrate to cooler waters. This situation will cause competition for food and habitat between them and the native species living in the places they will go (Karakaş, 2005).

The direct effect of global warming is the appears as an elevation of water temperature. This causes stress on species that are at or near their physiological limits. With the warming trend, most organisms develop different physiological tolerance differences according to temperature and precipitation. Some species cannot adapt to high temperatures and may die or have to migrate to regions with more favorable conditions (Sağlam et al., 2008).

It is thought that the effects of climate change on fish stocks will adversely affect their national economies, especially in fish-dependent countries (Allison, 2009).

Global warming can have the following consequences in fisheries specifically (Sağlam et al., 2008);

- *A longer growing season and increased biological process rates and the increasing risk of oxygen consumption*
- *Species more tolerant and possibly less oxygenated being diverted to the waters,*
- *The fish living in coastal areas are affected by the rise in sea water levels and the transfer of pollutants to the marine environment,*
- *Changes in precipitation, freshwater flows and lake levels*

[4]It is thought that the rise in sea level, which is one of the potential effects of global warming, will cause floods and overflows, and increase in soil loss in the coastal area. On the other hand, mixing of fresh and salt water and damage to the ecosystem in coastal areas can be listed among the possible effects (Doğan and Tüzer, 2011; Şanlı et al., 2017). Figure 4 shows sea level rise.

Figure 4. Rise in Sea Level Village of Eita in Tarawa, Kiribati(7)

Tuna, one of the most important commercial fish in the world, is an active, mobile and fast swimming creature that needs a lot of oxygen to maintain its life style. In order to obtain sufficient oxygen, they must continue swimming uninterruptedly by taking more water from their gills. Therefore, as the temperature rises, they are particularly sensitive to their need for oxygen to support their body's growth (Atar ve Kızılgök, 2018).

4 https://www.businessinsider.com/jellyfish-thriving-climate-change-warm-oceans-2019-10. Access:25.07.2022.
https://wwftr.awsassets.panda.org/downloads/wwf_med_tr3.pdf. Access:25.07.2022.

Precipitation irregularities due to global warming have led to the drying up of many rivers and lakes. In these habitats, which are used as fisheries resources, economic fish stocks have been lost in lakes and rivers due to excessive rainfall and floods. For example, anchovy fish, which takes the water temperature as a reference while forming a flock, delayed their migration to our shores during periods when there was no snowfall and the water temperature did not fall to 16-17 ^{0}C, or they could not form a flock. This adversely affected the anchovy fishing with purse seines (Sağlam et al., 2008).

The increase in seasonal and annual variability in precipitation and the resulting floods and droughts have the potential to be one of the worst scenarios in inland fisheries and fish[5] farming. In floods and higher rainy seasons, stream currents can cause a decrease in the spawning success of river fish, and a decrease in the survival potential of fish in drought periods.

In still waters; Especially in shallow lakes, the water level is the most important factor determining the stock size, and catch rates decrease when lake levels are low ((Atar ve Kızılgök, 2018).

It is thought that global warming may lead to the deterioration of coral reefs in the seas (Lespinas et al., 2014).

PHYTOPLANKTONS

The effect of global warming on phytoplankton will be increased stratification in the water column with warming. Increasing stratification in the oceans will lead to a decrease in primary production in the luminous surface layer, as the vertical mixing will decrease and thus the transport of nutrient salts to the upper layer will decrease. In addition to these changes in plankton metabolism and carbon cycles, increases in hypoxic conditions will be observed as the oxygen solubility in the seas will decrease with the increase in temperature (Salihoğlu and Öztürk, 2021). It is predicted that phytoplankton communities will shift towards small cell size with the warming in the seas. Therefore, the sinking rate

5 https://www.nrdc.org/experts/rhea-suh/inaction-climate-change-will-leave-us-lost-sea Access:25.07.2022.

of phytoplankton in the water column will slow down. This will increase the accumulation of CO_2 in the upper layer of the ocean, raising the ocean pH levels and causing acidification (Salihoğlu and Öztürk, 2021). Figure 5 shows phytoplanktons in Norway and Russia.

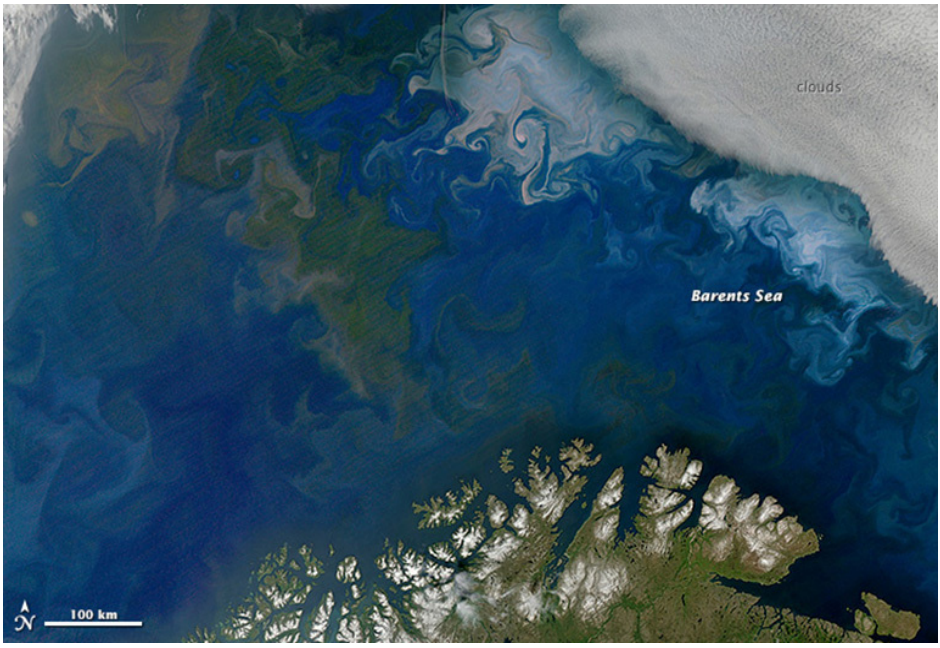

Figure 5. Phytoplanktons Coast of Norway and Russia[8]

The warming of the oceans has a strong impact on marine life, and biodiversity is at greater risk. This is best explained by looking at the state of warm water plankton in the Northeast Atlantic. Some copepods move northward, covering a distance of 200-250 km every ten years. These tiny copepods are near the bottom of the food chain. Animals living outside of their optimum temperature ranges expend more energy for respiration to the detriment of their other functions.

Also, the spores, eggs, and progeny of these animals will struggle to thrive at substandard temperatures. This chain of events can ultimately affect the overall functioning of the ecosystem, resulting in loss of biodiversity. As they rise up the food chain, animals that cannot find food are forced to migrate to survive. In Europe, where the sea surface tempera-

ture is rising faster than the global oceans, these animals predominantly move northward.

This phenomenon can affect fish reserves, as illustrated by the example of mackerel starting to live in waters further north. This could have a knock-on effect on local fishermen and more remote communities. One of the knock-on effects is the "mackerel war" between the EU and the Faroe Islands The extra time fish reserves spend in Faroese waters has resulted in a dispute over fishing rights. From the Faroese perspective, they have the right to fish in their own waters, but from the EU perspective, agreements on sustainable fishing quotas have been violated and could potentially lead to overfishing and the resulting loss of income and jobs in the EU.

The debate ended in 2014 when the EU lifted import bans on fish caught in Faroese waters in exchange for ending fishing by the islanders[(9)]. When evaluated in terms of water quality, the most important factor affecting the state of oxygen in water can be considered as temperature. Warming waters will reduce the amount of dissolved O_2 in its content, which can cause stress, disease, migration or loss of all aquatic organisms in a given habitat, from phytoplankton to fish (Atar ve Kızılgök, 2018).

Sea Grasses

Seagrasses are ecosystem engineers that cover large areas in light-sufficient regions along temperate and tropical coastlines around the world. Seagrasses have roles such as carbon and sediment sequestration, nutrition, protection of beaches against erosion, stabilization and biodiversity. Figure 6 shows Sea Grasses. [6]

6 https://climate.nasa.gov/news/2343/study-shows-oceanic-phytoplankton-declines-in-northern-hemisphere/ Access:25.07.2022.
https://www.clientearth.org/latest/latest-updates/news/how-does-seagrass-help-fight-climate-change/ Access:25.07.2022.

Figure 6. Sea Grasses[10]

It is thought that climate change will also affect seagrass meadows. Depending on global warming, the areas covered by seagrass meadows will decrease or even disappear. Destroyed meadows also release the carbon they contain, causing a decrease in pH in the environment, acidification of the seas and damage to living things (Salihoğlu and Öztürk, 2021).

Besides acidification, another global environmental problem is the rise in sea water. The change in light with a few centimeters of sea level rise can cause a linear regression of up to several meters at the deep boundary. This can cause seagrass to be pulled upwards (Salihoğlu and Öztürk, 2021).

Foreign invasive plants that have recently entered the Mediterranean have had many adverse effects on native seagrass meadows. On the seagrass meadows of these species; Negative effects such as decrease in leaf density, more energy expenditure for sexual reproduction, increase in phenolic compounds formed against stress, deterioration in sediment quality were determined (Salihoğlu and Öztürk, 2021).

Climate change poses threats on seagrass meadows such as increase in surface water temperatures, changes in sea water level, period of increase in storm intensity and frequency (Salihoğlu and Öztürk, 2021).

As a result, climate change may also accelerate seagrass losses (Salihoğlu and Öztürk, 2021).

ANTARCTICA

The changes that global warming has created on the earth so far; increase in sea surface water temperatures, decrease in ice masses at the poles, decrease in sea surface pH values and dissolved oxygen concentrations, and sea level rise (IPCC 2019). Antarctica is the coldest, windiest and driest continent with more than 70% of the world's fresh water in the form of ice sheets (Öztürk, 2015).

Although the Antarctic Region is far from other regions, there are studies that a possible increase in the temperature of the region will affect ecosystems all over the world (Barret et al., 2015; Antacli et al., 2021; González-Burgos, 2019).

Euphausia superba is a shrimp species used as food by fish, birds and whales. Penguins, albatrosses and seals also turn to this species when they are short of food. This species is mostly found in the Southern Hemisphere. The existence of this creature is based on the existence of phytoplankton living at depths where the sun's rays can penetrate the water sufficiently. The existence of this creature has decreased by 80% in 30 years [Atkinson et al., 2004; Özalp, 2012).

In the Figure 7, there are before and after photos of the glaciers in West Antarctica in the study by NASA. It is estimated that glaciers will disappear completely this century if necessary and adequate measures are not taken(11).

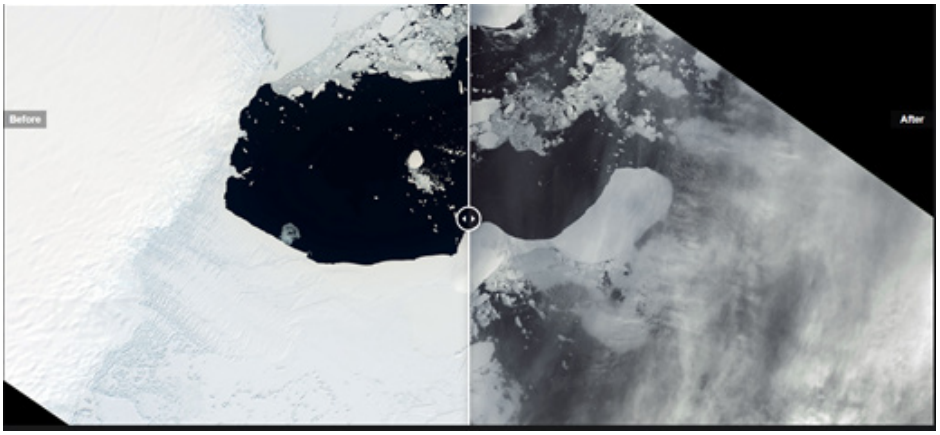

Figure 7. Change in the East Antarctica Ice Shelf[11]

[7]RESULT and DISCUSSION

It is a known fact that if necessary precautions are not taken, all parts of our world will be adversely affected by global warming. Changing climatic conditions will affect all societies in search of quality protein. Increases in water temperature will cause species to leave areas where they have lived for centuries. Mass deaths will occur, especially in species that live in cold waters. Global warming will also affect the food chain after the decrease in the number of these creatures or mass deaths. Invasive species will increase and disease risks will arise.

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7 (https://www.eea.europa.eu/tr/isaretler/isaretler-2015/makaleler/iklim-degisikligi-ve-denizler#:~:text=%C4%B0klim%20de%C4%9Fi%C5%9Fikli%C4%9Fi%2C%20okyanuslar%C4%B1%20%C4%B1s%C4%B1tarak%20deniz,deniz%20biyo%C3%A7e%C5%9Fitlili%C4%9Finin%20kayb%C4%B1na%20yol%20a%C3%A7ar.). https://climate.nasa.gov/images-of-change/?id=788#788-east-antarctica-ice-shelf-collapses. Access: 31.05.2022.

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MIRACLE OF QUR'AN IN MATERIAL SCIENCE

Zeki ÇİZMECİOĞLU[1], Ömer Cengiz SEZGİN[2]

Abstract: Fourteen centuries ago, Allah sent down the Qur'an to mankind as a book of guidance. He called upon people to be guided to the truth by adhering to this book. From the day of its revelation to the day of judgement, this last divine book will remain the sole guide for humanity. The matchless style of the Qur'an and the superior wisdom in it are definite evidence that it is the word of Allah. In addition, the Qur'an has many miraculous attributes proving that it is a revelation from Allah. One of these attributes is the fact that a number of scientific truths that we have only been able to uncover by the technology of the 21th century were stated in the Qur'an 1,400 years ago. Of course the Qur'an is not a book of science. However, many scientific facts that are expressed in an extremely concise and profound manner in its verses have only been discovered with the technology of the 21th century. These facts could not have been known at the time of the Qur'an's revelation, and this is still more proof that the Qur'an is the word of Allah. In this study, some Miracles of Qur'an are going to be explained about iron, the pairs of chemical bonds and Sed of Zulkarneyn in Material Science.

Keywords: Qur'an, Material Science, Iron, Pairs, Sed of Zulkarneyn

THE MIRACLE of QUR'AN ABOUT IRON in MATERIAL SCIENCE

The Mıracle Of Iron By The Van Allen Radıatıon Belts In The Earth

Iron is one of the elements highlighted in the Qur'an. In Sura Hadid, meaning Iron, we are informed:

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"…And We sent down iron in which there lies great force and which has many uses for mankind…" (The Qur'an, 57:25)

The word "sent down," particularly used for iron in the verse, could be thought of having a metaphorical meaning to explain that iron has been given to benefit people. But when we take into consideration the literal meaning of the word, which is, "being physically sent down from the sky", we realize that this verse implies a very significant scientific miracle.

This is because modern astronomical findings have disclosed that the iron found in our world has come from the giant stars in outer space.

The heavy metals in the universe are produced in the nuclei of big stars. Our solar system, however, does not possess a suitable structure for producing iron on its own. Iron can only be produced in much bigger stars than the Sun, where the temperature reaches a few hundred million degrees. When the amount of iron exceeds a certain level in a star, the star can no longer accommodate it, and eventually it explodes in what is called a "nova" or a "supernova". As a result of this explosion, meteors containing iron are scattered around the universe, and they move through the void until attracted by the gravitational force of a celestial body.

All this shows that iron did not form on the Earth, but was carried from exploding stars in space via meteors, and was "**sent down to earth**", in exactly the same way as stated in the verse: It is clear that this fact could not have been scientifically known in the 7th century, when the Qur'an was revealed.

The word **"*anzalna*,"** translated as "sent down" and used for iron in the verse, could be thought of having a metaphorical meaning to explain that iron has been given to benefit people. But, when we take into consideration the literal meaning of the word, which is, "being physically sent down from the sky, as this word usage had not been employed in the Quran except literally, like the descending of the rain or revelation, we realize that this verse implies a very significant scientific miracle. Because, modern astronomical findings have disclosed that the iron found

in our world has come from giant stars in outer space as ıt is shown in Figure 1.

Figure 1. The Iron Has Come From Outer Space[3]

In addition, there is another hidden truth in the Qur'an that draws attention to the importance of iron: The Surah Hadid, which refers to iron, contains two very interesting mathematical codes. "Al-Hadid" is the 57th surah of the Koran. When the numerological values of their letters are collected, the "abjad" of the word "Al-Hadid" in Arabic is 57. (An Abjad account is an accounting system of eight words written in Islamic letters, with each letter showing a number.) The value of the word "hadid" is 26. And 26 is the atomic number of iron.

Why Quran doesn't have a surah on silver or gold but it has about iron? Even with all this information, some might say it's just a coincidence. If it's just a coincidence, then it's a really great coincidence.

3 www.wamy.co.uk/announcements3.html

Not only the iron on earth, but also the iron in the entire Solar System, comes from outer space, since the temperature in the Sun is inadequate for the formation of iron. The sun has a surface temperature of 6,000 degrees Celsius, and a core temperature of approximately 20 million degrees. Iron can only be produced in much larger stars than the Sun, where the temperature reaches a few hundred million degrees. When the amount of iron exceeds a certain level in a star, the star can no longer accommodate it, and it eventually explodes in what is called a "nova" or a "supernova." These explosions make it possible for iron to be given off into space.[4]

One scientific source provides the following information on this subject:

"There is also evidence for older supernova events: Enhanced levels of iron-60 in deep-sea sediments have been interpreted as indications that a supernova explosion occurred within 90 light-years of the sun about 5 million years ago. Iron-60 is a radioactive isotope of iron, formed in supernova explosions, which decays with a half life of 1.5 million years. An enhanced presence of this isotope in a geologic layer indicates the recent nucleosynthesis of elements nearby in space and their subsequent transport to the earth (perhaps as part of dust grains)."[5]

All this shows that iron did not form on the Earth, but was carried from Supernovas, and was "sent down," as stated in the verse. It is clear that this fact could not have been known in the 7th century, when the Quran was revealed. Nevertheless, this fact is related in the Quran, the Word of Allah, Who encompasses all things in His infinite knowledge.

The fact that the verse specifically mentions iron is quite astounding, considering that these discoveries were made at the end of the 20th century. In his book Nature's Destiny, the well-known microbiologist Michael Denton emphasizes the importance of iron:

"Of all the metals there is none more essential to life than iron. It is the accumulation of iron in the center of a star which triggers a supernova explosion and the subsequent scattering of the vital atoms of life

4 www.wamy.co.uk/announcements3.html
5 www.americanscientist.org/template/AssetDetail/assetid/21173?fulltext=true.

throughout the cosmos. It was the drawing by gravity of iron atoms to the center of the primeval earth that generated the heat which caused the initial chemical differentiation of the earth, the outgassing of the early atmosphere, and ultimately the formation of the hydrosphere. It is molten iron in the center of the earth which, acting like a gigantic dynamo, generates the earth's magnetic field, which in turn creates the Van Allen radiation belts that shield the earth's surface from destructive high-energy-penetrating cosmic radiation and preserve the crucial ozone layer from cosmic ray destruction.

"Without the iron atom, there would be no carbon-based life in the cosmos; no supernovae, no heating of the primitive earth, no atmosphere or hydrosphere.

There would be no protective magnetic field, no Van Allen radiation belts (Figure 2) no ozone layer, no metal to make hemoglobin [in human blood], no metal to tame the reactivity of oxygen, and no oxidative metabolism.

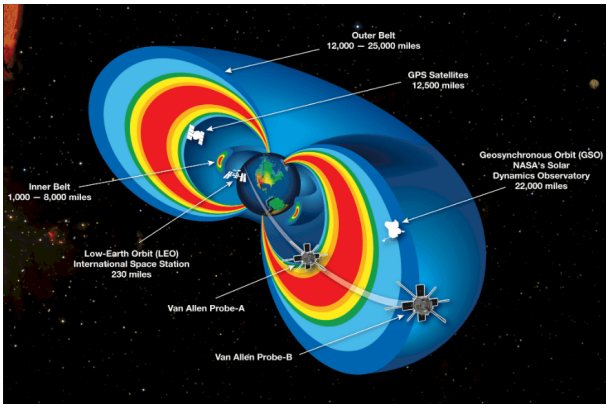

Figure 2. Van Allen Radiation Belts

A Van Allen radiation belt is a zone of energetic charged particles, most of which originate from the solar wind, that are captured by and held around a planet by that planet's magnetosphere. Earth has two such belts, and sometimes others may be temporarily created. The belts are named after James Van Allen, who is credited with their discover-

y.[6]Earth's two main belts extend from an altitude of about 640 to 58,000 km (400 to 36,040 mi)[2] above the surface, in which region radiation levels vary. Most of the particles that form the belts are thought to come from solar wind and other particles by cosmic rays. By trapping the solar wind, the magnetic field deflects those energetic particles and protects the atmosphere from destruction.[7]

Hard on the heels of the Soviet Union, the United States entered the space race fractionally over 50 years ago. The scientific instrumentation of America's first Earth-orbiting satellite, Explorer 1, launched on 31 January 1958, was designed and built under the direction of one James Van Allen of the University of Iowa. It included a Geiger counter, the first recordings from which reportedly moved one of Van Allen's team to utter an exclamation ripe for a science-fiction movie[1]: "My God, space is radioactive!" Since that first entirely unexpected revelation about our near neighbourhood, the belts of radiation that envelop Earth — the Van Allen belts — have only slowly yielded their secrets. The latest development is recounted by Bortnik *et al.*[2] on page 62 of this issue: a new explanation for how the gap found in their midst arises.

The Van Allen belts consist of a cloud (a 'plasma') of highly energetic charged particles, mainly electrons and protons, trapped by Earth's magnetic field. During 'quiet' times, the energetic electrons of the radiation belt are distributed into two regions: the inner belt, at altitudes above Earth's Equator of between around 1,500 and 10,000 km; and the outer

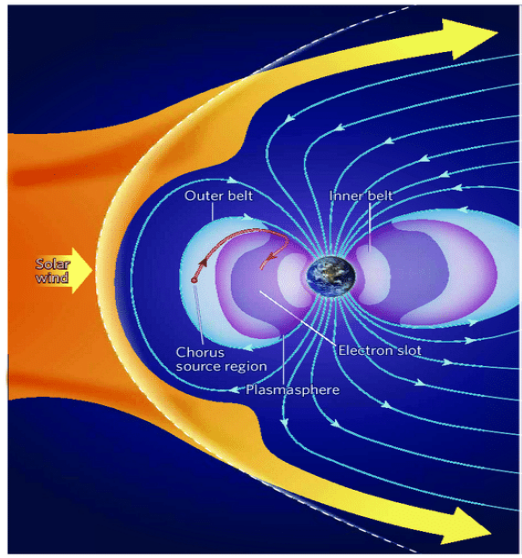

Figure 3. Protection of the Van Allen Belts[8]

MIRACLE of QUR'AN ABOUT USAGE of IRON ad STEEL in THE INDUSTRY

The iron and steel industry is very important industry as its output is required tomake houses and buildings, vehicles, equipment, machinery, houshold appliances, and much more. This industry is linked to

6 https://www.radiation-dosimetry.org/what-is-radiation-from-earths-radiation-belts-van-allen-belts-definition/

7 https://en.wikipedia.org/wiki/Van_Allen_radiation_belt

8 https://www.researchgate.net/profile/Michael-Tice/publication/5528868/figure/fig2/AS:667031867244566@1536044198844/Earths-engirdling-belts-The-Van-Allen-radiation-belts-light-blue-consist-of-hot.png

construction, agriculture, manufacturing, and transportation. It is a basic industry that supplies its products as raw material to other industries. Iron and steel industry is called the basic industry. Because it provides base to the other industries. Figure 4 shows flowsheet of ıron and steel from raw materials. Figure 5 shows top 10 Steel Producers in 2021.

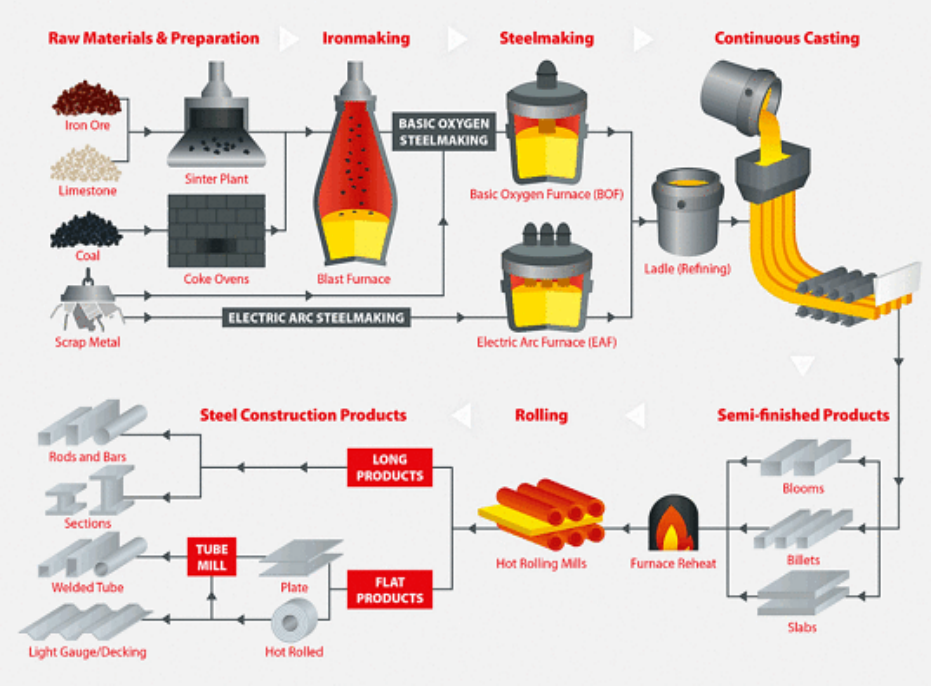

Figure 4. Flowsheet of Iron and Steel from Raw Materials[9]

9 https://www.vepica.com/hsfs/hubfs/V%C3%ADctor%20Nieto%203..gif?width=537&name=V%C3%ADctor%20Nieto%203..gif

Top 10 steel producers

Country	2021 output	% rise drop vs 2020
China	1,032.80	-3.0
India	118.10	17.8
Japan	96.30	14.9
US	86.00	18.3
Russia	76.00	Jun 1
South Korea	70.60	5.2
Turkey	40.40	12.7
Germany	40.10	12.3
Brazil	36.00	14.7
Iran	28.50	-1.8

Source: World Steel Association; Figures in million tonnes

Figure 5. Top 10 Steel Producers[10]

MIRACLE of QUR'AN ABOUT IRON in HUMAN BODY

The benefits of iron in human body:

Reduces tiredness and fatigue. Contributes to the normal formation of red blood cells and haemoglobin function, to carry oxygen around the body to support body function. Supports normal cognitive function. Improves physical performance, while contributing to muscle growth and body development. Supports the immune system. Assists with a healthy pregnancy. Supports vaccine efficacy.

What does it do in the human body?

Iron is an essential mineral that's needed for making haemoglobin, a protein found in red blood cells that helps transport oxygen around the body.

It plays a key role in supporting the immune system, too. Iron also helps maintain our energy levels, regulate body temperature and may even improve athletic performance.

10 https://www.thehindubusinessline.com/incoming/70ubcl/article64944322.ece/alternates/FREE_320/bl29_steel.jpg

If you don't get enough iron, you can feel tired and may be more susceptible to infections. A severe lack of iron could even lead to iron deficiency anaemia, which causes pale skin, feeling out of breath and heart palpitations.

Iron is important for making haemoglobin in red blood cells, which carries oxygen around the body into our muscles and tissues. Iron is also found in muscle cells as myoglobin, which accepts and stores oxygen for later use.

You also need iron to support your immune system. If you're not getting enough in your diet, you may be more susceptible to illnesses and infection.

Iron from animal sources (haem iron) is more easily absorbed by the body, but you can increase absorption of non-haem iron from plant sources by eating them with a source of vitamin C. So, you could have a glass of orange juice along with a veggie curry but avoid having a cup of tea, as it can stop your body absorbing non-haem iron. Leave at least an hour either side of eating before your cuppa.

What are the symptoms of iron deficiency?

If your body doesn't get enough iron, you won't have enough haemoglobin for your tissues and muscles to function normally. This leads to a condition called iron deficiency anaemia. Symptoms of iron deficiency anaemia include:

- fatigue
- feeling weak or tired
- pale skin
- shortness of breath
- heart palpitations
- headache
- sore tongue
- hair loss
- mouth ulcers

More than two billion people across the globe have iron deficiency anaemia, making it the world's most common nutritional deficiency. Women are particularly at risk, due to periods, pregnancy and breastfeeding. Vegetarians, vegans or those who don't eat a lot of meat may also have low iron levels.

"The intriguing and intimate relationship between life and iron, between the red color of blood and the dying of some distant star, not only indicates the relevance of metals to biology but also the biocentricity of the cosmos…"(Denton, M. J.,1998)

Iron plays a critical role in oxygen circulation in our body. It is component of hemoglobin, substance found in red blood cells that carried trough the bood. This account clearly indicates the importance of the iron atom. The fact that particular attention is drawn to iron in the Quran also emphasizes the importance of the element. Figure 6. and Figure 7 show the benefits of iron in our body. Figure 8 shows role of iron in oxygen circulation.

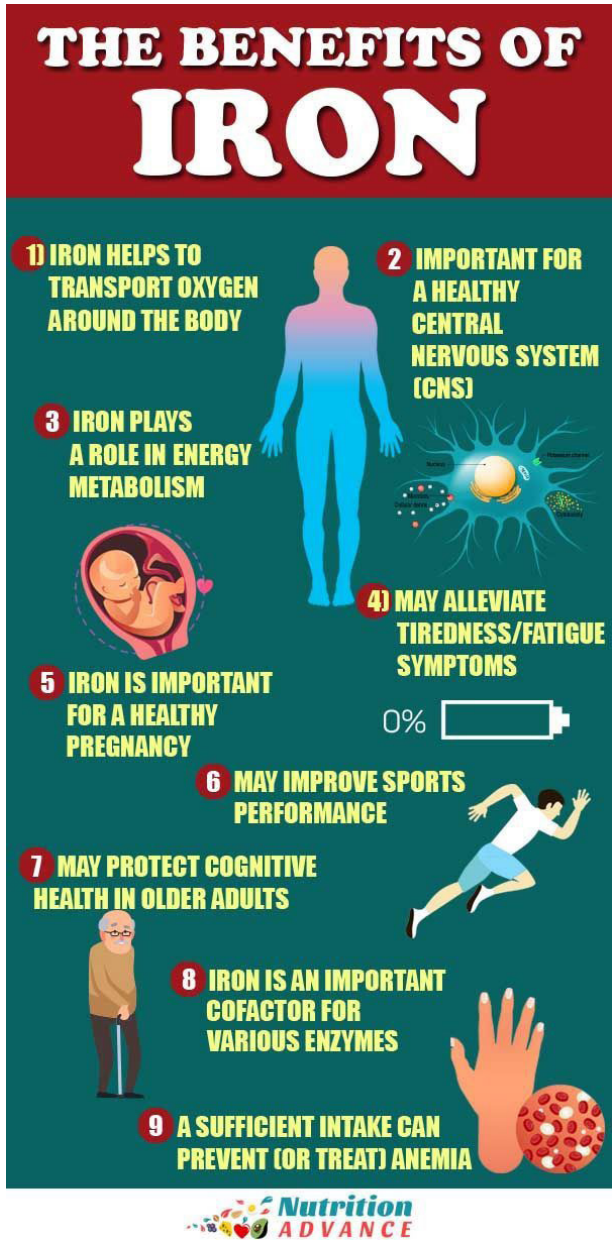

Figure 6. The 9 Benefits of Iron in Our Body[11]

11 https://i.pinimg.com/originals/7e/92/95/7e9295b38a13bbd7883a8aafa860be69.jpg

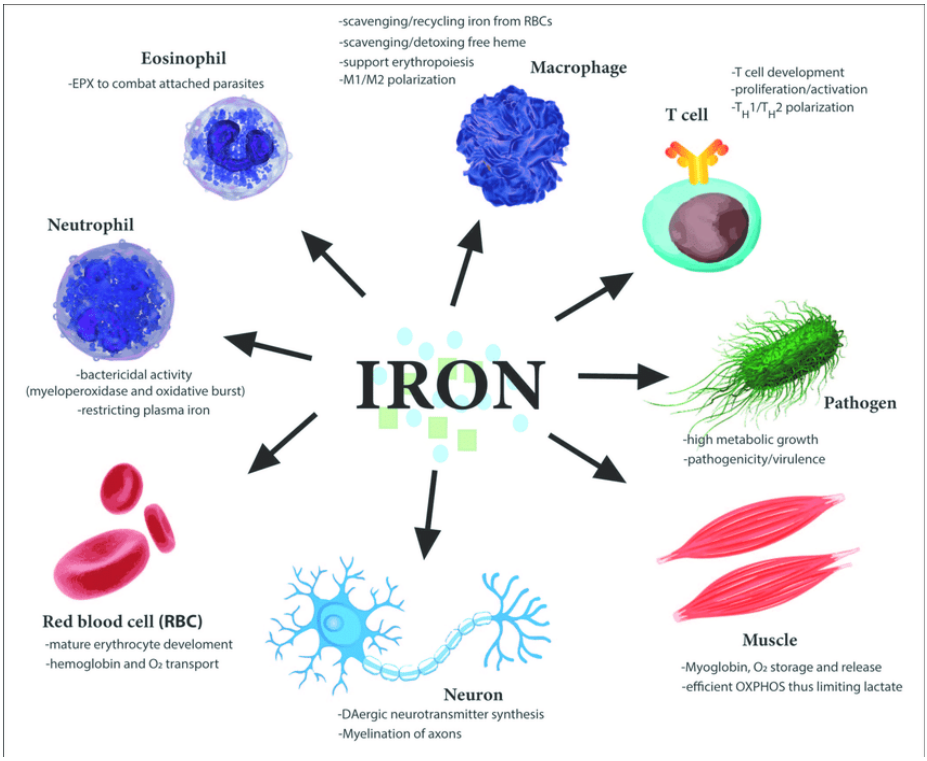

Figure 7. The Benefits of Iron in Our Body

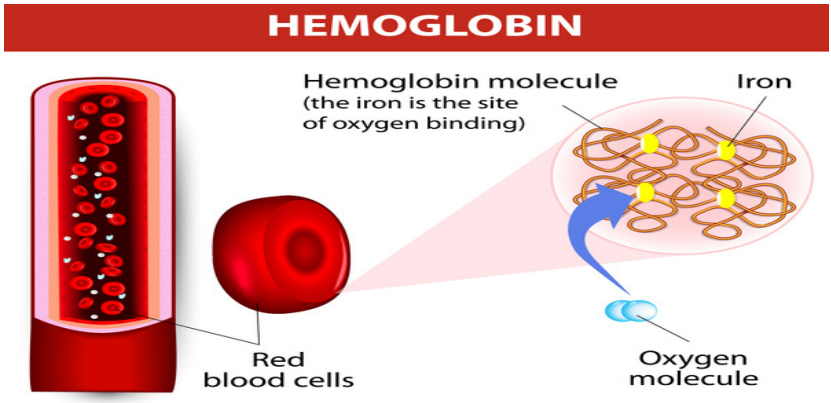

Figure 8. Iron Which Binds Oxygen in Hemoglobin Molecule of Blood[12]

12 https://www.researchgate.net/publication/337454535/figure/fig1/AS:828220819652609@1574474639402/Essential-role-of-iron-for-various-cell-types-Iron-is-needed-by-many-different-

Moreover, iron oxide particles were used in a cancer treatment in recent months and positive developments were observed. A team led by Dr. Andreas Jordan, at the world famous Charité Hospital in Germany, succeeded in destroying cancer cells with this new technique developed for the treatment of cancer—magnetic fluid hyperthermia (high temperature magnetic liquid). As a result of this technique, first performed on the 26-year-old Nikolaus H., no new cancer cells were observed in the patient in the following three months.

Figure 9 shows cancer treatment with iron oxide particles

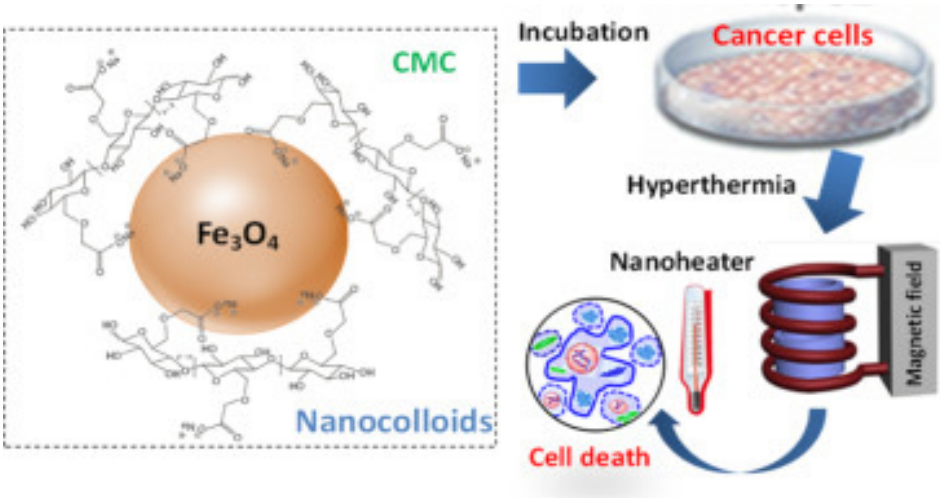

Figure 9. Cancer Treatment With Iron Oxide Particles-[13]

This method of treatment can be summarized as follows:

1. A liquid containing iron oxide particles is injected into the tumour by means of a special syringe. These particles spread throughout the tumour cells. This liquid consists of thousands of millions of particles, 1,000 times smaller than the red blood corpuscles, of iron oxide in 1 cm3 that can easily flow through all blood vessels.[14]

cell.png

13 https://ars.els-cdn.com/content/image/1-s2.0-S0141813019305537-ga1.jpg

14 www.inm-gmbh.de/cgi-bin/frame/frameloader.pl?sprache=en&url=http://www.inm-gmbh.de/htdocs/technologien/highlights/highlights_en.htm

2. The patient is then placed in a machine with a powerful magnetic field.

3. This magnetic field, applied externally, begins to set the iron particles in the tumour in motion. During this time the temperature in the tumour containing the iron oxide particles rises by up to 45 degrees.

4. In a few minutes the cancer cells, unable to protect themselves from the heat, are either weakened or destroyed. The tumour may then be completely eradicated with subsequent chemotherapy.

In this treatment it is only the cancer cells that are affected by the magnetic field, since only they contain the iron oxide particles. The spread of this technique is a major development in the treatment of this potentially lethal disease. Iron has also been found to be a cure for people suffering from anemia. In the treatment of such a widespread diseases, the use of the expression "iron in which there lies great force and which has many uses for mankind" (Quran, 57:25) in the Quran is particularly noteworthy. Indeed, in that verse, the Quran may be indicating the benefits of iron even for human health.

Iron SpaceIn addition, there is another hidden truth in the Qur'an that draws attention to the importance of iron: The Surah Hadid, which refers to iron, contains two very interesting mathematical codes. "Al-Hadid" is the 57th surah of the Koran. When the numerological values of their letters are collected, the "abjad" of the word "Al-Hadid" in Arabic is 57. (An Abjad account is an accounting system of eight words written in Islamic letters, with each letter showing a number.) The value of the word "hadid" is 26. And 26 is the atomic number of iron. Figure 10 shows the foods which content iron.

Figure 10. The Foods Which Content Iron[15]

The miracle of iron in the Qur'an as follows:

1. The Iron Sura is the 57th from the beginning and the 58th from the end, and these two numbers are the iron isotope numbers,

2. In addition, the abjad value of the word iron, 26, is the order of iron in the periodic table,

3. In addition, the abjad value of the word el Hadid with the hand jewelry on *its head is 57.

4. It is mentioned that iron is the balance provider of the Earth and the balance is lowered at the beginning of the verse.

5. In addition, the fact that Hadid verse 25 is the 5100th verse from the beginning and that the solid iron core of the Earth has been lowered 5100 km down shows that there is a miraculous balance in the Qur'an. This balance is one that has been designed so seriously that it cannot be explained by chance. It proves that the Qur'an comes from Allah.

15 https://www.newsmedical.net/image.axd?picture=2016%2F11%2FIron_shutterstock_522476422.jpg

1. The number 6378, which is the total scaled abjad value of Hadid 25 verse, gives the distance to the middle of the Earth, that is, to the middle of the iron core.

THE MERICAL of the PAIRS in MATERIAL SCIENCES

"Glory be to the One, who created in pairs all things that the earth produces, as well as themselves, and other things they do not know." (36- Ya-Seen, 36)

The Arabic word "azvaj" is the plural of "zavj" meaning "pairs," "matches," "partners." There are three sorts of pairs in the creation as described in the verse:

a- Pairs that grow from the earth, i.e., plants that have species of differentiated sex;

b- Human pairs, males and females. Also some included human characteristics like bravery/cowardice; love/hate; generosity/stinginess, etc.

c- Pairs unknown: men did not know anything about the creation in pairs at the time of the descent of the Quran. In this section we shall be dealing with the latter in particular.

d- "And We created pairs of everything that you may contemplate. "(51-The Dispersing, 49)

Although the concept of ''pair'' or "couple" commonly stands for male and female, the statement of ''from things unknown to them'' has wider implications. Today, one of the implications of the verse has been revealed. The British scientist Paul Dirac, who proposed that matter is created in pairs, was awarded the Nobel Prize for physics in 1933. This discovery, called ''parité'', maintains that matter is paired with its opposite: anti-matter. Anti-matter carries the opposite properties to matter. For instance, as opposed to matter, the electron of anti-matter is positively charged and its protons are negatively charged. This fact is stated in a scientific source in this way:

"...every particle has its antiparticle of opposite charge… … and the uncertainty relation tells us that pair creation and pair

annihilation happen in the vacuum at all times, in all places." The atom lies at the basis of all matter in the universe. A study of this smallest piece of matter may give an idea about the creation of everything in pairs (partners). As research conducted on the structure of the atom gained momentum, it became clear that the constituents of elementary particles were not limited to protons, neutrons and electrons and that their compositions were of a more complex nature and an unerring precision. Creation in pairs is also valid for elementary particles.

A proton has its anti-proton, an electron is coupled with a positron, and a neutron possesses an anti-neutron. The creation of matter in pairs is one of the discoveries of towering importance of physics. Paul Dirac, a British scientist, was awarded the Nobel Prize in 1933 for his discovery in this field.

Allah's ingenious calculation is also seen in the numbers of protons, neutrons and electrons, and of their respective pairs. Let us take as an example the electron and its counterpart, the positron. When these two get together, energy is generated. If there were 15 units of positron versus 10 units of electrons, 10 units of electrons and 10 units of positrons would be eliminated leaving behind 5 units of positron. If their numbers were equal, there would emerge only energy, leaving behind no electrons or positrons. The survival of protons, electrons and neutrons depends on the quantities higher than their respective pairs, while the numerical balance between protons, neutrons and electrons is also important. For example, if the number of electrons were less than the number of protons, there would be no life in the universe. All the fine calculations in our existence are based on this fact. Had one single formation of thousands of phenomena been left to chance, we would not have been on our planet today. We exist thanks to the omniscience of our Creator Who controls everything through His omnipotence. As we have already pointed out, the fact that the description of scientific phenomena in the Quran could not be accounted for by the knowledge acquired at the time of the Prophet is not the only outstanding point. This fact is certainly very important. However, our wonder becomes even greater when we examine the scientific data provided in the verses of the Quran which reflect Allah's omnipotence, art, science and design.

For instance, the statement in sura 21, verse 30 that the universe was created from an integrated mass, as the raw material of the heavens and the earth were closed up before Allah split them, could not possibly be the word of a mortal at the time of the Prophet. This also proved that Allah had created the matter, the universe and that He had preset objectives in His mind. Therefore, as we proceed, we shall try to point to the scientific miracles in the verses of the Quran as well as to the fact that these things testified to His existence and the splendor of His art. In brief, as important as the existence of the miracles themselves is the inspiration displayed by the miracles.

This also holds true of course for the verses announcing that the material world was created in pairs. At the time of the descent of the Quran the creation of the universe in pairs and the significant role of this phenomenon could not possibly have been known. Important as this is, all the wonders ranging from the forces to the balance between the protons and anti-protons, between neutrons and antineutrons are also important. The Quran's concern is not merely to stress the miracle as such, but also to draw attention to the creation in pairs so that we may have a better insight into the wonders of the creation.

ATOMIC STRUCTURE

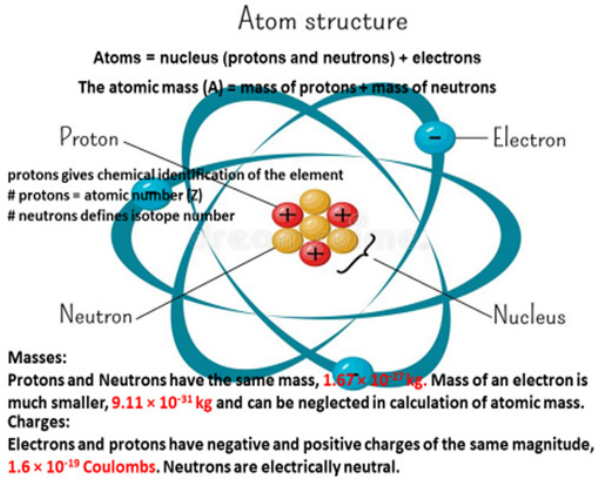

Figure 11. Atomic Structure

Figure 11. shows atomic structure in materials. An atom contents some particules such as protons and electrons and neutrons. Electrons and protons have negative and positive charges of the same magnitude, neutrons are electrically neutral. There will be attractive and repulsive forces between electrical charged particules in a single atom and neigbouring atoms according to Coulomb's Law as it is shown in Figures 12 and 13

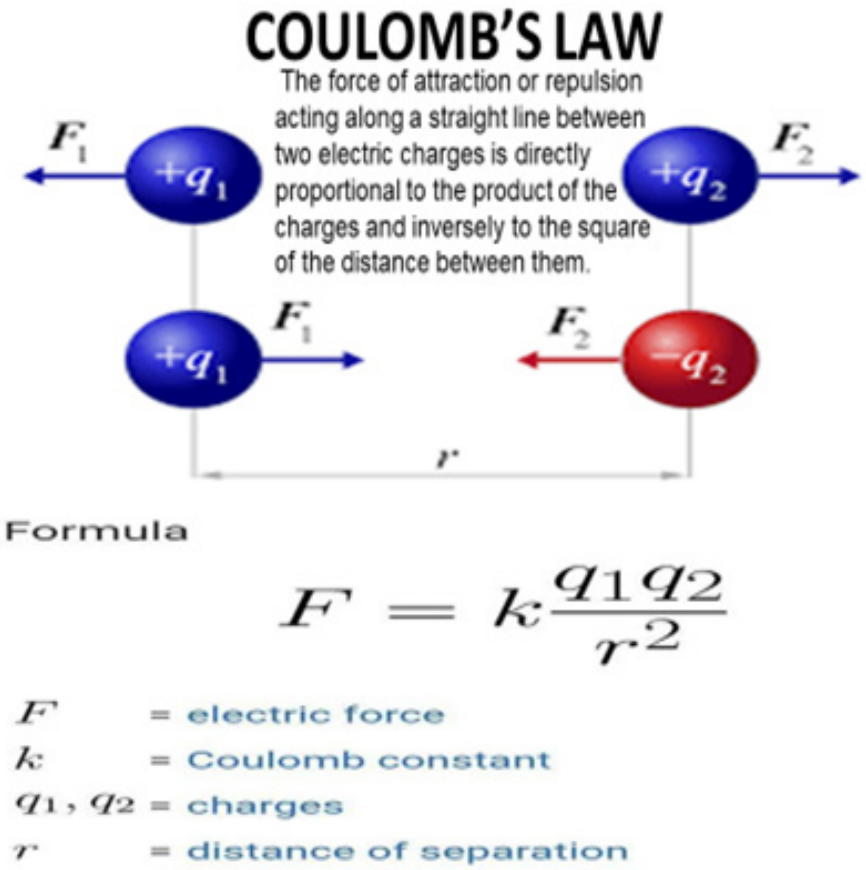

Figure 12. Coulomb's Law

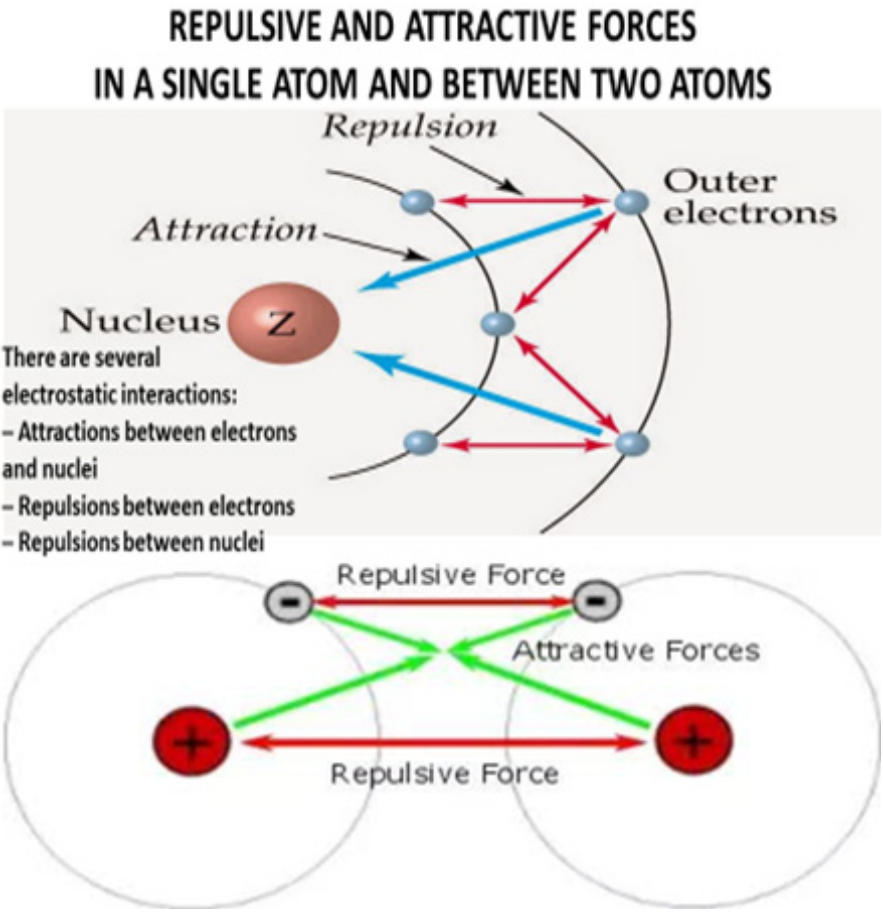

Figure 13. Attractive and Repulsive Forces

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SOLAR ENERGY AND SUSTAINABLE ARCHITECTURE: A CASE FOR INDIAN CITIES

Tariq MUNEER[1]

Abstract: The buildings along with its construction industry consume 30% of global final energy consumption. The related emissions are 27% of the world total. Energy demand from buildings and buildings construction continues to rise, driven by improved access to energy in developing countries, growing demand and rapid growth in buildings floor area. There is an urgent need to champion, identify and publicise sustainable architecture. We know that most of the energy used in buildings is either to heat- or cool them and with good architectural design it is possible to either significantly reduce or eliminate the above mentioned energy use. Historically, ancient civilisations used thick walls for buildings which kept them warm in winters and cool in summers. However, with the world population being more than 8 billion and high population density in urban areas use of heavy construction will be undesirable and uneconomic. There are, however, modern solutions available to reduce energy demand for heating and cooling. These are highlighted below.

Keywords: Solar Energy, Sustainable, Architecture

INTRODUCTION

Cooling load from ceiling and walls: Solar radiation that is absorbed by walls and ceiling, especially if they have dark paint, is conducted indoors through the masonry elements. The thermal wave arrives indoors

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with a lag time of 4 to 8 hours. In Middle Eastern countries, such as Bahrain, the double peak of air conditioning load is well known - first peak due to high afternoon temperatures and the second due to the arrival of radiative-conductive wave in the evening hours.

A simple solution is to either install solar photovoltaic (PV) modules on building walls and roof which will not only stop the transmission of thermal wave but will also generate electricity.

Another solution is to paint the walls/ceilings with highly reflective aluminium-based paint that will reflect back 90% of solar irradiation. Likewise, bronze coated windows that remove 90% of solar radiation are available that bring in useful daylight.

Solar heating of buildings located in locations above the tropics has been thoroughly researched and once again Xenon-filled, triple-glazed windows are available that have a heat loss coefficient of just 0.4W/m^2-K. Buildings clad with such glazing facades enable architecture that is not only sustainable but also a joy to live with as those buildings bring in high levels of daylight.

In this article we shall explore the effectiveness of providing shade on building walls by means of solar PV modules to sustainably manage building cooling load. The bi-fold advantages are: reduced cooling load due to shading from sun and generation of on-site electricity. As a test case an Indian city has been chosen for this article, its energy assessment being presently carried out.

THE RAPIDLY INCREASING DEMAND for AIR-CONDITIONING in INDIAN CITIES

Delhi has been growing warmer over the past three decades. Due to excessive hard and dark surfaces, cities tend to absorb the heat coming from the sun during the day; a city also generates a lot of waste heat due to human activities which adds to the natural heat.

In year 2022 the day-time Delhi temperature has been 1.8C more than the previous average. The heat index, which is a measure of both temperature and humidity and defines how hot one actually feels, was up by 1.6C compared to the 2010-19 baseline (1).

The highest land surface temperature in Delhi was observed in May 2020 when 53.9C was recorded within city limits.

Amid soaring temperature, demand for air conditioners has increased resulting in a cumulative record domestic sales of nearly 6 million units in the first half of year 2022. Most manufacturers are claiming an annual increase of sales of air conditioners between 25 and 50% with one manufacturer alone claiming to have sold half a billion USD worth of equipment (2).

BUILDING COOLING LOAD for DELHI RESIDENCES

Across the globe due to an increased economic prosperity there has been an accompanied increase in the urban heat island effect. Furthermore, urbanisation of large cities in India has also led to higher population densities. The above factors had the combined effect of a significant increase of cooling load of buildings. The high density of dwellings and other building construction has resulted in shading of walls. However, the flat roof spaces are exposed to an uninterrupted solar radiation regime and this in turn leads to generation of high sol-air temperatures which cause higher cooling loads.

Presently, it has been argued that roof spaces are one of the major contributors to building cooling load. In this article, the reasons behind the phenomenal rise in the installation of air-conditioners in India are reviewed. The dual role of roof-top PV systems in electricity generation and reduction of building cooling load due to the shading they provide is then investigated. For this purpose, the CIBSE (3) method to obtain sol-air temperature with solar radiation and outdoor ambient temperature has been used. Sol-air temperature is defined as the effective temperature of any given surface that takes into account the ambient temperature and incident solar radiation.

Sol-air temperature for the Indian capital city, Delhi, based on data obtained from NREL and India Meteorological Department consortium were then obtained. A computer simulation routine was developed by this author for solving the classical transient heat conduction problem with hourly sol-air temperature data and roof construction details provi-

ded to the routine. The above computer program was executed to obtain the cooling load profile for the respective design day.

India is a fast growing country with a large economy. India's electricity demand is increasing at the rate of 8.5%. A large part of the electricity demand in urban areas is due to a phenomenal rise of air-conditioners in buildings. India depends heavily on fossil fuels like coal and oil to meet its rapidly growing energy demand. All major power plants in India are based on thermal systems which provide three fifths of India's energy needs. Amongst the renewable energy sources, India is beginning to exploit solar, wind and biomass technology. India is endowed with rich solar energy resource.

Because of its location between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25C to 27.5C. Being a tropical country, India has huge potential for solar power generation. Annually, India receives 250–325 sunny days in a year. India receives 4–7 kWh/m^2-day of solar radiation, a fairly large amount of radiation as compared to many parts of the world especially Japan, Europe and the US where development and deployment of solar technologies is far ahead of India.

With one of the fastest growing economies in the world, India recorded an average economic growth rate of 7% for the period 2000–2003. The Indian middle-class population of around 500 million is getting used to an affuent lifestyle. The Korean air-conditioner manufacturer LG Electronics claims that in year 2012 India became the world's largest importer of its units. The annual energy consumption for cooling of buildings has now exceeded 25TWh. In a landmark article that explores the strong correlation that links the deployment of air-conditioners within homes to economic prosperity and cooling degree-days McNeil and Letschert (4) have provided some interesting data for India. They have shown that with 3120 cooling degree-days, India has the potential capacity to have 99% market saturation once economic prosperity comes on par with the western world. The latter work could be improved though as the base temperature that was used for obtaining cooling degree days was set at 18C.

The adaptive comfort theory suggests that the latter indoor temperature could be as high as 26C for the Indian sub-continent. However, even with a lower cooling degree-days profile it is evident that there will be an ever increasing deployment of air-conditioners in India. A further link that has been studied by the above research team is the one between availability of air-conditioners and household income and a strong relationship was demonstrated, once again.

PROCEDURE for OBTAINING COOLING LOAD DESIGN DATA

In the present article, a method for obtaining design solar radiation and outdoor ambient temperature for production of sol-air temperature is presented.

4.1 Sol-air temperature and building cooling load

Solar radiation absorbed at the outside, opaque surfaces of buildings such as walls and roofs is partly transmitted to the interior of the building. The absorbed radiation has the same effect as a rise in the outside temperature. CIBSE Guide (3) defines the sol-air temperature as 'the outside temperature which, in the absence of solar radiation, would give the same temperature distribution and rate of energy transfer through the wall or roof as exists with the actual outside air temperature and incident radiation'. The CIBSE Guides A and J provide extensive guidance on estimation method for sol-air temperature, a resume of which is presented below. For a given amount of cloudiness, C, the horizontal and vertical surfaces long-wave radiation loss (I_{lwl}, W/m2) are respectively given as:

$$I_{lwl} = 93 - 79\ C \quad (1)$$

$$I_{lwl} = 21 - 17\ C \quad (2)$$

The sol-air temperature, t_{eo}, may then be obtained as follows:

$$t_{eo} = (a\ l_{surface} - e\ l_{lwl})\ R_{so} + t_{ao} \quad (3)$$

where is the solar absorptance, $I_{surface}$ the incident solar irradiation (W/m^2), the long-wave emissivity, R_{so} the outside surface resistance (m^2-K/W) and t_{ao} the outdoor temperature (Celsius). The London-based

Chartered Institution of Building Services Engineers recommends the use of hourly sol-air temperature tables for cooling load estimation and these are obtained for the design 'maximum' irradiances that are exceeded on 2.5% of occasions in each month. The sol-air temperatures are then obtained using coincident dry-bulb temperature. Note that CIBSE recommends a = 0.9 for dark- and 0.5 for light-coloured surfaces and e = 0.9.

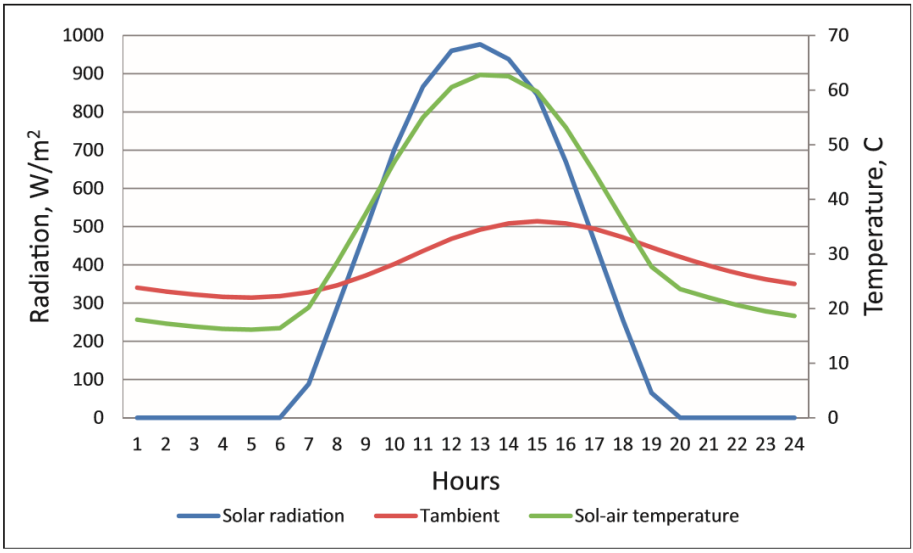

Figure 1. Hourly Sol-Air Temperature for Delhi for the Design Day

Table 1. Sol-Air Temperature Table for Delhi (Based On CIBSE Recommended 97.5 Percentile Daily Radiation Method)

Time, hour	Radiation, W/m2	Ambient temperature, C	Sol-air temperature, C
0	0	23.8	18
1	0	23.1	17.3
2	0	22.6	16.7
3	0	22.1	16.3
4	0	22	16.1

5	0	22.3	16.4
6	88	23	20.2
7	288	24.2	28.5
8	491	26.1	37.4
9	702	28.2	46.9
10	866	30.5	55
11	960	32.8	60.5
12	977	34.5	62.8
13	938	35.6	62.6
14	845	36	59.7
15	670	35.6	53.2
16	462	34.6	44.9
17	255	33.1	36.1
18	65	31.2	27.7
19	0	29.4	23.6
20	0	27.9	22
21	0	26.5	20.6
22	0	25.4	19.5
23	0	24.5	18.7

The design table for sol-air temperature for Delhi is shown in Figure 1 and Table 1. The production of the latter table was based on the recently measured data set for solar radiation and ambient temperature that has been made available by the NASA (5) and the India Meteorological Department. Furthermore, those solar radiation, ambient temperature and sol-air temperature tables were then used to study the impact of the installing PV module on the roofs of dwellings.

Figure 2 shows the finite element schematic for solving the one-dimensional heat conduction problem for ceiling of a typical Delhi residence.

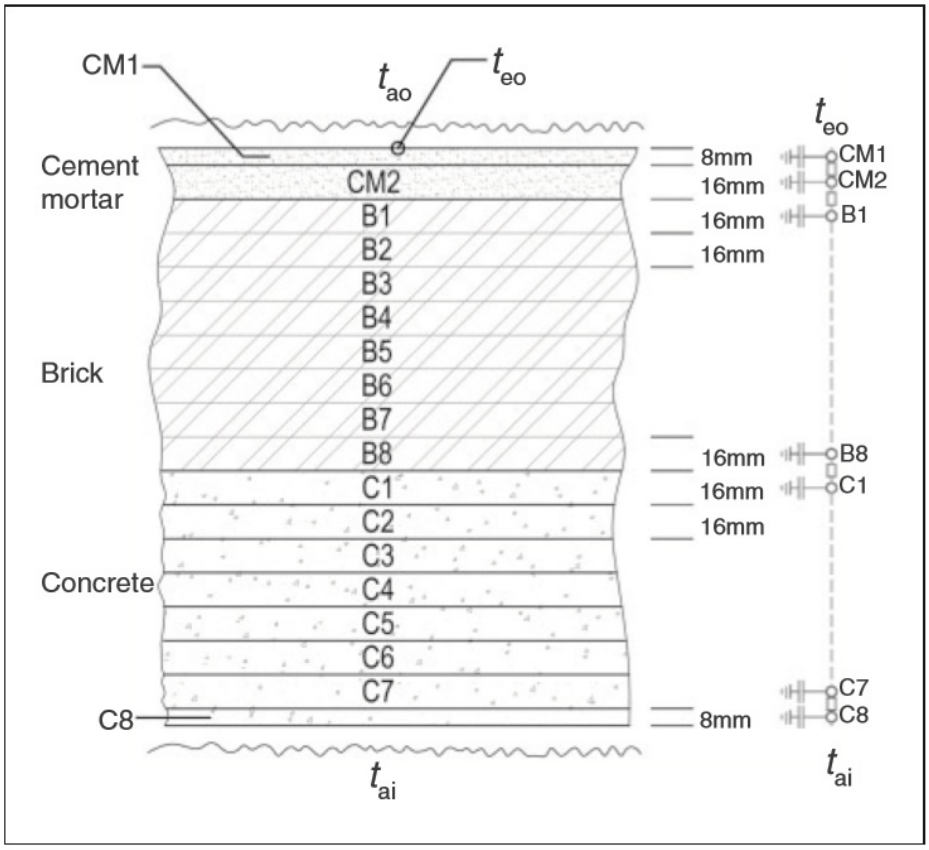

Figure 2. Thermal Model Developed by the Present Author for Obtaining Ceiling Transient Heat Load

DISCUSSION

Reference is made to Figures 3 and 4. The latter table demonstrates that on one hand a remarkable reduction of building cooling load can be achieved by roof shading provided by PV modules and on the other hand, a significant energy generation may be achieved.

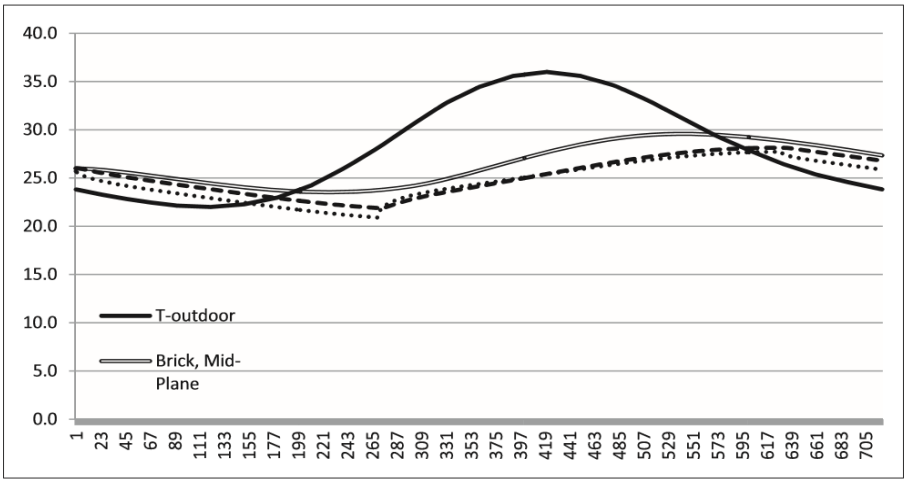

Figure 3. Thermal Wave Propagation for a Flat Roof Under Shade Provided by a 7 kWp Array. Note: The Thermal Loading in this Case is Due to Outdo-or-Indoor Temperature Difference

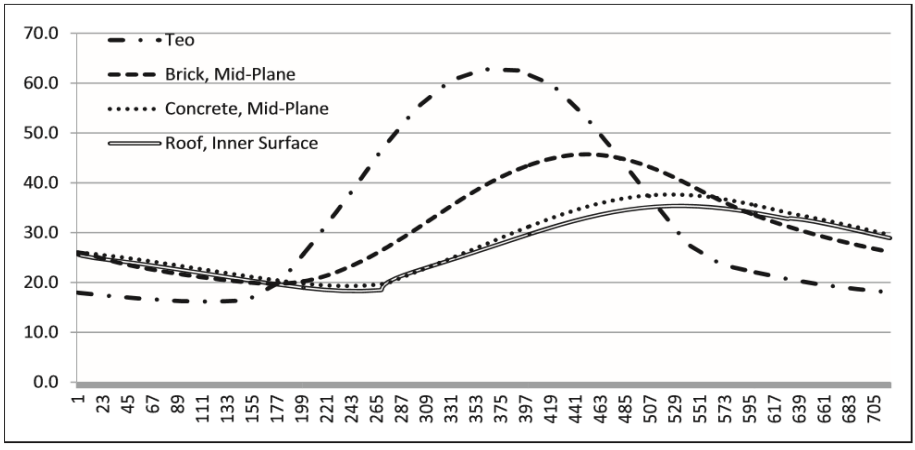

Figure 4. Thermal Wave Propagation for a Flat Irradiated Roof. Note: The Thermal Loading in this Case is Due to Sol-Air and Indoor Temperature Difference

In this respect the reader is referred to Table 2. The main contributor to the dual return may be traced to the high solar energy income for the Indian Sub-Continent.

Table 2. Roof-Induced Cooling Load (kWh) for a 97.5th Percentile day for Delhi

Roof irradiated by sun	33.2kWh
Roof shaded by PV array	3.4kWh
Cooling load savings	29.8kWh
Electricity saved in work of compression	10.6kWh
COP for cooling	2.8
$Q_{evaporation}$	3.73kW
Design outdoor temperature (C)	40.5–46
$W_{compressor}$ (kW)	1.33
Design indoor dry bulb temperature (C)	24
Design indoor wet bulb temperature (C)	19.4

To shed further light, Figure 5 has been prepared which compares the sol-air temperature profile for Indian location against London, which has a temperate, maritime climate. At peak times, the difference between sol-air temperature for India and London appears to be 26–32 Celsius. It is a known fact that there is a growing prevalence of the use of air-conditioning for cooling even in London.

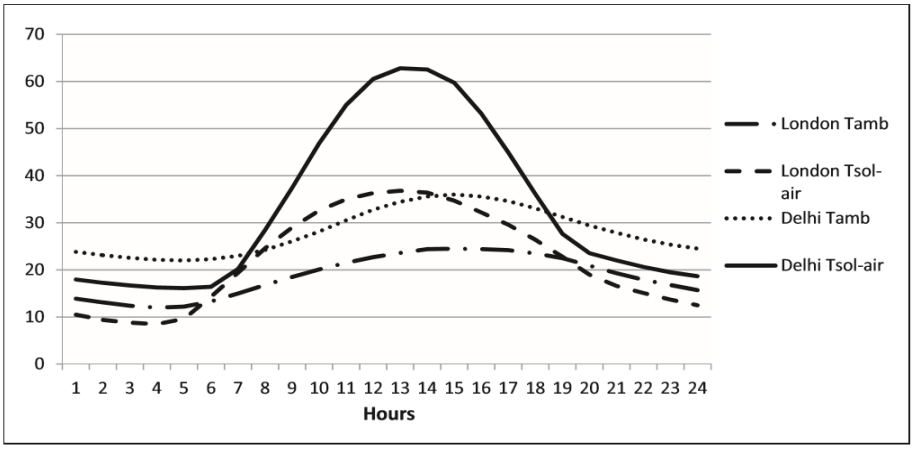

Figure 5. Comparison of Outdoor Ambient and Sol-Air Temperature for Two Locations: Delhi and London

Figure 6 shows the electricity demand profile for Delhi for a summer month. Note that most of the electrical demand is due to air-conditioners that are increasingly being used for building cooling.

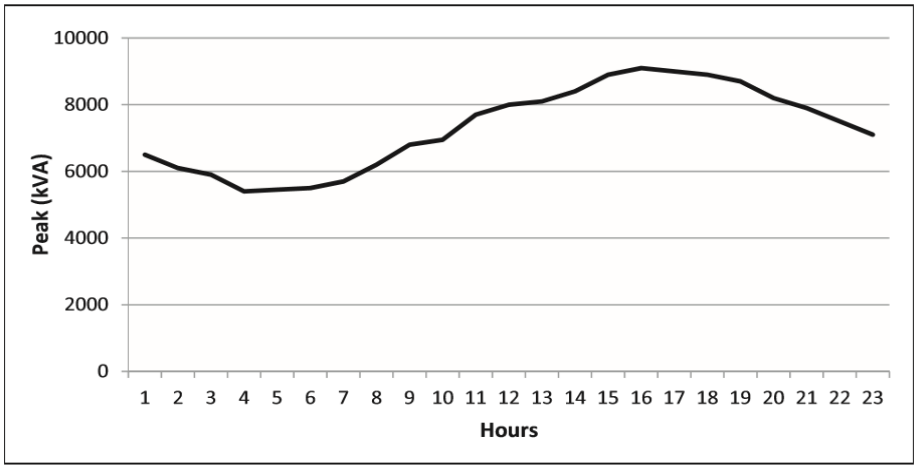

Figure 6. Typical Electricity Demand Profile for the Month of July for Delhi Grid

CONCLUSIONS

The CIBSE method to obtain sol-air temperature with solar radiation and outdoor ambient temperature has been presently used to produce design tables for five key Indian locations.

These tables are based on the recently presented data by the NREL-India Meteorological Department consortium. The ambient- and sol-air temperature tables were then used to study the impact of the installation of roof-top PV modules on sustainable electricity generation and their potential towards the reduction of building cooling load due to the shading provided by the PV modules.

A computer simulation routine was presently developed for solving the classical transient heat conduction problem with hourly sol-air temperature data and roof construction details provided to the routine. This program was executed to obtain the cooling load profile for Delhi residences for the given design day.

The computer simulation demonstrated that the energy required for roof-induced cooling load decreased by three-quarters after installation of the PV system. The PV system is expected to generate annual solar electricity of at least 11MWh from a 90 square metre roof-top. The advantage of the present method is that it enables the user to obtain cooling load estimates using a general transient heat conduction approach. The thermo-physical data that is required for external roof and wall construction is easily available in standard heat transfer texts or engineering guides provided by institutions such as CIBSE Guides.

In developing countries, varied types of building construction materials are employed. These construction materials may not necessarily conform to design tables associated with standard data provided in design guides.

The present method would fill-in that gap. In the present work, all software was developed within MS-Excel environment and this is also an additional advantage as the cost associated with purchase and training of proprietary building energy software can be prohibitive for many consultants who are based in developing countries.

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A DESCRIPTIVE CONTENT ANALYSIS OF THE PAPERS IN TURKEY ON ENGINEER IMAGES AND ENGINEERING PERCEPTIONS

Arzu KÜÇÜK[1], Mehmet KÜÇÜK[2]

Abstract: This study aimed to examine the published papers on the engineering image and engineering perception in Turkey by thematic content analysis. The papers published in the Turkish context in both national and also international databases were scanned. The keywords of "engineer image" and "engineer perception" showed that there were a total of 21 papers. They were analyzed in detail by considering parameters such as year of publication, the aim of the research, the method of research, the kind of sample, the data collection tool, the results of the research, content and time of the intervention program (if any), and conclusion. They were coded under each theme and included in the appendix are numbered and presented in tables. It was concluded that the most studied sample was middle school students, most used data collection tool was the "Draw an Engineer Test" developed by Knight and Cunningham (2004). These test results revealed that the images in question were mostly stereotyped as the engineers were male and engaged in classical jobs such as construction and computers. There are a limited number of papers in the Turkish context which aimed to change these images through STEM activities based on the engineering design model employed in science courses and some success has been achieved. The difference between the implementation times of these activities is quite wide. The boundaries of the activities for out-of-school learning environments and science talks, which

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are among the suggestions made to get rid of the stereotypes of the engineers' images of the students, have not been adequately explained.
Anahtar Kelimeler: STEM, Engineer Image, Engineering Perception

INTRODUCTION

It is discussed how to provide children with 21st-century skills such as critical and creative thinking, problem solving, entrepreneurship, communication, cooperation, leadership, responsibility, curiosity and imagination, creativity, and innovation (Fadel & Trilling, 2009). The results of international exams such as PISA and TIMMS, where these skills are measured, have the characteristics of a report card for countries. In this report, there is strong evidence about the potential of children who are the outputs of formal education systems and who will prepare their country for the race. This evidence also leads to fierce public debate as the expected outcomes are not achieved. The new emphasis in the workshops and reports prepared to solve this problem is on the approach of STEM education. It aims to integrate four fields such as science, technology, engineering, and mathematics in an interdisciplinary structure (Bybee, 2013; Sanders, 2007). Students are expected to do something innovative by blending the science and mathematics knowledge they have gained through formal education programs or informally with technology and engineering (Çorlu et al., 2014). While each area of this approach is of course important, the other three (science, technology, and mathematics) are well known. On the other hand, the engineering discipline, which aims to find solutions to life's problems by considering cost, size, environmental impact, manufacturability, and other limitations in projects, is new (Wulf, 1999).

Engineering as a discipline has an important place in both the integration of others in STEM education and the realization of learning (Kelley & Knowles, 2016). "Science, Engineering and Entrepreneurship Practices" has been added to the science curriculum with the latest regulation in 2018, which is a practice in Turkey. In this way, children are expected to recognize engineering as a profession by employing the engineering design process in solving the problem situations presented while learning science subjects and to grasp the place of the discipline in

STEM. With the explicit inclusion of science, engineering and entrepreneurship practices in the science curriculum, studies and activities on the STEM approach have become widespread. The engineering design process for developing projects, which is one of the three project types of Turkish Scientific and Technological Research Institution [TUBITAK] 4006 science fairs, is explained in detail in the guide (BFK, 2019). In addition, many projects on the STEM approach are carried out within the scope of the 4004 coded nature education and science schools project call. The participants of these projects include individuals of different ages, starting from early childhood to higher education, and even teachers. With these studies, it is aimed that the participants get to know engineering as a profession and the engineer as the one who does this work, apart from the specific purposes of the projects. However, considering that all children cannot have the opportunity to participate in these projects, structuring formal education in a way that can reveal this output emerges as a logical way. The best way is to add engineering education to the curriculum from early childhood (Wendell & Rogers, 2013). For this purpose, the Turkish Ministry of National Education designed and shared with teachers application plans for acquisition-centered STEM education for preschool and primary schools to encourage engineering education (KMSU, 2019). However, despite the STEM approach and the teaching practices employed, the issue of how engineering is structured in children's minds is controversial.

Many studies also revealed that children do not understand engineering, which is an important part of the process, and therefore cannot structure the image of an engineer in their minds well enough (Ergun, 2018; Gunsen et al., 2019). This issue is a problem both in Turkey (Balcin & Ergun, 2019; Cakmak et al., 2019; Gulhan & Sahin, 2018; Ozturk Irtem & Hasturk, 2021; Yar, 2017) and in other countries (Chou & Chen, 2017; Lampley et al., 2022) led the researchers to determine the engineer images and perceptions of children. In these studies, which are based on engineer drawings or measuring their perceptions, students' knowledge of engineering branches is limited, images of engineers are stereotyped, they mostly think of them as men, they believe they are people who work in construction, on the road or with computers, and sometimes they can

associate them with some other branches of engineering as a result of newly taught science subjects or possibly as a result of the special emphasis of the teacher or other informal activities (for example, aerospace engineer) (Balcin & Ergun, 2019; Cakmak et al., 2019; Cil & Ozlen, 2019; Ergun & Balcin, 2019; Gulhan & Sahin, 2018; Gulhan & Sahin, 2020; Karaca & Yalcinkaya, 2019; Ozturk Irtem & Hasturk, 2021; Uzel & Canbazoğlu Bilici, 2020; Yildirim & Turk, 2018). Similarly, it has been reported that students who actively participated in engineering design-based activities have a better understanding of the engineering discipline (Ergun & Kiyici, 2019; Felix, 2016; Gulhan & Sahin, 2016; Sarıgul & Cinar, 2021; Sahiner & Koyunlu Unlu, 2022). In a study conducted by Uzel and Canbazoglu Bilici (2020), 6th-grade students who participated in engineering design-based activities were carried out in the context of their real lives. They shared that there was an improvement in students' images of the engineering profession and their knowledge structures for STEM education. Engineer image and perception of gifted students attending science and art centers were also studied. The results of these studies are unfortunately very similar to those who attend regular schools (Koyunlu-Unlu & Dokme, 2016; Nacaroglu & Arslan, 2020). In another study, it was found that normal and gifted students had similar views on science, technology, and society (Kucuk et al., 2021). There is a study claiming that engineer images, which are known to be resistant to change, as in scientist images, can be corrected even with a short scientific conversation (Cavus & Balcin, 2022). On the other hand, even the engineering perceptions of undergraduate engineering students have changed over the years (Polat et al., 2020). In the structuring of engineering perceptions, out-of-school learning environments can also be effective in addition to formal teaching, where the model based on engineering design is used (Balcin & Yavuz-Topaloglu, 2019). In the STEM education approach, students are expected to question and solve life problems. Therefore, there are some relationships between these skills and students' STEM attitudes and perceptions (Oner & Ozdem-Yimaz, 2019).

In the Turkish context, the outputs of the formal or informal studies about STEM should be evaluated in the last five years since it entered into Turkish science teaching programs in 2015. There are many

pedagogical studies on STEM approaches and models. There are some studies in the type of meta-analysis and synthesis in which the papers are examined according to some criteria (Dasdemir et al., 2018; Elmali & Balkan-Kiyici, 2018; Ergun, 2020; Herdem & Unal, 2018; Kaleci & Korkmaz, 2018; Kanadli, 2018; Kizilay, 2017; Kucuk & Ayvaci, 2022; Sarac, 2018; Tabar, 2018). Engineering image as the dependent variable in these studies draws attention in particular. Now, there are many studies on the dimensions of engineering image and perception. These studies serve to explain the potential of what has been done in revealing children's images or perceptions of engineers up to now. For these reasons, analysis of the articles published in the last years is valuable in terms of both explaining the current situation and guiding researchers who will work on the same subject.

This research was carried out to examine the articles on the image and perception of engineers made in Turkey between the years 2016-2022 and to determine the trends.

METHOD

In this study, a descriptive content analysis method, which is a type of content analysis, was used. The approach that involves identifying and organizing the trends and results of qualitative and quantitative research on a subject is known as descriptive content analysis (Bag ve Kucuk, 2019; Calik & Sozbilir, 2014; Namdar & Kucuk, 2018). Producing a perspective on the subject, not only makes it easier for researchers who want to work on the same subject to have information about what has been done, but also draws a solid path for them. In this study, papers on engineering image and perception were examined using descriptive content analysis.

Data Collection

The data in this study consisted of papers on engineering image and perception published in TRDizin, Google scholar, and ERIC databases. In this direction, the databases were scanned in detail to reach related studies. For this process, the keywords "engineer image" and "engineer

perception" were used. A descriptive content analysis was conducted on 21 papers.

Data Analysis

The papers reached in this study were coded in detail in line with the parameters determined by the researchers. The approach employed in other content analysis studies were used in the creation of the coding scheme (Bag & Calik, 2017; Bag & Kucuk, 2019). The researchers have set appropriate themes for the research and a total of eight themes that provide a holistic view have been reached. The papers were analyzed according to a total of eight themes. These are the year of publication, the aim of the research, the method of research, the kind of sample, the data collection tool, the results of the research, the content and time of the intervention program (if any), and the conclusion. The publications coded under each theme and included both in the text and in the bibliography as marked are numbered and presented in tables.

Validity and Reliability

The papers reviewed were analyzed in detail by the thematic content analysis method. To avoid any data loss in this process, they were examined by both researchers experienced in similar studies (Kucuk & Kucuk, 2019). Each paper examined and included in the appendix was numbered and the reader was allowed to analyze the data if he/she wishes. They were independently coded by both researchers and then codes were compared and full compliance was achieved.

RESULTS

Theme 1. Published Papers by the Years

Table 1. Published Papers by the Years

Theme	Code	Number	f
Publishing Year	2016	9	1
	2017	17	1
	2018	13,20	2
	2019	1,2,4,5,8,12,14,15,21	9
	2020	3,7,16,18	4
	2021	10,19	2
	2022	6,11	2

Theme 2. Research Aim

Table 2. The Research Aims of the Papers

Theme	Code	Number	f
Research Aim	Examining students' perceptions of engineers and/or scientists	2,4,5,12,13,14,17,18,19	9
	Examining the effects of Science-Technology-Engineering-Mathematics integration on students' preferences, perceptions, and attitudes about these fields	3,9,10,20	4
	Determining the effects of design-based science education practices on pre-service teachers' engineering education, STEM awareness, and engineering perceptions.	8,11	2
	Identification of thoughts and areas for STEM areas in scientist images	1	1
	Examining the effect of science talks on the perception of engineers	6	1
	Examination of the change in the perceptions of industrial engineering students about the industrial engineering profession	7	1
	Examining the relationship between middle school students' 21st-century skills and STEM attitudes and perceptions	15	1
	Determining the metaphorical perceptions of middle school students about STEAM (science, technology, engineering, mathematics, art) fields	16	1
	Determining the perceptions of students about the professions and some other professions mentioned in the social studies textbooks that include the subject of professions.	21	1

Theme 3. Research Method

Table 3. Methods Used in the Papers

Theme	Code		Number	f
Method	Qualitative	Phenomenology	3,16,17,18,21	5
		Explanatory case study	10	1
	Quantitative	Descriptive research	2,4,5,13,15,19	6
		Survey	7,12	2
		Experimental Study	9	1
	Mixed methods		6,8,11,14,20	5

Theme 4. Type of Sample

Table 4. Sample Type of the Papers

Theme	Code	Number	f
Sample *Type*	Kindergarten	1	1
	Elementary school	12	1
	Middle School	2,3,4,5,6,9,10,13, 14,15,16,19,20,21	14
	High school	-	-
	University	7,8,11	3
	Gifted Middle School	17,18	2
Total			

Theme 5. Data Collection Tool

Table 5. Data Collection Tools of the Papers

Theme	Code	Number	f
Data Collection Tool	Draw an Engineer Test	2,8,11,13,14,17,20	7
	STEM Attitude Test	9,15,17,20	4
	Draw a Scientist Test	1,13,19	3
	Interview Form	1,17	2
	Engineering Image/Information Form	3, 19	2
	Word Association Test	3,21	2
	Perception Scale for Engineers and Scientists	6,12	2
	STEM Perception Test	9,15	2
	"Who is an Aerospace Engineer?" Form	4	1
	Engineer and Engineering Perception Test	5	1
	Short-answer and open-ended question form	6	1
	Survey form	7	1
	Engineering Education Survey	8	1
	Profession Free Drawing Test	10	1
	STEM Awareness Scale	11	1
	Engineering Severity Scale	14	1
	Perception Scale for Problem-Solving Skills	15	1
	Inquiry Learning Skills Perception Scale	15	1
	Metaphor Form	16	1
	Draw-write-tell form	18	1

Theme 6. Content and Time of the Intervention Program

Table 6. Content and Time of the Intervention of the Papers

Content of the Intervention	Time	Number
Five engineering design-based activities prepared for the matter and heat unit of the science course	Five weeks and four hours a week	3
Design-Based Science Education Practices	14 weeks and 4 hours per week in the Science Teaching Laboratory Applications II course	8
Activities carried out in the science class	4 hours per week for a total of 12 weeks	9
Engineering design activities applied in their classrooms by the science teacher	Nine weeks	10
Activities based on the engineering design model	7 weeks and 2 hours each week	11
STEM applications designed for the Force-Motion unit	Four weeks and 4 hours a week	20

Theme 7. Result

Table 7. Results of the Papers

Theme	Code	Number	f
Results	Students' knowledge structures about engineering are stereotypical or do not know at all.	1,2,4,5,12,13,14,16,17,18,19,21	12
	Engineering design-based activities contribute to the development of students' images of the engineering profession and their knowledge structures for STEM education.	3,8,10,11,20	5
	The image of a scientist is mostly integrated with science and technology from STEM fields.	1	1
	There is a positive and significant relationship between the perception of problem-solving skills and attitude towards STEM, whereas there is no relationship between problem-solving skills and perceptions of STEM.	15	1
	Short-term science conversation positively affects students' perceptions of engineering.	6	1
	Even students studying an undergraduate program in engineering have a wide range of engineering perceptions over the years.	7	1
	Engineering design-based activities highlight STEM's engineering field the most and mathematics the least.	9	1

Theme 8. Conclusion

Table 8. Conclusion of the Papers

Theme	Code	Number	f
Conclusion	Learning environments for science, mathematics, engineering, and technology education should be designed and this education should be given to children from an early age.	1,8,9,13,16,17,18,19,20	9
	Trips to out-of-school learning environments should be organized to communicate with engineers and develop career awareness.	4,12,14,19,21	5
	Engineering design-based activities should be used to find solutions to daily life problems and for different engineering branches in STEM applications both in and out of school.	2,3,5,19	4
	By increasing the number and quality of activities such as science talks, activities should be carried out for students to get to know different professions.	6,14	2
	Engineer pictures/photographs in textbooks should not highlight a single gender and various engineering branches should be included in engineering pictures/photographs.	5	1
	Teachers should use activities to develop problem-solving and inquiry-learning skills in STEM education.	15	1
	Collaboration with different organizations should be made in the implementation of STEM education.	11	1
	Parents should also participate in design activities.	10	1

DISCUSSION and RESULTS

Outcomes of STEM education include improving perceptions of STEM fields. The improvement in question can be achieved by removing the stereotypes of knowledge structures, perceptions, and images for STEM fields. In this context, it is important to conduct descriptive content analyzes of the papers carried out since the 2000s, when the STEM education approach first entered into the literature in Turkey, and since 2005, when it was directly reflected in the science teaching curriculum. At this point, there are many studies in which content analyzes of STEM or the models in which it is employed are conducted.

However, there is a need for descriptive content analysis specific to engineering, which is one of the STEM fields and a different field compared to the others. Now it is necessary to reveal the engineer images and perceptions of the children who participate in the programs based on the STEM education approach or are the output of the science curriculum that prioritizes STEM. In the current paper, 21 articles published in scientific journals in Turkey were examined. It has been revealed that the studies in question were limited before 2019, intensified in 2019, and then again in a limited number of studies (see Table 1). In most of these studies, the aim was to examine students' perceptions of engineers and/or scientists. This is followed by studies examining the effects of Science-Technology-Engineering-Mathematics integration on students' preferences, perceptions, and attitudes about these fields and in which research methods are similar in number (see Table 2,3). In this type of education, students use the steps of the engineering design model to research and discuss to understand the problem, produce solutions, reflect their solutions into the design picture, and develop them by creating and testing models based on this design picture. In this process, it is stated that especially students' making design drawings, presenting their design drawings in front of the class, and designing their models by adhering to the drawing are a factor in their preference for STEM professions such as engineering and architecture (Sarigul & Cinar, 2021). It has also been reported that only the design aspect of engineering stands out in such trainings (Gulhan & Sahin, 2020).

The most studied group is middle school students, as revealed in other studies. This is followed by university students and gifted children on a limited basis (see Table 4). In these studies, which aimed to examine engineer images through drawings, the "Draw an Engineer Test" developed by Knight and Cunningham (2004) was used mostly (see Table 5). In addition, it was determined that the draw-a-scientist test was used simultaneously in the studies. Many studies have reported that these images are stereotypical (Balcin & Ergun, 2019; Cakmak et al., 2019; Chou & Chen, 2017; Gulhan & Sahin, 2018; Lampley et al., 2022; Ozturk Irtem & Hasturk, 2021). A relationship is sought between the stereotypical perception of the emerging scientist from early childhood to K-12 and the perception of the engineer. In this context, although not all, the drawings are similar in terms of some features (for example, the image of men as gender). It turned out that a limited number of intervention programs were put to work to deconstruct the engineer image (see Table 6). Although it is stated that these programs are based on STEM, the scope and time of these studies are highly variable. It has been reported that this training was able to partly relieve the stereotypes of the engineering implications of the students and change their perceptions of engineers in a positive way (see Table 7). When each study is analyzed in terms of contribution and suggestions to the field, it has been revealed that almost all researchers are confident about the contribution that STEM can encourage. They emphasized this intensely with the suggestion that learning environments for science, mathematics, engineering, and technology education should be designed in schools and this education should be given to children from an early age.

In this process, it was also suggested that out-of-school trips be made to science centers or universities, the scope of which was not sufficiently explained, to structure the images of engineers. It was emphasized that such activities should be done since even a short science talk can correct the implications. However, it is known that students predominantly have certain engineering fields (for example, construction and computing) and male gender image. At this point, the correction of the images in question does not make an ordinary conversation, but a well-constructed conversation with a specially selected guest for a science talk. Despite

the innovations in information and communication technologies, books are still the most used teaching materials by students. Considering that the children who read the books in question develop career awareness about the professions, there is a relationship between the stereotypical perception of engineers and the content of the books. In this context, there is a need for qualified books in which examples from various fields of engineering are included and introduced, both visually and in writing.

CONCLUSION

It is clear that from pre-school to higher education (including engineering students) in a way that supports each other, the stereotypes and weak perceptions of students as engineers. Therefore, there is a need for studies to be planned to solve the problem and to emerge as remedial interventions. The inclusion of STEM-related subjects in science curricula alone is not enough for teachers to comprehend and apply it successfully. Moreover, although teachers' views on these issues, which are introduced as an innovative approach, are positive, the issue of how they conceptualize it and how it applies is still debated. Just as the patient does not get better when useful prescriptions are not given to the patient, not giving useful teaching materials to the teachers will deepen the problems instead of solving them. As a suggestion, instead of giving fish to teachers, teaching how to hunt fish, that is, instead of giving structured and inflexible teaching materials based on demand, is perhaps the best way to be convinced of the value of these materials and to provide comprehensive training on how to develop them. Educators who are experts in the field of STEM are more willing to employ such training in local in-service training or project-based activities. As a final contribution, it is of course very important for teachers to apply activities related to science, engineering, and entrepreneurship in their lessons. However, during these practices, they need to make direct reflections so that students can understand what the value of engineering is and what work is related to engineering. For this, first of all, teachers should be sufficient in this regard. However, the literature reports that there are serious problems at this point as well. In short, doing some-

thing without knowing the nature of the work, even if it is science, engineering, or entrepreneurship applications, does not teach engineering even to the student in higher education, starting from early childhood, and does not sufficiently introduce who the engineer is. When the nature of the engineering contribution, which is one of the fields in the STEM approach, is not internalized, even if a job emerges, it is not sufficiently understood who does what in this job.

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EVALUATION OF THE RE-USE POTENTIAL OF VACANT BUILDINGS

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Abstract: The built environment areas are expanding day by day. Because the human population and the need for buildings are increasing in the world. This leads to the reduction of natural resources and natural environmental areas. New constructions do not always have to be built for new building needs, people started to meet new needs from aging and existing abandoned buildings. Thus, they both meet their building needs, and the aging building stock has started to become useful again. The re-use of buildings is necessary to prevent environmental, socio-cultural, and economic problems caused by demolition and rebuilding. In this study, we holistically evaluated the re-use potential of vacant buildings that were abandoned for various reasons. Moreover, whether the building is reusable or not will be revealed objectively. For this, we examined the building by considering various aspects. The methodology of the research is primarily based on a literature review. The reasons for the abandonment of the buildings were investigated. Because these factors drive the re-use potential of the building. Key performance indicators (KPIs) that drive re-use have been identified. These KPIs were categorized according to the building's location, design, and structural and functional characteristics. Thus, by the holistic approach, the building was evaluated not only as a physical object but also with the environment and users. After the theoretical findings were made suitable for analytical evaluation, a field study was conducted to test the method. A sample building was selected for the field study and a building performance evaluation

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(BPE) was applied. Case study was held in an abandoned old dispensary building which is located in the Mentese district of Mugla province. The building: according to structured KPIs, we rated on four-point Likert scale and discussed its reusability. With the findings obtained, the strengths and weaknesses of the building were revealed, and possible intervention options for re-use were determined. Accordingly, the location of the building was very high for the re-use potential ($\bar{x}$ = 3,80). However, considering the design of the building, the potential was considered as low ($\bar{x}$ = 1,83). The parameters that reduce the general average so much are technical and functional. When the technical ($\bar{x}$ = 1,40) and functional ($\bar{x}$ = 1,60) evaluation, the re-use potential is very low. As a result of the evaluation made in the old Dispenser building, it was concluded that the re-use potential of the building was low ($\bar{x}$ = 2,15). Therefore, when it comes to building re-use, the building should be strengthened structurally. In addition, accessibility, user health and safety, and comfort conditions should be improved. The research and the results presented will guide the improvement of existing buildings and re-use options.

Keywords: Re-Use, Reusability, Building Performance Evaluation, Existing Buildings, KPIs.

INTRODUCTION

The world is facing critical environmental problems like global warming, increased population, waste accumulation, etc. today. Because of building sector has an important effect on the total resource consumption and on the emissions released (Sharma et al., 2011)it is a part of these problems. A study (Goodier & Gibb, 2007) shows that half of the building industry in the UK consists of re-use applications. Recent and more recent studies are similar shows that half of the building industry in Europe consists of re-use applications (Giresun Erdoğan, 2022).

This chapter presents a study supporting the re-use of vacant buildings. The re-use of the building aims to avoid the costs of demolition and removal of debris, environmental problems caused by waste, and socio-cultural problems caused by the disappearance of the building. However, this study does not advocate protecting every building unnecessarily. If it is not possible to re-use the building, recycling is also an option.

A common misunderstanding view the realms of recycling and re-use of vacant buildings. Although there is a major difference, they are often considered together when they are competing for choices for the continuing use of resources. Re-use is the rebirth of the building before its demolition. Recycling those building elements, materials, etc. is the recycling of the old by using it in a new building after its demolition. For these reasons, it is difficult and complex to decide which option would be better for the building. It is important to make this decision objectively and systematically. Because it is impossible to revert not only the effort spent to keep a building that will not work but also the destruction.

The scope of this chapter is to reuse decision problems. The performance-based evaluation approach was developed for empty buildings. Also enables the building's stakeholders who are decision-making to better resolve the complex relationships of relevant properties in reuse selection problems, which can then increase the acceptability of the decision.

REASON for RE-USE

Examining the life cycle of buildings was deemed necessary in terms of environmental, economic (Borkovskaya, 2013; Sharma et al., 2011), and socio-cultural (Giresun & Tönük, 2018; Wang & Zeng, 2010). Also, according to Wang and Zeng (2010), the effective and appropriate decision of re-use ensures sustainable conservation (Figure 1).

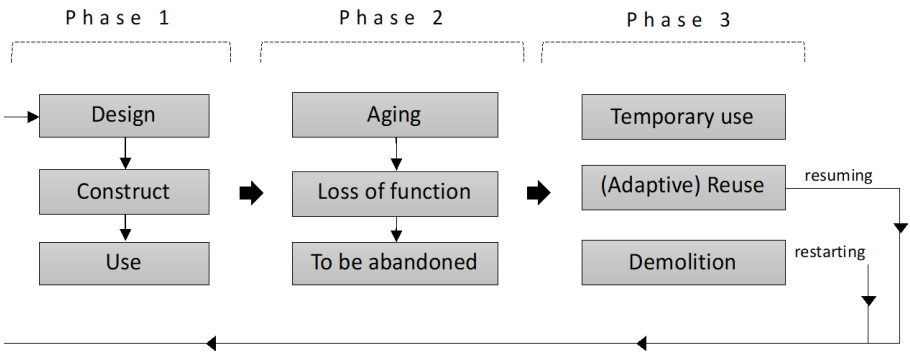


Figure 1. Phases in the Life Cycle of Buildings (Source: The Authors, 2022)

The first phase starts from the process which is pre-design when the building is an idea phase and continues until the usage starts. In the second phase, Buildings start to get old for various reasons during the usage process, and for this reason, they may reach the point of completing their useful life. These reasons can be classified as structural, environmental, economic, legal, and/or functional as indicated by Giresun and Tönük (2018) and are abandoned at the end of the process. In the last phase of the building life cycle, some decisions are made about the building. When a decision cannot be made, the building will remain vacant or may be used for temporary use.

If it is possible to reuse the building, it is revitalized with reuse if it is possible to maintain its function, or with adaptive reuse, sometimes it is necessary to adapt it to new functions or new requirements. In cases where the re-use of the building is not possible, the demolition of the building is inevitable. Blengini's (2009) study shows that when buildings end their useful life, recycling building waste is economically possible and gainful, as well as sustainable in terms of embedded energy and the environment. On the other hand, reusing vacant buildings provides similar benefits and likewise helps to retain the heritage (Langston et al., 2008).

THE DECISION to RE-USE

Re-use should be considered as a priority compared to recycling but this option increasingly does not occur (Hobbs & Adams, 2017) On the other hand implies use is transformative but ultimately diminishing (Kinney, 2011).

A wide variety of factors drive decisions. "*Evaluation of a building can lead to a better under- standing of the motives, expected or actual, underlying the decisions and roles of the various participants*" (Preiser, 1988; Vischer, 1989, as cited in Voordt & Wegen, 2007). The use of Key Performance Indicators (KPIs), the impact of stakeholders' views, and the resolution of conflicting interests are considerations in decision-making.

In Murtagh's study (as cited in Wang & Zeng, 2010), there are some questions that need to be asked before making a re-use decision. Some of the research questions we created based on his questions are as follows:

- *Does a need exist for re-use?*

- *What sorts of transportation are available, such as parking, bus stops, or bicycle paths?*
- *What is the existing environmental quality of the neighborhood?*
- *What are the requirements of the building's function?*
- *Does the site allow or potentially allow the proposed annex?*
- *What is the structural stability of the building?*
- *In what condition are the technical systems?*
- *How much is it feasible to preserve?*

Based on these questions, we defined the framework of the study with a systematic evaluation method. For this we developed a five-step approach to deciding on re-use, first of all, for the re-use decision, categories of factors to be assessed are determined. The second step is to identify the key performance indicators that affect the re-use potential according to the determined categories. Then evaluating building and measuring KPIs scores. After that analyze the scores. The last step is interpreting the analysis findings for the re-use decision (Figure 2).

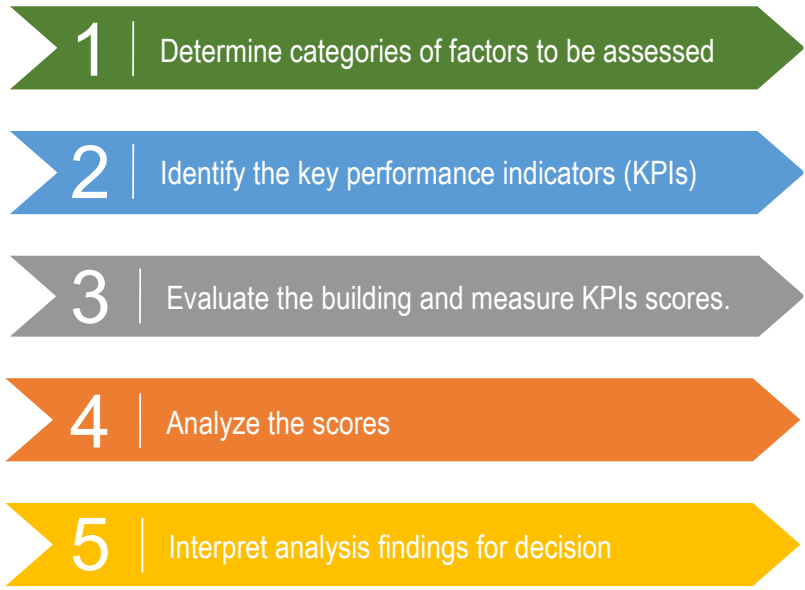


Figure 2. Five-Step Approach for Decision for Reuse of Vacant Buildings

(Source: The Authors, 2022).

Determining Categories and Identify KPIs

Key performance indicators (KPIs) to pinpoint areas where performance may need to be improved are essentially useful for performance evaluation (Ho et al., 2021; Maslesa et al., 2018), but the researchers have not yet found a set of practical KPIs for a comprehensive evaluation of re-use for vacant buildings. This study was done to deal with this problem. constructed using the results of a thematic literature analysis that looked at 20 KPIs for location, design, technical, and functional assessments of a building's potential for reuse. These KPIs act as a starting point for the construction of a more thorough system of objective evaluation for determining re-use potential. The KPIs from this study can also be used as a guide for studies on re-use decision-making in related fields of study.

KPIs are utilized to simply and effectively communicate aggregated information about a building. KPIs are essential for every re-use decision because they show the building's strengths and weaknesses.

KPIs are common in facilities management because they can be used to monitor and manage the desired outcomes of existing buildings (Maslesa et al., 2018). At this point, attention should be paid to selecting the appropriate number of performance indicators. As stated by Lasvaux et al. (2016) choosing only a few indicators can result in information loss. Therefore, a large number of indicators may make it difficult to understand and gauge their relative importance. As a result, there should only be a few indicators used to evaluate the building's potential for reuse.

For the selection and limitation of KPIs, we first determined the categories of factors that drive reuse pathways. In the thematic literature review conducted for this purpose, it has been seen that the reuse of a building is mostly related to its location, design, technical and functional condition (Figure 3).

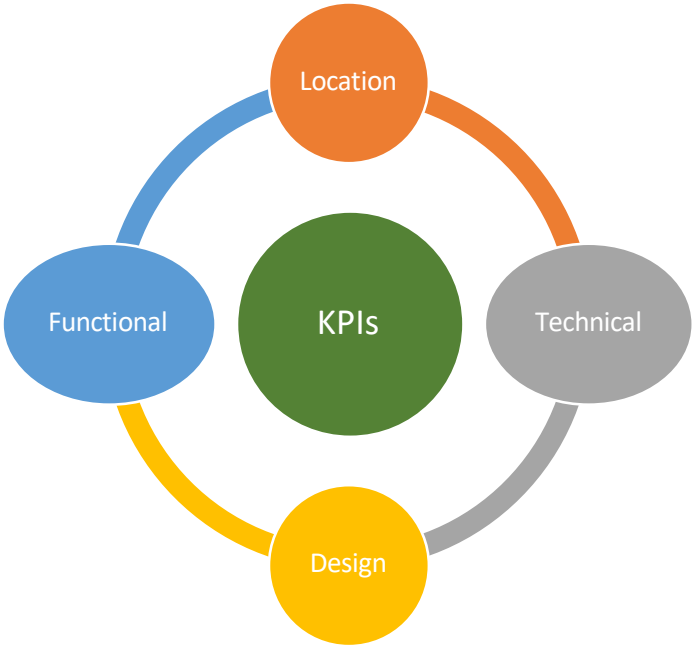


Figure 3. Categories of Factors for Re-use Potential of Building (Source: The Authors, 2022).

After determining the categories, the most frequently encountered KPIs from the literature were identified for each category. For example, the most common indicators related to the location are:

- *Flexibility*
- *Site access*
- *Relating the city center*
- *Neighborhood and amenity*
- *Perceptibility*

Free spaces around the building are an advantage when building capacity needs to be increased. In addition, transportation to the building is one of the important determinants of re-use. Facilities that facilitate transportation such as parking facilities, bus stops, and bicycle paths also increase the demand for use of the building. A building located in an unsafe and uncared-for area is not preferred by users. In such cases, it is necessary to wait for the improvement of the building environment

first. A perceptible building is a better candidate for re-use than a secluded building.

The other category is design. The indicators identified to evaluate the building design are:

- *Circulation*
- *Building flexibility*
- *Spatial flexibility*
- *Aesthetic value*
- *Facade/Shell well-being*
- *Flexible facade*

Aesthetics in building design, flexibility, and compatibility of circulation with usability are advantages for re-use. An aesthetically disturbing building or a building with circulation problems is undesirable to be reused. Again, if it does not have a flexible design, there may be problems in adapting to re-use.

One of the identified categories is technic of building. Five KPIs were determined

- *Aging*
- *Deterioration*
- *Infrastructure*
- *Air conditioning*
- *Waste management*

The stronger the building is technical, the more usable it is. If the building is technically weak, its use can be risky and dangerous.

The last category is function. Building should be evaluated functionally. Functional KPIs are not essential for building re-use, but they quite increase the re-use potential for optimal use of the building, occupant health, and comfort.

- *Accessibility*
- *Health*
- *Physical well-being*
- *Fire safety*
- *Comfort*

Measurement of KPIs

The measurement of building performance is obviously complex because unless the purpose of the measurement is clearly defined, there is a risk of being overwhelmed by the potential number of KPIs available (Then, 2005). It is possible to measure "performance." Achieving production goals is important, but so is performance level. The main topics discussed in recent years by the stakeholders of the construction industry, academia, and literature on the construction industry in addition to many other sectors have included "what method of measuring performance is used" and "how performance can be increased" (Ülker et al., 2021).

A wide variety of methods and frameworks have been proposed for the performance measurement of building assets (Lützkendorf et al., 2005; Seminara et al., 2022; Szigeti & Davis, 2005). These range from detailed technical evaluations of physical aspects of buildings (Augenbroe & Park, 2005; Bavaresco et al., 2019), to performance change after functional transformation (Aigwi et al., 2019; Aksah et al., 2016; Giresun Erdoğan & Polatoğlu, 2021) and user satisfaction surveys (Preiser et al., 1988; Szigeti & Davis, 2005) about the quality of the space and indoor environment used.

While Evaluation makes it easier to make decisions about building re-use and also improves new programs, design, building, and use quality of re-use. The reason for this study is pragmatic. For example, the re-use of an abandoned building can be beneficial for the environment, the community, or the owner of the building. Besides practical purposes, it can also include scientific goals. For example, it can contribute to the formation of new theories, or new tools can be developed, and secondary, subsidiary goals can be derived from the main goals.

Aspects considered should be very clear for the determined KPIs measurement. Otherwise, the findings will change when the evaluator changes. Systematizing the evaluation also objectifies the decision. For this, we created the checklist in Table 1. We used a scoring system in the range of "very poor" to "very good" for the measurements.

Table 1. Checklist for KPIs

	KPIs	Aspects considered	Sources
Location	Flexibility	Spaces around the building / flexibility for annex	(Heath, 2001; Wilkinson et al., 2014; Yung et al., 2014)
	Site access	Parking, public transport and bike paths facilities	(Conejos, 2013; Heath, 2001; Kincaid, 2003; Remoy & Voordt, 2007; Yung et al., 2014)
	Relating the city center	Walking distance to central points	
	Neighborhood and amenity	Well maintained, clean, safe area, vandal-free environment	(Bullen, 2007; Conejos, 2013; Heath, 2001; Wilkinson et al., 2014)
	Perceptibility	Easy and perceptible building entry	(Wilkinson et al., 2014; Yung & Chan, 2012)
Design	Circulation	Easy access to spaces with horizontal and vertical circulation	(Heath, 2001; Kincaid, 2003; Vizzarri & Fatiguso, 2020)
	Building flexibility	Ability to enlarge by adding on or on the building	(Brooker & Stone, 2019; Bullen, 2007; Conejos, 2013; Douglas, 2006; Kincaid, 2003; Langston, 2012; Latham, 2014; Powell, 1999; Vizzarri & Fatiguso, 2020; Wilkinson et al., 2014)
	Spatial flexibility	Dividing or combining spaces / spatial flexibility	
	Flexible facade	Facade design can be changed / flexible facade	
	Facade/Shell well-being	Negligent, deteriorated, improperly altered facade/shell	(Bullen, 2007; Conejos, 2013; Kincaid, 2003; Langston, 2012; Vizzarri & Fatiguso, 2020)
	Aesthetic value	High aesthetic value, remarkable, preserved, undisturbed form	(Brooker & Stone, 2004; Cantacuzino, 1975; Heath, 2001; Kincaid, 2003)

Technical	Aging	Year of Build/Renovation/Adaptation (+50, +30, +20, +10 years)	(Bullen, 2007; Conejos, 2013; Kincaid, 2003; Langston, 2012; Vizzarri & Fatiguso, 2020)
	Deterioration	Deterioration, humidity, leakage intervention, cracks, etc.)	
	Infrastructure	Water, electricity, communication, heating infrastructure	(Douglas, 2006; Yung & Chan, 2012)
	Air conditioning	Heating-Cooling, Ventilation etc. equipment and conditions	(Douglas, 2006; Kincaid, 2003; Vizzarri & Fatiguso, 2020)
	Waste management	Waste management in the building	(Douglas, 2006; Wilkinson et al., 2014)
Functional	Accesibility	Clear, easy access and wc for the elderly, children and disabled	(Conejos, 2013; Vizzarri & Fatiguso, 2020; Wilkinson et al., 2014)
	Health	Unhealthy, dangerous, materials / substances	(Cramer & Breitling, 2007; Wilkinson et al., 2014)
	Physical well-being	Mold, fungus, infestation, etc.	
	Fire safety	Fire escape plan, ladder, firefighting equipment/safety	(Conejos, 2013; Cramer & Breitling, 2007; Vizzarri & Fatiguso, 2020)
	Comfort	Lighting/ noise/ heating etc.	(Conejos, 2013; Remoy & Voordt, 2007)

Analysis and Description

The re-use potential could describe as high and low. However, since the performance evaluation carried out is at an indicative level and reveals the general feasibility, it is not correct to direct the stakeholders to a final decision. The Likert scale can be used for evaluating the findings, as it is a quantitative scale widely used in research at this level (Giresun Erdoğan & Polatoğlu, 2021). Therefore, the scale was expanded by making it four-point.

Following the comparison of the evaluation data with literature data, re-use potential outcomes with very high values are counted as "4", outcomes with high values are counted as "3", outcomes with low values are counted as "2" and outcomes with very low values are counted as "1". In order not to give an ambiguous response to the actor at the decision points, the indecisive, ambiguous, or average options, which are the middle points, were not included in the scale.

Determine categories of factors to be assessed building evaluation findings obtained at the end of the field study transformed to KPIs scores in accordance with a four-point scale and analyzed as an example shown in Table 2.

Table 2. An Example of Evaluation and Analysis Table

Categories	KPIs	Score
Category1	KPI 1	x_1
	KPI 2	x_2
	…	…
	KPI n	x_n

$1 \leq x \leq 4$; Category 1 score is $\bar{x} = (x_1 + x_2 + \ldots + x_n) / n$

Following the determination of the performance of the building through averaging the scores of KPIs, a grading scale is constructed using the formula as *"Gap width=series width/number of the group"* (Aydin et al., 2015). It is determined as Gap width=3/4= 0,75. According to this value, score intervals are constructed, as demonstrated in Table 3.

Table 3. Score Intervals for the Four-point Likert Scale

Score	Response	Interval Range
4	Very High	3,25- 4,00
3	High	2,50- 3,24
2	Low	1,75- 2,49
1	Very Low	1,00- 1,74

The reuse potential of the vacant building should be evaluated on a category basis. The building may be suitable for reuse according to one category, but not to another category. For example, a building is functionally very weak but technically a good candidate for reuse. In this case, the scores obtained for the four categories are discussed by the stakeholders and reviewed for decision. In some cases, the findings are sufficient for a decision, while sometimes a detailed examination is required for some categories.

CASE STUDY EXAMPLE

The case study takes place in the city of Mugla in Turkey. The example is the old dispensary building (Figure 4), which was abandoned among the primary healthcare buildings in Mentese district. Primary health care buildings are non-complex structures that do not require much cost compared to other health buildings and are easily accessible (Farmer & Nimegeer, 2014). Dispensaries provide outpatient and preventive health services to their users. And they are designed according to this function.

It is known that the dispensary was built between 1950-1960 and has been serving until today (Giresun Erdoğan, 2022). The building was abandoned because it could not afford primary health care, and users for the dispensary service were transferred to a different building. At the time of this case study, the building has been vacant for 3 months. Therefore, it has become a suitable example for testing the developed approach.

Mugla provincial health department is connected, and questions were asked about why the building is vacant and whether it could be reused. The content of the research whether the building can be made usable with the same, similar, or different function by adaptive re-use was explained. After the interviews, the field study started with the permission of the administrative staff to conduct research.

Figure 4. Old Dispensary Building in Mugla (Source: The Authors, 2022)

Evaluation for the Location

The fieldwork started with the location evaluation of the building. First of all, the building and its location were examined by observation, map analysis, and walking tour.

The building is in the city center and is intimately associated with public buildings (Figure 5).

It is within walking distance of the town square and the open bazaar. The building and its entrance are on Cumhuriyet street, which is one of the most important and busy streets of the city, so it is easy to perceive.

There is not only car parking but also a bus stop and bicycle path on the street, so it is easy to access the building.

There are administrative, educational, and many commercial buildings near the building, which is in a strategic location. especially due to the density of commercial buildings, the area where the building is located is very lively, well-maintained, and safe.

Figure 5. Old Dispensary Location (Source: Giresun Erdoğan, 2022)

Cumhuriyet Street is an axis that divides the area into two. From these axes, it was observed that the buildings on the side of the dispensary were separated and sparsely located, while the opposite axis was built in an adjacent order.

The fact that there is quite a large space in the building area is an opportunity for the construction of an additional building located behind the building. The existing annex gives an idea of space flexibility but is beyond the scope of the study. In addition, the area between the annex building and the main building is used as a parking lot (Figure 6).

Figure 6. A View from the Building (Source: The Authors, 2022)

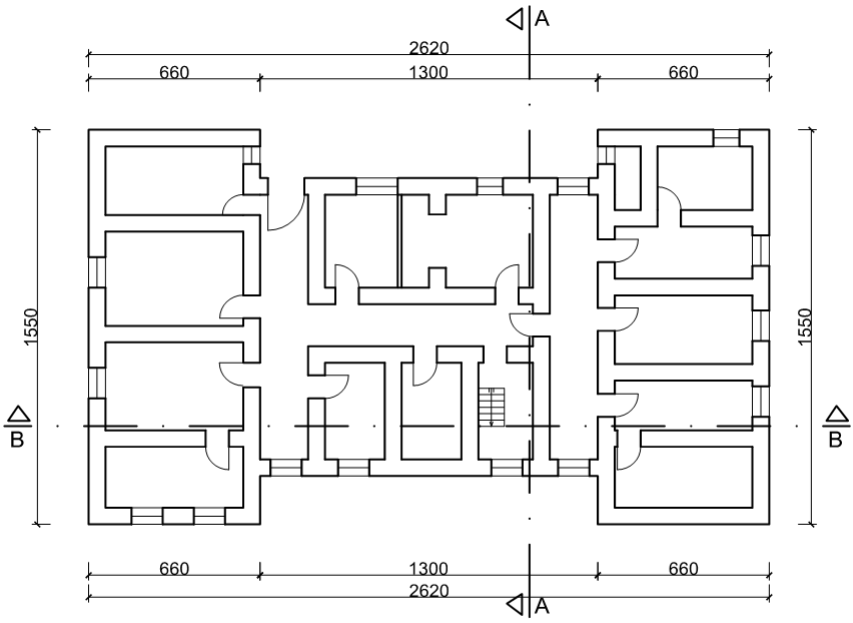
Evaluation for the Design

The dispensary building has 3 floors in total. In the basement, there are archives, warehouses, and technical volumes. In addition, on a part of this floor, there are places for listening and eating, and drinking for the emergency service personnel. The ground floor consists of the places where the users who come to the dispensary receive treatment. On the upper floor of the building, which is accessed by a separate entrance, there are 112 emergency departments, executive rooms, a chief physician's room, and auxiliary spaces.

The building design consists of cellular spaces. Some problems have been identified in the circulation. First of all, long corridors make it a bit difficult to find relevant places. The fact that the staircase leading to the upper floor has a separate entrance from the outside and the absence of an elevator makes vertical circulation quite difficult (Figure 7).

The fact that the building was built with a masonry construction system does not allow the spaces to be combined, but considering the size of the space, the spaces have the potential to be divided. In addition, as emphasized at the entrance, the flexibility of the building was found to be positive, since additional buildings could be built in the building area (Figure 8).

The joinery, the original material of which is estimated to be wood, has been replaced by plastic-based joinery over time. Apart from this, it can be said that the structure and originality of the building are relatively preserved.



BASEMENT FLOOR

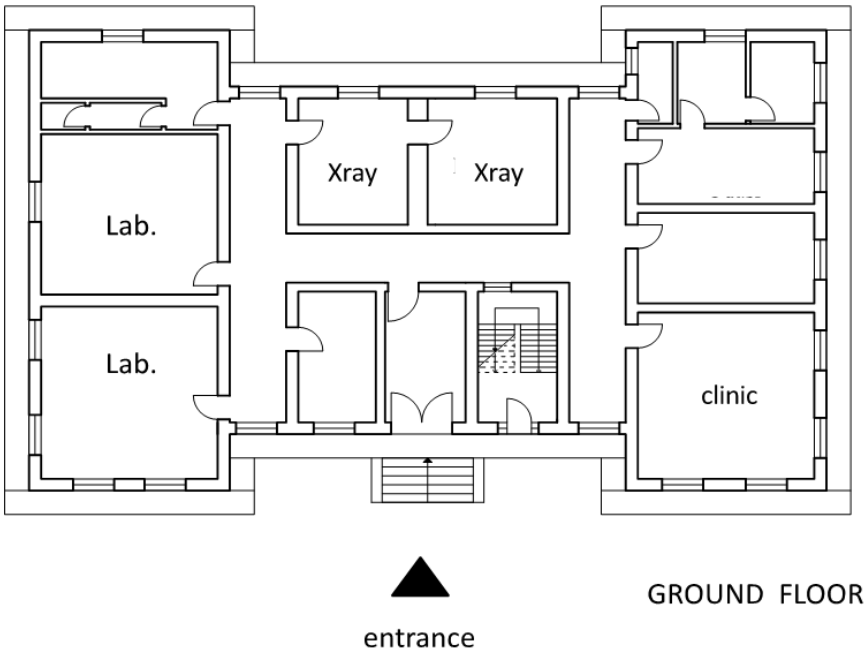


Figure 7. Basement and Ground Floor Plans
(Source: Giresun Erdoğan, 2022)

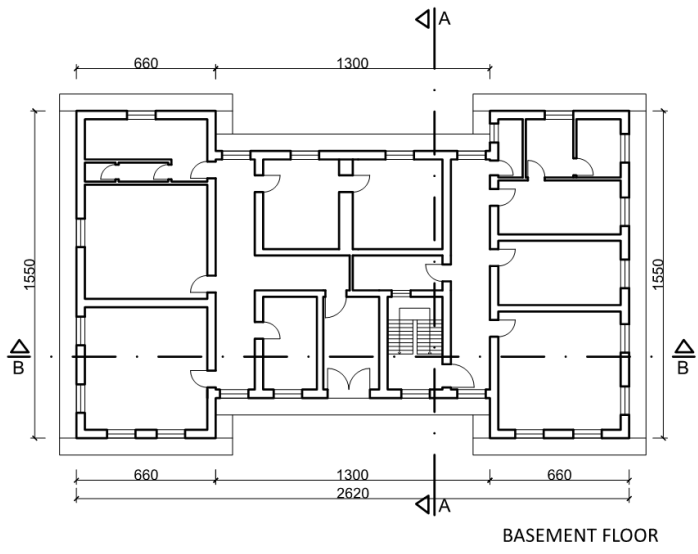


Figure 8. First Floor Plan and Building Sections
(Source: Giresun Erdoğan, 2022)

Evaluation for the Technic

It is usual for the building to age over time as it is about 70 years old. Although the building has been regularly maintained and repaired, quite intense wear and tear has been detected due to its abandonment.

There are cracks, dampness, and mold formations on the plaster on the masonry stone walls (Figure 9). In addition, the technical equipment used in the building is quite old. Installation elements added later the walls cause visual pollution.

Figure 9. An Exterior View (Source: The Authors, 2022)

No improper intervention has been made to the carrier system. Not adding illegal floors or removing load-bearing walls is a positive situation in terms of building durability. however, the age of the building and the missing codes at the time it was built raise questions about the robustness of the structure. Detailed and technical research is required on this subject.

The heating system and elements were added later. Air conditioning is done with air conditioning units. However, since the building was not in use, its performance could not be evaluated.

There is no management of building waste in the building also no garbage collection points in common areas. That's why pollution has formed.

Evaluation for the Function

The building has been functionally evaluated. Accessibility is poor. The building is entered via a six steps staircase. The staircase neither has a railing nor a ramp for the use of the disabled and the elderly (Figure 10). This causes a risk of falling at the entrance.

Figure 10. Perspection of the Building (Source: Giresun Erdoğan, 2022)

In vertical access, steep and narrow stairs are not suitable for comfortable use. These deficiencies in vertical access restrict access to the upper floor for users with special needs.

Conditions harmful to health (such as dampness and mold) were observed in the building besides that Lead-based materials in the x-ray room adversely affect user's health.

Although the fire extinguishers located in places are positive, the absence of a fire escape ladder in the building is a major deficiency and makes it difficult to escape from the fire.

Windows and openings in every space are sufficient for natural ventilation and are necessary for user comfort. There is no need for extra reinforcement for artificial ventilation. Window openings are not wide enough due to the masonry construction system. Despite this, the natural light level is sufficient on the ground and the first floor. But that's not

enough in the basement. The windows in the basement are very narrow so artificial lighting support is required. However, there is not enough equipment for artificial lighting elements in the basement. Artificial lighting is also insufficient on other floors. Because of some equipment does not work. Buttons are old and worn. Moreover, electrical and communication cables are exposed in a way that poses a risk. These determinations about the lighting can be seen in Figure 11.

Figure 11. Window Sizes in Basement (left), Ground (middle) and First floors (right) (Source: The Authors, 2022)

Space dimensions are part of the functional evaluation. Both clinic rooms and Staff study rooms are suitable. However, since the sizes and designs of the toilets are wrong, there are problems with their use. Some toilet doors shown in Figure 12 are 55 cm. The lack of a toilet in the building for visitors and the disabled is a serious problem.

Figure 12. Some Toilet's Design Problems (Source: The Authors, 2022)

Results

The findings obtained at the end of the building evaluation are shown in the analysis table (Table 4). As a result of the evaluation made in the old Dispenser building, it was concluded that the re-use potential of the building was low ($\bar{x}$ = 2,15). Of course, this is a general assessment and the factors that are due to this should be examined separately.

When evaluated in the parameters, the location of the building was very high for the re-use potential ($\bar{x}$ = 3,80). However, considering the design of the building, the potential was considered as low ($\bar{x}$ = 1,83).

The parameters that reduce the general average so much are technical and functional. When the technical ($\bar{x}$ = 1,40) and functional ($\bar{x}$ = 1,60) evaluation, the re-use potential is very low.

As a result of the evaluation made in the old Dispenser building, it was concluded that the re-use potential of the building was low ($\bar{x}$ = 2,15). However, this result does not mean that the building cannot be reused. These findings will change if the weak points in the parameters revealed are improved. Location findings, which are the most difficult parameter to change and improve, are quite good. Design and functional problems are not in a position to be solved. However, the critical build-

ing is the robustness of the carrier. Considering the age and construction technique of the building, question marks occur on the carriage of the building. For this reason, technical issues should be diagnosed before making a decision to reuse the building.

Table 4. Evaluation for Re-use Potential

Categories	KPIs	Score	Mean
Location	Flexibility	4	3,80
	Site access	4	
	Relating the city center	3	
	Neighborhood and amenity	4	
	Perceptibility	4	
Design	Circulation	1	1,83
	Building flexibility	1	
	Spatial flexibility	2	
	Aesthetic value	3	
	Facade/Shell well-being	3	
	Flexible facade	1	
Technical	Aging	1	1,40
	Deterioration	1	
	Infrastructure	2	
	Air conditioning	2	
	Waste management	1	
	Accesibility	1	
	Health	1	
Functional	Physical well-being	1	1,60

	Fire safety	2
	Comfort	3
Overall avarage		2,15

CONCLUSION

Expanding built environments is an ongoing global issue that has negative effects on the economy, environment, and society. Repurposing abandoned structures would slow down this expansion. Implementations of reuse are crucial to the development of sustainability in the future. Energy use for construction should be kept to a minimum in order to create a sustainable industry that can sustain itself over time on a socio-cultural, environmental, and economic level.

Vacant buildings should be able to serve the same purpose or a different one. Recycling is another choice, though. Recycling building elements, materials, etc. also contributes to sustainability. Both options are useful, but it is necessary to make a difficult and complex decision to return. It will reverse all these benefits spent to keep a building that will not work but also the destruction of a reusability building. To make the right decision about the building, the performance of the building should be evaluated systematically and objectively. Thus, the building will reveal the suitable and unsuitable aspects for reuse to the decision maker. Stakeholders will consider these aspects and review the decision before making a decision. This evaluation provides time and information support in decision-making, implementation, and design and implementation processes of reuse.

The study reveals the effect of different characteristics of idle buildings on the adaptability decision. As seen in the example building, determining the strengths and weaknesses of an inactive building provides decision support to the stakeholders who have a say on the building in the decision of adaptability, design, and implementation. Thus, the reuse potential of idle buildings can be ignored and their demolition or, on the contrary, unsuccessful adaptation attempts can be prevented.

In this study, four categories of KPIs were introduced and impact weights in the decision were excluded. In future studies, different methodologies can be developed for determining KPIs and weighting effects. Thus, the decision-making process of decision makers can be accelerated.

While decision-making methodologies improve not only existing buildings can be used more beneficially but also by enriching the literature on the subject, academic research will increase.

All these contributions will have an impact on making the built stock more beneficial for a sustainable environment.

ACKNOWLEDGMENTS

This chapter supervised of the second author resulted from the doctoral (Ph.D.) thesis study of the first author. We would like to thank the administrators and staff of the Muğla Provincial Health Directorate for their help and information sharing. We also acknowledge and thank Samet Çelik for helping to draw the Figure 7- 8 and 10.

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