

PROCEEDINGS BOOK OF THE 1st
**ADVANCED
ENGINEERING DAYS**

23 DECEMBER 2021 / MERSIN, TURKEY

International Engineering Symposium



Congress Chairman

PROF. DR. MURAT YAKAR

<http://aed.mersin.edu.tr/>



ISBN: 978-605-73805-0-0

The proceedings of the 1st Advanced Engineering Days



Editor-in-Chief

Prof. Dr. Murat YAKAR

Editors

Asst. Prof. Dr. Ali ULVI

Lecturer Atilla KARABACAK

Lecturer Şafak FİDAN

Res. Asst. Aydın ALPTEKİN

Res. Asst. Abdurahman Yasin YİĞİT

Eng. Engin KANUN

ISBN: 978-605-73805-0-0

Mersin, 2021

HONOR BOARD

Ali İhsan SU - Governor of Mersin Province
Prof. Dr. Ahmet ÇAMSARI - Rector of Mersin University
Prof. Dr. Orhan AYDIN - Rector of Tarsus University

SCIENCE BOARD

Prof. Dr. Murat YAKAR (Mersin University)
Prof. Dr. İlker Fatih KARA (Mersin University)
Prof. Dr. Mehmet Cihan AYDIN (Bitlis Eren University)
Prof. Dr. Ali Rıza SÖĞÜT (Konya Technical University)
Prof. Dr. Şükrü DURSUN (Konya Technical University)
Prof. Dr. Donato ABRUZZESE (Roma University)
Prof. Dr. Erdem KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Erdiç AVAROĞLU (Mersin University)
Assoc. Prof. Dr. Khalil Valizadeh KAMRAN (University of Tabriz, IRAN)
Assoc. Prof. Dr. Hayri ULVİ (Gazi University)
Assoc. Prof. Dr. Nida NAYCI (Mersin University)
Assoc. Prof. Dr. Musa ÇIBUK (Bitlis Eren University)
Assoc. Prof. Dr. Ümit BUDAK (Bitlis Eren University)
Assoc. Prof. Dr. Beyhan KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Barış BULDUM (Mersin University)
Assoc. Prof. Dr. İskender ÖZKUL (Mersin University)
Assoc. Prof. Dr. Fatih ÜNAL (Mersin University)
Assoc. Prof. Dr. Şenay GÜNGÖR (Nevşehir Hacı Bektaş Veli University)
Asst. Prof. Dr. Merve Şentürk ACAR (Bilecik Şeyh Edebali University)
Asst. Prof. Dr. Abdulkadir AYANOĞLU (Mardin Artuklu University)
Lect. İbrahim BOZ (Mardin Artuklu University)
Lect. Lale KARATAŞ (Mardin Artuklu University)
Dr. Hakan DOĞAN (Turkish State Meteorological Service)
Dr. Ahmet Erhan AKAN (Namık Kemal University)
Dr. Fatih ADIGÜZEL (Nevşehir Hacı Bektaş Veli University)

ORGANIZING COMMITTEE

Prof. Dr. Murat YAKAR (Mersin University)
Prof. Dr. Cengiz ALYILMAZ (Uludağ University)
Prof. Dr. Semra ALYILMAZ (Uludağ University)
Prof. Dr. Şükrü DURSUN (Konya Technical University)
Prof. Dr. Mehmet Cihan AYDIN (Bitlis Eren University)
Prof. Dr. Erdem KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Beyhan KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Bünyamin DEMİR (Mersin University)
Asst. Prof. Dr. Ali ULVİ (Mersin University)
Asst. Prof. Dr. Vahdettin DEMİR (KTO Karatay University)
Asst. Prof. Dr. Esra URAY (KTO Karatay University)
Dr. Hakan DOĞAN (Turkish State Meteorological Service)
Lect. Atilla KARABACAK (Mersin University)
Lect. Şafak FİDAN (Mersin University)
Res. Asst. Aydın ALPTEKİN (Mersin University)
Res. Asst. Abdurahman Yasin YİĞİT (Mersin University)
Res. Asst. Ramazan AKKURT (Mersin University)
Res. Asst. İrem YAKAR (Istanbul Technical University)
Eng. Engin KANUN (Mersin University)
Eng. Mücahit Emre ORUÇ (Mersin University)

Session-1		
09.00-09.50	Geotechnical Examination of Ermenek District in the Province of Karaman Fevzi Sevimli, İsa Kul	
	Forecasting of Monthly Average Lake Levels of Lake Michigan with Artificial Neural Networks Esra Asli Çubukçu, Cavit Berkay Yılmaz, Vahdettin Demir, Mehmet Faik Sevimli	
	Drought analysis of Black Sea Region by StandardizeDrought analysis of Black Sea Region by Standardized Precipitation Index (SPI) and Percent of Normal Index (PNI) Bilgehan İnan, Vahdettin Demir, Mehmet Faik Sevimli	
	Investigation of Prestressed Anchor Retaining Systems within the Scope FHWA-99-015 and BS 8081:2015 Yusuf Bozkurt, Esra Uray	
	In-plane numerical analysis of a double-layered ashlar wall Ahmad Javid Zia, Abdulkерim İlgün	
	Session-2	
	10.00-11.00	Investigation of the effect of the burnishing applied to the Al2024 alloy on the surface roughness Suleyman Cinar Çağın, Berat Baris Buldum
The effect of process and solution parameters on the size of nanofibers produced by the electrospinning method Alper Günöz, Yusuf Kepir, Bünyamin Demir, Memduh Kara, Uzay Gezer		
Effect of environmental conditions on the mechanical properties of composite tubes Yusuf Kepir, Alper Günöz, Memduh Kara		
Different nozzle types in electrospinning applications Uzay Gezer, Bünyamin Demir, Alper Günöz, Memduh Kara, Yusuf Kepir		
Modelling of supercapacitor by using parameter estimation method for energy storage system Gökhan Yüksek, Yusuf Muratoğlu, Alkan Alkaya		
Session-3		
11.20-12.40		Advantages of slit-check dams in practice and investigation of bed slope effect Mehmet Cihan Aydın, H. Seda Aytemur, Ali Emre Ulu
	Effect of infill walls on limit states in reinforced-concrete frames Ercan Işık, Mehmet Cihan Aydın, Ali Emre Ulu	
	A study on the flow velocities and energy dissipation potential of flow separator placed in spillway flip bucket Ali Emre Ulu, Mehmet Cihan Aydın, Ercan Işık	
	Investigation of failed node method to support healthy communication for linear wireless sensor networks Musa Çibuk, Davut Arı, Fikri Ağgün	
	The effect of the geometric features of the road on traffic accidents Sümeyra Kaya Arman	
	The superiorities of concrete roads over asphalt roads Muhammed Tanyıldızı, Erden Ozan Karaca	
	Regeneration application in Bitlis city multi-storey housing construction Veda Seven Biçen	
	Investigation of the existing situation of the Surp Ağpırig (Déra Spı) Monastery Enes Arkan, Fatih Avcıl	
	Session-4	
13.10- 13.50	The investigation of on-site generation of disinfectant by electrochemical methods Alper Erdem Yılmaz, Yeşim Dede Sağsöz, Beyhan Kocadağistan	
	Adsorption of Astrazon red GTLN (AR) with volcanic tuff Bayburt Stone Beyhan Kocadağistan, Erdem Kocadağistan	
	Construction stages of gold mining waste storage facility, Gümüşhane Mastra Koza Mining Volkan Emre Demir, Beyhan Kocadağistan	
	Investigation of temporal changes of green field changes using image processing and geographic information systems: The case of Bayburt Province Mustafa Alptekin Engin, Sinan Kul	

Session-5	
14.00-14.40	Determination and Modelling of PM2.5 Level in Summer time in Selcuk University Shopping Centres Konya, Turkey Şükrü Dursun, Mina Naseer Qasim
	PM2.5 Concentration Measurements and Mapping at Gökuşagi Mall for Autumn2018, in Konya, Turkey Şükrü Dursun, Mina Naseer Qasim
	Determination of water quality in Hadim district of Konya (Turkey) and the investigation of disinfection efficiency Şükrü Dursun, Abdurrahman Sarcan
	Konya Aslim wild storage field rehabilitation and gains Şükrü Dursun, Lütfü Şen
Session-6	
15.00-15.50	Changes in land use between 1990 and 2018 on the basis of the Corine system in Adana Province Elif Saydan, Şenay Güngör, Efdal Kaya
	Determining the effect of urbanization on green spaces by NDVI analysis: Bilecik City example Hüseyin Taş, Fatih Adigüzel, Müjdat Güngör
	Analysis for traffic/road and vehicle tracking/planning systems (TRVTPS) in the road transport within the scope of smart cities Aziz Cumhuri Kocalar
	Monitoring the effects of vegetation cover change on land surface temperature in Nimbia Forest Reserve, Nigeria Abubakar Abubakar Bello, Abubakar Abubakar Sani
	Virtual reality supported design and manufacturing suitable for use in hand and wrist function disorders Pınar Aslan Yıldırım, Adnan Akkurt
Session-7	
16.00-17.10	A concept study of the recycling of end-of-life tires for use in the construction of buildings Çağrı Çağan, İskender Özkul
	Soft-Story Deficiency due to open ground story in properly designed reinforced concrete buildings Emre Akın
	Evaluation of the soil conditions in Alikahya Region (İzmit) Talas Fikret Kurnaz
	Physical Properties of Cement Mortars Containing Steel Fiber Cahit Bilim, İlker Fatih Kara, İsmet Vapur
	Effect of fiber content on the liquefaction potential of improved soils Özgür Lütfi Ertuğrul, Fatma Dülger Canoğulları
	Investigation of the effect of groundwater flow velocity on energy efficiency in energy pile groups positioned parallel to the groundwater flow direction Fatma Dülger Canoğulları, Özgür Lütfi Ertuğrul
Assessment of the artificial fiber contribution on the shear strength parameters of soils Özgür Lütfi Ertuğrul, Furkan İnal	

Contents	Page
Geotechnical examination of Ermenek District in the province of Karaman Fevzi Sevimli *, İsa Kul	1
Forecasting of monthly average lake levels of Lake Michigan with artificial neural networks Esra Aslı Çubukçu *, Cavit Berkay Yılmaz, Vahdettin Demir, Mehmet Faik Sevimli	4
Drought analysis of Black Sea Region by standardized precipitation index (SPI) and percent of normal index (PNI) Bilgehan İnan *, Vahdettin Demir, Mehmet Faik Sevimli	8
Investigation of prestressed anchor retaining systems within the scope FHWA-99-015 and BS 8081:2015 Yusuf Bozkurt *, Esra Uray	11
In-plane numerical analysis of a double-layered ashlar wall Ahmad Javid Zia *, Abdulkerim İlğün	14
Investigation of the effect of the burnishing applied to the Al2024 alloy on the surface roughness Suleyman Cinar Cagan *, Berat Baris Buldum	17
The effect of process and solution parameters on the size of nanofibers produced by the electrospinning method Alper Gunoz *, Yusuf Kepir, Bünyamin Demir, Memduh Kara, Uzey Gezer	20
Effect of environmental conditions on the mechanical properties of composite tubes Yusuf Kepir *, Alper Gunoz, Memduh Kara	23
Different nozzle types in electrospinning applications Uzey Gezer *, Bünyamin Demir, Alper Günöz, Memduh Kara, Yusuf Kepir	26
Modelling of supercapacitor by using parameter estimation method for energy storage system Gökhan Yüksek *, Yusuf Muratoğlu, Alkan Alkaya	29
Advantages of slit-check dams in practice and investigation of bed slope effect Mehmet Cihan Aydın *, H. Seda Aytemur, Ali Emre Ulu	32
Effect of infill walls on limit states in reinforced-concrete frames Ercan Işık *, Mehmet Cihan Aydın, Ali Emre Ulu	35
A study on the flow velocities and energy dissipation potential of flow separator placed in spillway flip bucket Ali Emre Ulu *, Mehmet Cihan Aydın, Ercan Işık	38
Investigation of failed node method to support healthy communication for linear wireless sensor networks Musa Çıbuk *, Davut Arı, Fikri Ağgün, Ümit Budak	41
The effect of the geometric features of the road on traffic accidents Sümeyra Kaya Arman	45

The superiorities of concrete roads over asphalt roads Muhammed Tanyıldızı*, Erden Ozan Karaca	48
Regeneration application in Bitlis city multi-storey housing construction Veda Seven Biçen	51
Investigation of the existing situation of the Surp Ağpırig (Déra Spî) Monastery Enes Arkan*, Fatih Avcil	54
The investigation of on-site generation of disinfectant by electrochemical methods Alper Erdem Yılmaz*, Yeşim Dede Sağsöz, Beyhan Kocadağistan	57
Adsorption of Astrazon red GTLN (AR) with volcanic tuff Bayburt Stone Beyhan Kocadağistan*, Erdem Kocadağistan	60
Construction stages of gold mining waste storage facility, Gümüşhane Mastra Koza Mining Volkan Emre Demir*, Beyhan Kocadağistan	63
Investigation of temporal changes of green field changes using image processing and geographic information systems: The case of Bayburt Province Mustafa Alptekin Engin*, Sinan Kul	66
Determination and modelling of PM_{2.5} level in summer time in Selcuk University Shopping Centre Konya, Turkey Sukru Dursun*, Mina Naseer Qasım	69
PM_{2.5} Concentration Measurements and Mapping at Gökuşağı Mall for Autumn 2018, in Konya, Turkey Sukru Dursun*, Mina Naseer Qasım	72
Determination of water quality in Hadim district of Konya (Turkey) and the investigation of disinfection efficiency Sukru Dursun*, Abdurrahman Sarcan	75
Konya Aslim Wild Storage Field Rehabilitation and gains Lütfü Şen, Sukru Dursun	78
Changes in land use between 1990 and 2018 on the basis of the corine system in Adana Province Elif Saydan*, Şenay Güngör, Efdal Kaya	81
Determining the effect of urbanization on green spaces by NDVI analysis: Bilecik City example Hüseyin Taş*, Fatih Adıgüzel, Müjdet Güngör	84
Analysis for traffic/road and vehicle/cargo tracking/planning systems (TRVCTPS) in the road transport within the scope of smart cities Aziz Cumhur Kocalar	87
Monitoring the effects of vegetation cover change on land surface temperature in Nimbia Forest Reserve, Nigeria Bello Abubakar Abubakar*, Sani Abubakar Abubakar	90

Virtual reality supported design and manufacturing suitable for use in hand and wrist function disorders	93
Pınar Aslan Yıldırım*, Adnan Akkurt	
A concept study of the recycling of end-of-life tires for use in the construction of buildings	96
Çağrı Çağan*, İskender Özkul	
Soft-story deficiency due to open ground story in properly designed reinforced concrete buildings	99
Emre Akın	
Evaluation of the soil conditions in Alikahya Region (İzmit)	102
Talas Fikret Kurnaz	
Physical properties of cement mortars containing steel fiber	105
Cahit Bilim*, İlker Fatih Kara, İsmet Vapur	
Effect of fiber content on the liquefaction potential of improved soils	108
Özgür Lütfi Ertuğrul*, Fatma Dülger Canoğulları	
Investigation of the effect of groundwater flow velocity on energy efficiency in energy pile groups positioned parallel to the groundwater flow direction	111
Fatma Dülger Canoğulları*, Özgür Lütfi Ertuğrul	
Assessment of the artificial fiber contribution on the shear strength parameters of soils	114
Özgür Lütfi Ertuğrul*, Furkan İnal	





Advanced Engineering Days

aed.mersin.edu.tr



Geotechnical examination of Ermenek District in the province of Karaman

Fevzi Sevimli *¹, İsa Kul¹

¹KTO Karatay University, Undergraduate Education Institute Head Department of Construction Engineering, Department of Civil Engineering, Konya, Turkey, fevzisevimli@gmail.com; isa.kul@karatay.edu.tr

Cite this study: Sevimli, F., & Kul, İ. (2021). Geotechnical examination of Ermenek District in the province of Karaman. 1st Advanced Engineering Days, 1-3

Keywords

Ermenek
Ground
Carriage
Earthquake
Liquefaction

ABSTRACT

In recent years, as a result of the increasing interest in construction in our country, the demand for construction areas has also increased. Regarding the buildings we plan to build, we should examine whether the ground being the surface on which the structure will sit or be adjacent, can respond to us positively in terms of strength. As a result, if the soil strength is poor, either the ground must be improved or the property of the structure to be built must be changed. Hence, the building and the ground cannot be considered separately. They need to be considered as a whole. In our country, there are not many geotechnical studies which deal with the structure-soil relationship and explain the ground infrastructure of the region, especially in settlements with medium and small populations. Due to this reason, in this study, it is aimed to address the Ermenek district of Karaman from this respect and to eliminate this deficiency of the district. In accordance with this, ground structure of district, various ground survey reports and geophysical reports prepared in recent years were examined. Furthermore, structure class of building planned to be made on that parcel, as well as ground settlement area, number and height of floors, approximate building and foundation loads were calculated with respect to architectural aspects and static and dynamic loads that were formed were brought together and their suitability for the structure, amount of seating that may occur on the ground, and liquefaction situations were examined with respect to bearing capacity of ground. In this way, an infrastructure information bank was created with regards to geotechnical aspects of district.

Introduction

Natural disasters occur almost every year in our country and in different parts of the world. These disasters cause situations of loss of life and property. Earthquake, which is one of these disasters, is the most damaging ground movement. About 500,000 earthquakes occur annually in the world whereas 80% of these earthquakes are palpable, and nearly 100 of them are destructive. Unfortunately, earthquakes in urban areas cause physical and socio-economic losses. As an example of this, we are a country that experienced earthquakes in 1999 in Gölcük and Düzce, in 2003 in Bingöl, in 2011 in Van, and in 2020 in Elazığ and İzmir. As a result of these earthquakes, tens of thousands of our citizens lost their lives and were injured, and thousands of families were left homeless and unemployed.

Besides, incidents such as “Building-Soil Incompatibility”, that is, the construction of a structure on a ground with unsuitable strength for the structure, are often confronted with. This event does not only cause settlement or swelling in the buildings built over time, but also damages and even collapses the structures situated on the adjacent parcels.

Even though it is not possible to prevent the occurrence of earthquakes or to determine when they will occur with today's technology, it is possible to minimize the damage they will cause, and it is possible to prevent the dangers and damages that will occur by improving the soils with unsuitable strength and by choosing the appropriate construction/manufacturing method.

Ermenek District of Karaman Province, which has been examined regarding this issue, is one of the safest regions in our country in terms of seismicity. No large earthquakes occurred in the mentioned region. Considering the earthquake events of the last 15 years in the region, it is seen that the largest earthquake had a Magnitude of 3. Maybe due to these reasons, no geotechnical studies and investigations covering Ermenek and its surroundings that can be taken as a reference in general terms have been carried out. However, the recent major construction attack in the district, in addition to this, the Ermenek Dam with a crest height of 274 meters that is built on the Ermenek Stream, which passes through the south of the district and feeds the Göksu River, the presence of many regulators on the same brook and the construction of Tekeçatı Regulator on Tekeçatı Stream, which passes through the north of the district constitute the evidence that more interest must be shown on the region with regards to geotechnical aspects.

In this study, geological and geophysical reports previously prepared in province of Ermenek were evaluated, and structures built or planned to be built as per zoning plan were evaluated and required numerical values were calculated and accordingly, bearing capacity of ground, amount of floor seating, liquefaction situation were examined parcel by parcel with certain geotechnical programs. By means of this study, ground status of province has been revealed.

To give examples of some studies similar to this study, we can mention about study conducted by [1] in the Sakarya region, study conducted by [2] in Bursa province and its surroundings, study conducted by [3] in the Çayırhan District of Ankara, study conducted by [4] around Batman Province, study conducted by [5] in Osmaniye, study conducted by [6] in Kaynaşlı District, study conducted by [7] in the northeastern region of Şanlıurfa in 2008, study conducted by [8] in the south of the Bosphorus and the Golden Horn region in 1992, and study conducted in Denizli city center by [9].

As a result of this study, it is aimed to examine whether the structures suitable for the ground are built in this district, where almost no geotechnical studies have been carried out, whether any soil Improvement is needed for the ground of the structures to be built, and to shed light on the future studies.

Material and Method

If we would mention about the district being examined, Ermenek District is located in Karaman province and it is 67 kilometers southeast of Karaman. There is Mut district in the east of the district, Anamur in the south and Balkusan Village in the west, 15.75 km north of the Antalya provincial border. While the land structure of the district varies from north to south, that is, from Tekeçatı Region to Ermenek Dam, between an altitude of 1400 and 700, there is no great difference in elevation from east to west. Geologically, the region is a structure that generally contains limestone, clay, marl, fossiliferous sandstone and even coal. At a distance of 40 km from the district, there are many small faults that are distributed within a zone of 17 km length and 3 km width. This region is named as Mut Fault Zone. The researchers state that the fault is strike-slip with vertical component and possibly alive due to the river valleys and parallel ridges following the faults.

The study was started by obtaining the Geological and Geophysical Report, which was prepared as a result of the Field and Laboratory Test results obtained from the Ermenek Municipality, from more than 40 parcels and more than 100 boreholes built by both state institutions and private companies, and by examining these reports in detail.

Experiments and results of the Geological Surveys on the land, the results of the laboratory experiments made on the samples taken, as well as the results obtained as a result of the Geophysical Surveys and seismic refraction tests carried out on the same plot, were presented in plots. Then, all data were transferred to a Geotechnical Analysis program known as Geotransportation, again separately. In the meantime, the building classes, number of floors, residence areas, estimated foundation models, foundation depths, Groundwater Levels and total building load of the structures built or planned to be built on the parcels were calculated and processed in the same analysis program. As seen below, 5 parcels selected from different regions and neighborhoods are presented in Table 1.

Geotechnical analysis results

After all the data were entered into the Geotransport Soil Analysis Program separately, the Controls for the Transport Forces, Settlement Amounts and Soil Liquefaction of all processed parcels were made as a result. Here again, the results of the 5 plots I mentioned above are presented in Table 2.

Conclusion and Suggestions

The soil class determined in the district is mainly ZC class and has a structure mainly composed of limestones. In the analysis made in the examined parcels, it was seen that it has sufficient and suitable properties in terms of Bearing Power, Elastic and Consolidated Settlement Amounts and Liquefaction potential. It has been concluded that there is no need for any ground improvement for these structures planned to be built on the said parcels. In addition, the results of these geotechnical analyzes in higher building loads and multi-storey structures, can be examined and even examination can be made about how far the endpoints can be.

Table 1. Data relating with 5 parcels presented as example among examined parcels

Quarter Plot Parcel	Underground Water Level Df Form type	Vp speed Vs speed Vs30 and To	Ss-Fs-SDS S1-F1-SD1 PGA-PGV	TA-TB-TL TAD-TBD-TLD	Building details Foundation form Building weight
Seyran 112 33	None -2,00m Raft	483-2495 274-809 564-0,24	0,280-1,30-0,364 0,076-1,50-0,114 0,127-6,142	0,063-0,313-6,000 0,021-0,104-3,000	BKS=1 I=1,5 DTS=3a BYS=6 1097m ² 104586 kN
Taşbaşı 761 5	None -5,30m Raft	316-1172 192-723 434-0,30	0,283-1,30-0,368 0,076-1,50-0,114 0,128-6,179	0,062-0,310-6,000 0,021-0,103-3,000	BKS=1 I=1,5 DTS=3a BYS=6 2950m ² 103826 kN
Meydan 460 36	None -2,00m Continuous	719-1190 440-568 558-0,38	0,286-1,30-0,372 0,077-1,50-0,116 0,130-6,223	0,062-0,311-6,000 0,021-0,104-3,000	BKS=3 I=1 DTS=3a BYS=5 175m ² 34030 kN
Güllük 701 1	None -3,50m Continuous	556-1228 223-558 401-0,38	0,282-1,30-0,367 0,076-1,50-0,114 0,128-6,173	0,062-0,311-6,000 0,021-0,104-3,000	BKS=3 I=1 DTS=3a BYS=6 1580m ² 32282 kN
Değirmenlik 174 36	-3,00m -2,00m Raft	616-884 223-354 334-0,59	0,282-1,57-0,444 0,076-2,40-0,182 0,128-6,167	0,082-0,411-6,000 0,027-0,137-3,000	BKS=3 I=1 DTS=3a BYS=5 280m ² 29049 kN

Table 2. Geotechnical Analysis Results of examined parcels

Quarter Plot-Parcel	Bearing capacity analysis as per TBDY	Elastic fit amount Consolidated fit amount.	Liquefaction Analysis
Seyran 112-33	238,578>166 Sufficient	E.F.A. s=0,010m Suitable C.F.A. s=0,088m Suitable	Layer 1: 4,49>1,1 Suitable Layer 2: 3,177>1,1 Suitable
Taşbaşı 761-5	1252,286>200 Sufficient	E.F.A. s=0,063m Suitable C.F.A. s=0,027m Suitable	Layer 1: 0,335<1,1 Suitable (Layer is above UWL) Layer 2: 2,799>1,1 Suitable
Meydan 460-36	2005,714>184 Sufficient	E.F.A. s=0,000m Suitable C.F.A. s=0,007m Suitable	Layer 1: 0,331<1,1 Suitable (Layer is above UWL) Layer 2: 2,769>1,1 Suitable
Güllük 701-1	788,67>302 Sufficient	E.F.A. s=0,000m Suitable C.F.A. s=0,001m Suitable	Layer 1: 4,459>1,1 Suitable Layer 2: 4,49>1,1 Suitable
Değirmenlik 174-36	2331,429>151 Sufficient	E.F.A. s=0,003m Suitable C.F.A. s=0,004m Suitable	Layer 1: 0,278<1,1 Suitable (Layer is above UWL) Layer 2: 1,441>1,1 Suitable

Acknowledgement: The authors thank KTO Karatay University.

Author contributions: **Fevzi Sevimli:** Conceptualization, Methodology, Data supply, Writing-Original draft preparation, **İsa Kul:** Writing-Reviewing and Editing.

References

- [1] Sert, S., Özocak, A., Arel, E., Bol, E. (2005) The Effect of Local Soil Properties on Damage Size in Sakarya Region, Arifiye-Geyve-Güneşler Example. Earthquake Symposium. Kocaeli, Turkey
- [2] Şahin, H. C. (2020). Geotechnical evaluation of Bursa Özlüce Region. Master Thesis, Bursa Uludag University, Institute of Science and Technology, Bursa.
- [3] Kurtuluş, C., Bozkurt, A., (2009) Investigation of Soil Properties of Çayırhan District, Ankara, Using Geophysical and Geotechnical Methods. Journal of Applied Earth Sciences, 8(2), 15-27.
- [4] Cute, S. (2019). Evaluation of Batman and its surroundings in terms of geotechnical earthquake engineering. Master Thesis, Batman University Institute of Science and Technology, Batman.
- [5] Bayrakçı, S., Baran, T. (2018, October). Evaluation of microzonation maps of Osmaniye city center (OKM) based on geotechnical features. Proceedings of the 3rd International Mediterranean Science and Engineering Congress (IMSEC-2018). In the paper (p. 98-104).
- [6] Ateş, A., Yeşil, B. & Toprak, B. (2014). Kaynaşlı (Düzce) TOKİ Yerleşim Alanı Zeminlerinin Geoteknik Özelliklerinin Jeofizik ve Geoteknik Yöntemlerle Araştırılması. Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 16 (1), 1-13. Retrieved from <https://dergipark.org.tr/tr/pub/baunfbed/issue/23851/254090>
- [7] Amount, H. (2008). Establishment of a geotechnical data bank of the north east region of Şanlıurfa city center. Doctoral Thesis, Harran University, Institute of Science and Technology, Şanlıurfa.
- [8] Özyayın, K., Anlı, A., Evre Mühendislik Ltd. (1992) Geological Structure and Geotechnical Features of the South of the Bosphorus and the Golden Horn. Geological Engineering (4) 5-14.
- [9] Akyol, E., Aydın, A., Alkan, M., Hazer, G. (2014). The Effects of Seismic and Geotechnical Parameters on Construction: Example of Denizli. Adiyaman University Journal of Educational Sciences 4(1), 36-46.



Forecasting of monthly average lake levels of Lake Michigan with artificial neural networks

Esra Aslı Çubukçu ^{*1}, Cavit Berkay Yılmaz ¹, Vahdettin Demir ¹, Mehmet Faik Sevimli ¹

¹ KTO Karatay University, Faculty of Engineering and Natural Sciences, Civil Engineering Department, Konya, Turkey
cubukcuasli@gmail.com; cavitberkayilmaz@gmail.com; vahdettin.demir@karatay.edu.tr; mehmet.faik.sevimli@karatay.edu.tr

Cite this study: Çubukçu, E. A., Yılmaz C. B., Demir, V., & Sevimli, M. F. (2021). Forecasting of monthly average lake levels of Lake Michigan with artificial neural networks. 1st Advanced Engineering Days, 4-7

Keywords

Artificial Neural Network
Lake Michigan
Modeling
Lake level

ABSTRACT

Forecasting of water level at various time intervals using historical record series is important in water resource management and related engineering. Similarly, a reliable estimation of water level change is required in drought and flood hydrology studies. In this study, Lake Michigan between 1981-2020 was modeled with 3 different Artificial Neural Networks (ANNs) using monthly average water level data. These are Multilayer ANN, Radial Based ANN, and Generalized ANN models. Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Coefficient of Determination (R^2) were used as comparison criteria. When the results were compared, the lowest error rate and the highest coefficient of determination were seen in the 12 inputs of the MANN model (MAE= 0.0342, RMSE= 0.0435, R^2 = 0.9906).

Introduction

Anthropogenic climate change, which has emerged especially in the last century and affects the whole earth, also has important effects on lakes. Temperature increases due to climate change also increase open surface evaporation in lakes with a larger surface area than other surface fresh water sources. Changing temperatures bring along the need for more water consumption. The use of water resources to provide more water than normal, due to both agricultural water needs and water needs in cities, causes the capacity of water reserves such as lakes to decrease or disappear [1]. Changes in lake level can lead to erosion, destruction of wetlands, changes in bird, fish and plant populations, increase or decrease in micro-organisms in the lake, and destruction of habitats. The main causes of changes in the decreasing level of lakes in many parts of the world have been associated with various anthropogenic factors such as changes in ground cover and land use, urbanization, increased agricultural and animal water needs, excessive use of the resources that feed [2-7]. In water resources engineering, estimating the water level at certain intervals according to the past records plays an important role for the continuity and feasibility of the planning. ANN is an information processing technology inspired by the working principle of the human brain. Neurons form a network system by connecting to each other in various ways, and these networks have features such as learning and memorizing the relationship between data. The main element of ANNs are mathematical functions. They evolve with the architecture of the network structure. ANNs are structures that reveal the relationship between input and output behaviorally [8-9]. In his study in 2004, Yazar tried to successfully predict the water level changes of Beyşehir Lake in Konya with various parameters and different training algorithms of MANN [10]. Abu Salam, in his study in 2018, used 10-year flow data from the Dibis dam in Iraq to make level estimation with ANN models and compared it with real measurements [11]. Çubukçu, in this study in 2019, it has been tried to predict the changes in sea level by six different Artificial Neural Networks (ANN's) training algorithms and Multiple Linear Regression (MLR) methods. Levenberg-Marquardt is faster and has a better accuracy than the other training algorithms in modeling sea level [12]. In his study in Damla 2020, he

created the estimation model of the water level of Yalova Gökçe Dam for 2019 using ANN. The input parameters were; Basin precipitation and evaporation values, dam water discharges, leachate amount, dam water level are the measurements and dam water level the flow rate of Sellimandira stream, which is effective in the formation used as. As a result, while the average dam water level estimated by the Levenberg-Marquardt training function in 2019 was 73.77 meters, the actual average water level in the dam was 72.13 meters, thus giving successful results [13]. The occurrence of such hydrological events depends on many parameters, so it can be difficult to predict and model. The literature shows that ANN can be applied, but the study on its comparison is quite limited.

In this study, 3 different types of ANNs were modeled using monthly average water level data of Lake Michigan in the US between 1981 and 2020. These are Generalized Regression, Multilayer, Radial Based ANN models. In modeling, the oldest 2/3 of the data number was used in the training phase, and the most recent 1/3 was used in the testing phases. The main reason for choosing this field of study is that the data is continuous and accessible.

Material and Method

Material

Lake Michigan is the only Great Lake entirely contained within the United States. The lake is surrounded by the states of Michigan, Wisconsin, Illinois, and Indiana. The Straits of Mackinac connect Lake Superior to Lake Huron, allowing the two lakes to function as one large body of water. The statistical information of the data is given in Table 1. According to Table 1; There are 480 pieces of data. The mean of these data is 176,479 m, the standard deviation is 0.432. Physical characteristics of Lake Michigan are given in Table 2.

Table 1. Statistical information

Criteria	Value
Average	176.479
Standard error	0.020
Standard Deviation	0.432
Kurtosis	-0.783
Distortion	0.178
The biggest	175.570
Smallest	177.500
Total	84710.040
Number	480



Figure 1. Study area [14]

Table 2. Physical characteristics [14]

Data	Value
Length	494 km
Breadth	190 km
Elevation	176 m
Depth	85 m aver; 281 m max
Volume	4,918 km ³
Water surface area	57,753 km ²
Drainage basin area	118,095 km ²
Shoreline length	2,639 km
Outlet	Straits of Mackinac to Lake Huron
Retention or replacement time	62 years
Population	12+ million

Method

ANNs perform learning processes with the help of examples, that is, it can be defined as the machine-transferred version of the learning mechanism of humans by experience. This learning mechanism, unlike what is known, brings the computational feature to the computer by using the ability to adapt to the environment, to adapt, to work according to past experiences or incomplete information in times of uncertainty. In ANNs, various pre-processes are applied to the inputs and outputs of the network cells, and the training process of the data that is included in the ANN cycle and trained can become more efficient. In this study, 3 different ANN models were used. First of all, one of the most widely used ANN models, MANN is an input layer, at least one-cell intermediate It consists of a layer and an output layer. Second, Radial-based ANN model of neuron cells in the nervous system seen in humans. Finally, the generalized regression neural network uses back propagation, requires no iterative training, and predicts any function between the input and output vectors. For detailed information [15-18] can be examined.

Application

In modeling, 320 of 480 data were used in training phase and 160 in testing phase. Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Coefficient of Determination (R^2) were used as comparison criteria. Related equations are given in Equation 1-3 below.

$$MAE = \frac{1}{N} \sum_{i=1}^N |Z_e - Z_o| \quad (1)$$

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (Z_e - Z_o)^2} \quad (2)$$

$$R^2 = \left(\frac{N * (\sum Z_o * Z_e) - (\sum Z_o) * (\sum Z_e)}{\sqrt{(N * \sum Z_o^2) - (\sum Z_o)^2} * \sqrt{(N * \sum Z_e^2) - (\sum Z_e)^2}} \right)^2 \quad (3)$$

In the equations, “Ze” and “Zo” show the estimated and observed elevation values and “N” represents the amount of data. Training and test results are given in Table 3. In the table, the models with the lowest RMSE and MAE, and the highest models in R² are colored closer to red.

Table 3. Training Results and Test Results

Criteria	Methods	Inputs											
		1	2	3	4	5	6	7	8	9	10	11	12
RMSE (Training)	MANN	0.065 1	0.045 4	0.042 1	0.045 2	0.044 8	0.044 0	0.044 4	0.040 8	0.041 7	0.039 7	0.039 6	0.040 8
	GRNN	0.063 2	0.038 4	0.026 0	0.040 3	0.028 8	0.038 9	0.031 0	0.039 5	0.031 4	0.024 9	0.046 3	0.039 4
	RBANN	0.064 9	0.044 4	0.044 4	0.042 6	0.042 4	0.041 9	0.041 8	0.043 3	0.042 6	0.043 4	0.042 6	0.041 4
MAE (Training)	MANN	0.052 5	0.036 2	0.032 8	0.035 2	0.034 9	0.034 4	0.034 6	0.032 9	0.033 0	0.031 6	0.031 4	0.032 3
	GRNN	0.050 7	0.030 1	0.019 4	0.031 0	0.020 6	0.029 3	0.022 4	0.030 1	0.023 5	0.017 5	0.036 4	0.029 8
	RBANN	0.052 4	0.035 3	0.034 7	0.032 8	0.033 2	0.032 9	0.033 2	0.034 2	0.033 9	0.034 5	0.033 6	0.032 6
R ² (Training)	MANN	0.972 7	0.986 7	0.988 6	0.986 9	0.987 1	0.987 5	0.987 3	0.989 3	0.988 8	0.989 9	0.989 9	0.989 3
	GRNN	0.974 3	0.030 1	0.995 7	0.989 7	0.994 7	0.990 5	0.993 9	0.990 3	0.993 9	0.996 1	0.986 9	0.990 5
	RBANN	0.972 9	0.987 3	0.987 3	0.988 3	0.988 4	0.988 7	0.988 8	0.988 0	0.988 3	0.987 9	0.988 3	0.989 0
RMSE (Test)	MANN	0.074 3	0.050 2	0.047 1	0.048 0	0.049 9	0.048 4	0.048 1	0.051 6	0.050 3	0.044 9	0.043 6	0.043 5
	GRNN	0.076 1	0.068 3	0.082 3	0.085 9	0.092 6	0.099 4	0.105 1	0.109 5	0.112 5	0.119 0	0.123 6	0.128 3
	RBANN	0.072 2	0.048 2	0.052 1	0.048 6	0.045 1	0.044 7	0.046 1	0.046 7	0.046 9	0.049 7	0.048 7	0.045 1
MAE (Test)	MANN	0.057 5	0.038 8	0.036 5	0.037 7	0.038 7	0.037 1	0.036 9	0.040 7	0.039 9	0.035 5	0.034 4	0.034 2
	GRNN	0.059 3	0.052 3	0.062 6	0.065 3	0.071 5	0.077 2	0.082 0	0.086 7	0.089 1	0.095 4	0.101 2	0.105 9
	RBANN	0.056 1	0.038 0	0.039 3	0.037 6	0.034 5	0.034 5	0.035 4	0.036 7	0.035 9	0.038 8	0.037 4	0.035 2
R ² (Test)	MANN	0.972 3	0.987 5	0.988 6	0.988 7	0.988 4	0.989 1	0.988 8	0.987 7	0.988 0	0.990 2	0.990 4	0.990 6
	GRNN	0.971 2	0.977 5	0.967 2	0.966 3	0.961 7	0.956 3	0.951 2	0.947 9	0.943 8	0.934 2	0.929 0	0.921 6
	RBANN	0.973 5	0.988 0	0.986 7	0.988 4	0.989 9	0.990 1	0.989 3	0.989 3	0.989 2	0.988 0	0.988 1	0.989 8

Results

When we look at the tables in general, it is seen that all models can make very good predictions regardless of the training and test parts. According to the training results, the algorithm that trains the best with the least error and the highest coefficient of determination GRNN (10 input) RMSE= 0.0249, OMH=0.0175, R²=0.9961. For the training pieces the best method is GRNN, then MANN and RBANN respectively. However, according to the test results, the best training algorithm is MANN. It is seen that it gives the best result in 12 inputs RMSE= 0.0435, OMH=0.0342, R²=0.9906. For the test pieces the best method is MANN, then RBANN and GRNN respectively.

References

- [1] Göncü, S., Albek, E. A., & Albek, M. (2017). Trend Analysis of Burdur, Eğirdir, Sapanca and Tuz Lake Water Levels Using Nonparametric Statistical Methods. *Afyon Kocatepe University Journal of Sciences and Engineering*, 17(2), 555–570. <https://doi.org/10.5578/fmbd.57389>
- [2] Du, Y., Cai, S., Zhang, X., & Zhao, Y. (2001). Interpretation of the environmental change of Dongting Lake, middle reach of Yangtze River, China, by 210Pb measurement and satellite image analysis. *Geomorphology*, 41(2–3), 171–181. [https://doi.org/http://dx.doi.org/10.1016/S0169-555X\(01\)00114-3](https://doi.org/http://dx.doi.org/10.1016/S0169-555X(01)00114-3).
- [3] Kiage, L. M., Liu, K. B., Walker, N. D., Lam, N., & Huh, O. K. (2007). Recent land-cover/use change associated with land degradation in the Lake Baringo catchment, Kenya, East Africa: Evidence from Landsat TM and ETM+. *International Journal of Remote Sensing*, 28(19), 4285–4309. <https://doi.org/10.1080/01431160701241753>
- [4] Legesse, D., & Ayenew, T. (2006). Effect of improper water and land resource utilization on the central Main Ethiopian Rift lakes. *Quaternary International*, 148(1), 8–18. <https://doi.org/10.1016/j.quaint.2005.11.003>
- [5] Penny, D., & Kealhofer, L. (2005). Microfossil evidence of land-use intensification in north Thailand. *Journal of Archaeological Science*, 32(1), 69–82. <https://doi.org/10.1016/j.jas.2004.07.002>
- [6] Yıldırım, Ü., Erdoğan, S., & Uysal, M. (2011). Changes in the coastline and water level of the Akşehir and Eber Lakes between 1975 and 2009. *Water Resources Management*, 25(3), 941–962. <https://doi.org/10.1007/s11269-010-9735-4>
- [7] Yuan, Y., Zeng, G., Liang, J., Huang, L., Hua, S., Li, F., Zhu, Y., Wu, H., Liu, J., He, X., & He, Y. (2015). Variation of water level in Dongting Lake over a 50-year period: Implications for the impacts of anthropogenic and climatic factors. *Journal of Hydrology*, 525, 450–456. <https://doi.org/10.1016/j.jhydrol.2015.04.010>.
- [8] Papik, K., Molnar, B., Schaefer, R., Dombovari, Z., Tulassay, Z., & Feher, J. (1998). Application of neural networks in medicine — a review. *Diagnostics and Medical Technology*, 4(3), 538–546.
- [9] Tekkanat, İ. S., & Sarış, F. (2015). Long-term trends observed in stream flows in the Porsuk Stream Basin. *Turkish Journal of Geography*, 64, 69–83.
- [10] Yazar, A. (2004). Determination of water level fluctuations of Beyşehir Lake using artificial neural network. Master Thesis. Selçuk Uni. Graduate School of Natural and Applied Sciences, Konya.
- [11] Abu Salam, Z. K. A. (2018). Prediction of water level in Dibis Dam using artificial neural network. Master Thesis, Süleyman Demirel Uni, Graduate School of Natural and Applied Sciences, Isparta.
- [12] Çubukçu, E. A. (2019). Modeling of annual maximum flows with geographic data components and artificial neural networks. Master Thesis, KTO Karatay Uni, Graduate School of Natural and Applied Sciences, Konya.
- [13] Damla, Y. (2020). Estimation of water level of Yalova Gökçe Dam by artificial neural networks. Master Thesis. Kırklareli Uni, Graduate School of Natural and Applied Sciences, Kırklareli.
- [14] URL-1 <https://www.michiganseagrant.org/topics/great-lakes-fast-facts/lake-michigan/> Last Access Date 07.12.2021.
- [15] Ari, A., & Berberler, M. E. (2017). Interface design for the solution of prediction and classification problems with artificial neural networks. *Acta Infologica*, 1(2), 55–73.
- [16] Çavuşlu, M. A., Becerikli, Y., & Karakuzu, C. (2012). Hardware implementation of neural network training with levenberg-marquardt algorithm. *Turkish Informatics Foundation Journal of Computer Science and Engineering*, 5(5), 1–7.
- [17] Çubukçu, E. A., Demir, V., & Sevimli, M. F. (2019). Sea Water Level Estimation Using Six Different Artificial Neural. ICEARC'19, 716–725 Trabzon.
- [18] Okkan, U., & Mollamahmutoğlu, A. (2010). Modeling of daily flows of Yigitler Stream with artificial neural networks and regression analysis. *Dumlupınar University Journal of Science Institute*, 23, 33–48.



Drought analysis of Black Sea Region by standardized precipitation index (SPI) and percent of normal index (PNI)

Bilgehan İnan ^{*1}, Vahdettin Demir ² Mehmet Faik Sevimli ³

¹KTO Karatay University, Faculty of Engineering and Natural Sciences, Civil Engineering Department, Konya, Turkey, bilgehan751@gmail.com; vahdettin.demir@karatay.edu.tr; mehmet.faik.sevimli@karatay.edu.tr

Cite this study: İnan, B., Demir, V., & Sevimli, M. F. (2021). Drought analysis of Black Sea Region by standardized precipitation index (SPI) and percent of normal index (PNI). 1st Advanced Engineering Days, 8-10

Keywords

Drought
Black Sea Region
SPI
PNI

ABSTRACT

Drought has become a critical problem for the whole world today. One of the main causes of drought is the decrease in precipitation regimes over time. In this study, the Black Sea Region was based on the annual total precipitation (mm) data between 1961-2019. Annual drought analysis was applied to 16 stations in the Black Sea Region with Standard Precipitation Index (SPI) and Percentage of Normal Index (PNI), which are two of the most used methods in drought analysis. As a result of the study, it was determined that the stations showed normal and above drought levels.

Introduction

Among the natural disasters of meteorological nature, the drought has the most impact. In other words, drought is the decrease of the water level below the normal level as a result of events such as decreases in precipitation, misuse of water resources, and hydrological adverse effects on water resources [1]. We divide drought into three different classes in general, these are meteorological drought, agricultural drought and hydrological drought. Meteorological drought is defined as a decrease in precipitation below the normal level in the long term and is the type of drought that is impossible to avoid [2]. In addition to the environmental damage of drought, it has a great long-term negative impact on the country's economy, agriculture, energy, tourism and forestry activities. The cost of the drought in Europe in 2003 was 11 billion euros, and the drought in Spain in 2006 damaged the agricultural sector more than 2 billion euros. As for our country, the agricultural sector shrank by 7.3% as a result of the drought in 2007 [3]. Today, many methods are used for drought analysis, the most common of which are the standard precipitation index and the percentage of normal index. In their study, Sarış and Gedik [4] analyzed the precipitation data of 11 stations in the Konya Closed Basin between the years 1930-2019 according to the standard precipitation index at different periods (6,12,24 and 36 months). As a result of the study, the temporal and hydrological variability of drought in Konya Closed Basin was statistically demonstrated with SPI analyzes applied at 20 different times [4]. Beden et al. made a two-stage drought analysis between 1960 and 2015 using the precipitation data of Samsun province. In the first stage, standard precipitation index and percent of normal index values were calculated. In the second stage, the index values of Mann Kendall method were applied. In this study, it was determined that the drought in the region was close to normal and above normal as a result of both stages [5]. In another study, Dinç, et al. [6] made standard precipitation index analysis in 3-, 6-, 12- and 24-month periods by using long-term precipitation data of 8 stations in Antalya province. When the results of the study are examined seasonally, it is concluded that the study area can be dry in winter as well as in summer and there is a constant risk of moderate drought in [6].

The Black Sea Region is the region that receives the most precipitation in our country and has diversity in terms of vegetation. It is a developed region of the agricultural sector, mainly tea and hazelnut production, therefore, drought analysis of the Black Sea Region is important and critical for future agricultural activities. In this study, 16 stations in the Black Sea Region investigated according to the precipitation data between 1961-2019 according to the standard precipitation index and the percent of normal index.

Material and Method

Material

In this study, data of 16 stations in the Black Sea region of Turkey were obtained from the Turkish State Meteorological Service (TSMS). In this region, the Black Sea climate varies as western, eastern, and central parts due to landforms. It is the region that receives the most precipitation in Turkey and the Black Sea, in line with the factors such as the elevation of the Eastern Black Sea-type mountains after the coast and the extension form. The climate and vegetation between the coast and the interior are completely different from each other. In the Middle Black Sea type, the amount of precipitation is less due to the decrease in altitude and the mountains being far from the coast. It has a flatter land than the Western and Eastern Black Sea Regions, as a result, it has arable lands [7]. The spatial distribution of the stations is given in Figure 1.

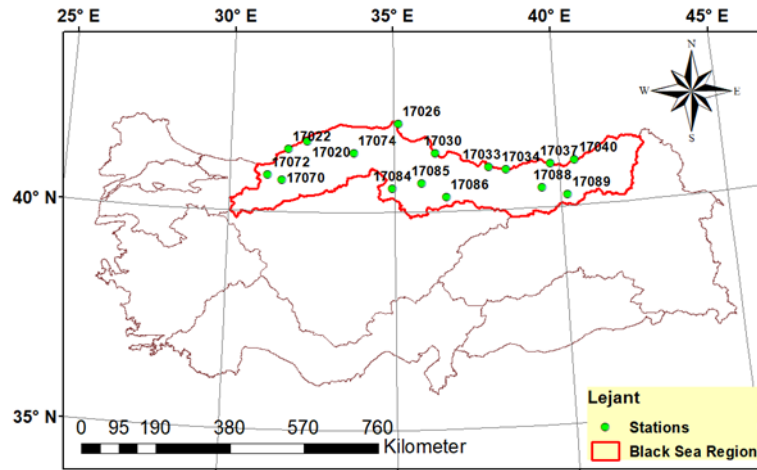


Figure 1. Study area and stations

Method

Standardized Precipitation Index (SPI)

More than one method is used in drought analysis. One of the most common of these methods is the standard precipitation index. The standard precipitation index was first developed by [8]. The standard precipitation index is calculated by dividing the difference from the average of the precipitation in a given period by the standard [8]. The index calculation of the SPI method is performed with Equation 1. The classes as a result of this calculation are given in Table 1 [9].

Percent of Normal Index (PNI)

Another method commonly used in drought analysis is the percentage of the normal index. The percentage index of normal is calculated by dividing the precipitation amount in a certain time by the average precipitation. PNI method is performed with Equation 2. The classes as a result of Equation 2 are given in Table 2 [8].

Table 1. Classifications of the SPI

Index Range	Classification
2.0 and more	Exceptionally Moist
1.60 - 1.99	Extremely Moist
1.30 - 1.59	Very Moist
0.80 - 1.29	Moderately Moist
0.51 - 0.79	Abnormally Moist
0.50 - -0.50	Near Normal
-0.51 - -0.79	Abnormally Dry
-0.80 - -1.29	Moderately Dry
-1.30 - -1.59	Severely Dry
-1.60 - -1.99	Extremely Dry
2.0 and less	Exceptionally Dry

Table 2. Classifications of the PNI

Period	Normal and Above (%)	Slightly Dry (%)	Moderately Dry (%)	Severely Dry (%)
1	> 75	65-75	55-65	< 55
3	> 75	65-75	55-65	< 55
6	> 80	70-80	60-70	< 60
9	> 83.5	73.5-83.5	63.5-73.5	< 63.5
12	> 85	75-85	65-75	< 65

$$SPI = \frac{(X_i - X_i^{avg})}{\sigma} \quad (1)$$

$$PNI = \frac{X_i}{X_i^{avg}} \times 100 \quad (2)$$

X_i^{avg} is average amount of precipitation,
 σ is standard deviation,
 SPI is standardized precipitation index,
 X_i current amount of precipitation (mm).

PNI is percent of normal index,
 X_i current amount of precipitation,
 X_i^{avg} is average amount of precipitation.

Results

The index values obtained according to the SPI and PNI methods were examined between 1961 and 2019 and the data of 16 stations were analyzed. As a result of this analysis, normal and above drought symptoms were detected at the rate of 67.4% according to the SPI method and 79.22% according to the PNI method.

Conclusion

In this study, two different drought indices were used to determine the drought of the Black Sea Region. These indexes are SPI and PNI indices. In the study, 16 provincial stations were used to represent the region. The monthly average precipitation data used in the analyzes cover the years 1961-2019. When the results were examined, there are no signs of drought for the region in the near future.

Acknowledgement: The authors thank KTO Karatay University and Mersin University.

Funding: This research received no external funding.

Author contributions:

Bilgehan İnan: Writing-Reviewing, Methodology, Application, **Vahdettin Demir:** Conceptualization, Editing, **Mehmet Faik Sevimli:** Last Editing.



Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Kapluhan, E. (2013). Türkiye’de kuraklık ve kuraklığın tarima etkisi. Marmara Coğrafya Dergisi(27), 487-510.
- [2] Gümüş, V., Başak, A., & Nazife, O. (2016). Standartlaştırılmış Yağış İndeksi (SYİ) yöntemi ile Şanlıurfa istasyonunun kuraklık analizi. Harran Üniversitesi Mühendislik Dergisi, 1(1), 36-44.
- [3] URL-1 <https://www.wwf.org.tr/?2620/nedirbukuraklik>
- [4] Sarış, F., & Gedik, F. (2021). Konya Kapalı Havzası’nda meteorolojik kuraklık analizi. Coğrafya Dergisi(42), 295-308.
- [5] Keskin, A. Ü., Beden, N., & Demir, V. (2018). Analysis of annual, seasonal and monthly trends of climatic data: a case study of Samsun. Nature Sciences, 13(3), 51-70.
- [6] Dinç, N., Aydınşakir, K., Işık, M., & Büyüktaş, D. (2016). Drought analysis of Antalya province by standardized precipitation index (SPI). Derim, 33(2), 279-298.
- [7] URL - 2 https://tr.wikipedia.org/wiki/Karadeniz_B%C3%B6lgesi
- [8] McKee, T. B., Doesken, N. J., & Kleist, J. (1993). The relationship of drought frequency and duration to time scales. Paper presented at the Proceedings of the 8th Conference on Applied Climatology, 17-22 January 1993, Anaheim, California.
- [9] Willeke, G., Hosking, J., Wallis, J., & Guttman, N. (1994). The national drought atlas. Institute for water resources report, 94.



Investigation of prestressed anchor retaining systems within the scope FHWA-99-015 and BS 8081:2015

Yusuf Bozkurt ^{*1}, Esra Uray ²

¹KTO Karatay University, Faculty of Engineering and Natural Sciences, Department of Civil Engineering, Konya, Turkey, bozkurtyusuf97@gmail.com; esra.urray@karatay.edu.tr

Cite this study: Bozkurt, Y., & Uray, E. (2021). Investigation of prestressed anchor retaining systems within the scope FHWA-99-015 and BS 8081:2015. 1st Advanced Engineering Days, 11-13

Keywords

BS 8081:2015
FHWA-99-015
Geotechnical engineering
Prestressing anchors
Shoring system

ABSTRACT

As a result of migration from rural to urban areas, city centers are developed and expanded. With the increase of need in the life and business centers need, the decrease in the solid soil to be built and the presence of structures close to being affected from each other geotechnically has been brought economic problems and made deep excavations obligatory. In this study, the examination of the prestressed anchor shoring systems, which is one of the deep excavation support systems, has been carried out in terms of design criteria defined in regulations. Regulations of FHWA-99-015 and BS 8081:2015 and the circular which is published by the Ministry of Environment and Urbanization on 31 August 2018 in Turkey have been taken into consideration for the stability criteria of deep excavation systems. Also, the limiting situations that should be considered in terms of the stability of the shoring system have been investigated in the design. General comparisons of the regulations and standards used in the design of the shoring system and recommendations are given.

Introduction

As a result of the Industrial Revolution that started in the 18th century, there has been intense population mobility from rural to urban areas. Due to the increasing needs in developing and expanding cities, more complex structures have been built and the necessity for complex structures in city centers has made deep excavations obligatory. In this context, geotechnical engineers undertake the mission of safety and economy of deep excavations.

It is known that there are three solutions to a geotechnical problem to be encountered in an engineering structure to be built;

- making changes in the land to be built,
- making concessions from the project and making it suitable for the land,
- soil improvement using Geotechnical Engineering.

Retaining systems are designed so that construction equipment and crews can work safely in the works to be carried out below the natural soil level. One of the deep excavation support systems used today is the prestressed anchor shoring system. They are implemented by gradually descending from the natural level of the ground, making the supporting walls or piles, passing the steel ropes through the drilled drills and filling them, subjecting them to pre-tension forces, and repeating these processes until the required working level.

Various regulations have been established by various institutions and organizations in the light of many years of observations, experiments, and experiences to carry out the applications without any problems. In our country, in the circular on "Excavation Safety and Precautions to be Taken" published by the Ministry of Environment and Urbanization on 31 August 2018, the issues to be taken into account in the implementations are specified. In this

circular, “The norms and standards to be taken into account for pre-stressed permanent and temporary anchors are as follows: “TS EN1537, DIN4125, BS8081, FHWA-IF-99-015”.

When it is looked at the literature, it is possible to come across both theoretical and practical studies on prestressed anchor shoring systems. It has been emphasized that the need for deep excavation support systems has increased in urban centers with high populations and the determinants of the structural performance of the prestressed anchorage shoring systems used for this need and the changes that occurred after the application. In the studies, real-life applications of prestressed anchor shoring systems are included, as well as theoretical analyzes [1-4].

In this study, a brief review of the design criteria of prestressed anchor retaining systems has been presented by comparing international and national regulations and standards.

Material and Method

The purpose of the prestressed anchors, which is one of the deep excavation support systems, is to prevent the excavation from collapsing towards the excavation area and loss of life and property due to the stress changes in the soil as a result of the deep excavation. Its basic working principle is based on the fact that it works in adherence between the soil and anchorage bond by creating a friction force and providing stability. It is passed with free length up to the outside of the ground slip plane. After the displacement of the failure plane by the value found as a function of the excavation depth, the root part is transported. This system is shown in Figure 1.

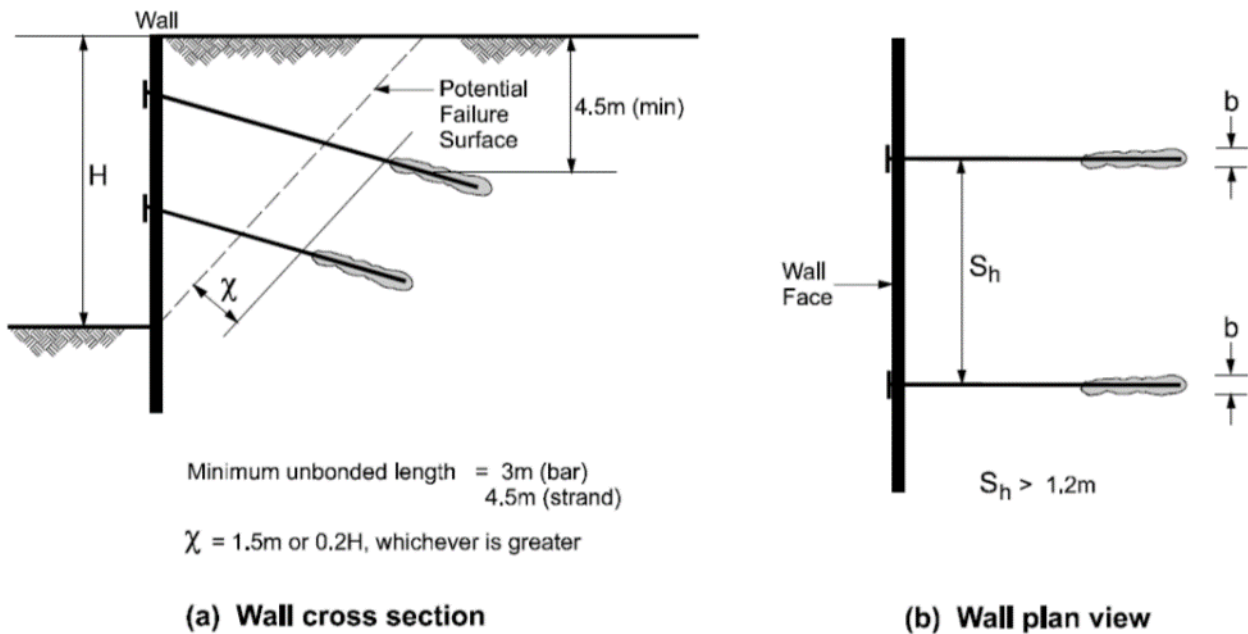


Figure 1. Cross-sections of the anchored system (FHWA-99-015) [1]

Anchors and Anchored Systems Scope FHWA-99-015 [1] and BS 8081:2015 [2]

It is seen that the anchors are structurally composed of three main parts (Figure 2.). Anchor head, free length, and anchor root form the general structure of anchors. Anchors are classified as permanent and temporary anchors according to their service life. The anchors to be used for the period of 18-36 months are temporary anchors. This period may vary according to the needs of the project. The estimated service period for permanent anchors is 75-100 years. The factor here is of course how well the structural and systemic integrity of the anchors is protected from internal and external factors. One of four different anchor types is used according to the required stress magnitude and soil environment (Figure 3.).

The applied anchor systems must be safe against various failure scenarios and protected from environmental factors during their service life. After the application, measurements and observations should continue at the construction site. Directions for their maintenance and follow-up are specified in the relevant sections of the regulations.

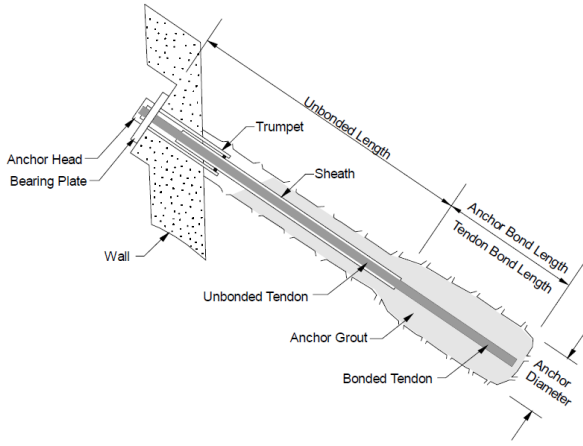


Figure 2. Components of a ground anchor [1]

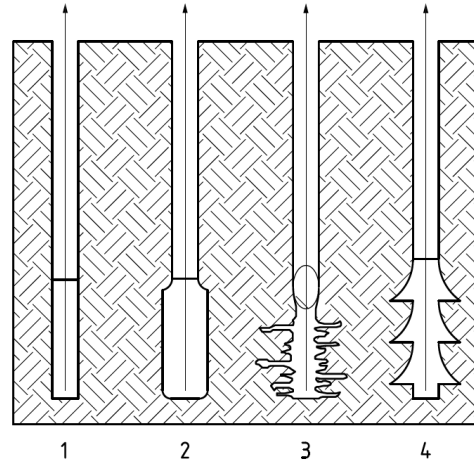


Figure 3. Types of anchorages [2]

Results

While the safety factor for ropes is 1.5 according to the BS 8081:2015 standard, the design load should not exceed 60% of the maximum capacity and the test load should not exceed 80% of the maximum capacity according to the FHWA. According to BS 8081, the minimum free length is 2m for rod elements and 5m for ropes, while these values are 3m and 4.5m, respectively, according to FHWA.

It is stated that the extension of the service life of the anchors will be through maintenance and monitoring. Hazardous situations where these systems require protection against corrosion should be avoided.

After the application, measurements and observations should continue at the construction site.

Discussion

As a result of the studies, it was concluded that the FHWA-IF-99-015 regulation has the widest scope among the examined regulations. While BS 8081:2015 focuses on the issues to be considered during the selection, application, and service life of the elements, FHWA-IF-99-015 also includes detailed calculation steps for different loading and soil types, and the boundary conditions are determined in a stricter framework. In BS 8081:2015, boundary conditions are specified in a softer framework, depending on the designer and the tests to be applied in the field.

Conclusion

When the relevant regulations are examined, it is seen that they are in different languages. To eliminate the disadvantages of this situation, designers, implementers, and supervisors should be informed in their mother tongue.

References

- [1] Özberk, B. S. (2009). Ankraj destekli derin iksalarda deformasyonların incelenmesi (Master's thesis, Yıldız Teknik Üniversitesi).
- [2] Dadaşbilge, O. (2015). Ankrajlı İksa Sistemlerinin Tasarım Esasları ve Proje Uygulamalarından Örnekler. Türkiye Mühendislik Haberleri, TMH-485-2015/2, 30-43.
- [3] Vural, U., & Işık, N. S. Ankrajlı İksalarda Analiz Sonuçlarının Saha Deneyle İle Karşılaştırılması. Bayburt Üniversitesi Fen Bilimleri Dergisi, 2(1), 83-92.
- [4] Büyükgökçe, F. (2018). Derin kazılarda yanal yüke maruz iksa sistemlerinin parametrik analizi (Master's thesis, Sakarya Üniversitesi).
- [5] FHWA-IF-99-15. (1999). Ground Anchors and Anchored Systems
- [6] BS 8081:2015. (2015). Code Of Practice for Grouted Anchors



In-plane numerical analysis of a double-layered ashlar wall

Ahmad Javid Zia^{*1}, Abdulkerim İlğün²

¹ KTO Karatay University, Faculty of Engineering and Natural Sciences, Civil Engineering, Konya, Turkey
javid.zia@karatay.edu.tr; kerim.ilgun@karatay.edu.tr

Cite this study: Zia, A. J., & İlğün, A. (2021). In-plane numerical analysis of a double-layered ashlar wall. 1st Advanced Engineering Days, 14-16

Keywords

Stone walls
Numerical Analysis
Initial Shear
Compressive

ABSTRACT

In this study, experimental and numerical analysis results of double-layered stone walls were compared. The numerical model was modeled in the Abaqus program, and the modeling stages were given in detail. As a result of the study, the analysis of the model was carried out and it was observed that it corresponded with the experimental data near perfectly.

Introduction

Masonry structures constitute an important part of today's building stock. Since some of these structures have the status of historical buildings, their preservation and restoration are of great importance. For this reason, many researchers around the world carry out experimental and numerical studies in order to determine the behavior of masonry structures and to evaluate possible situations and take precautions. In this study, modeling, and analysis of the in-plane behavior of a layer of hollow double-layered cut stone walls, designed to be used in new modern stone buildings with monumental value, using the finite element method has been carried out.

In recent years, the use of numerical tools and the development of these tools have become quite common in examining the structural behavior of masonry structures. Thanks to these developments, especially considering the irregularity of masonry structures and the uncertainty of the parameters, numerical analysis has gained superiority over analytical analysis and has become most preferred. In some instances, it is even proposed as an alternative to physical experiments. The main idea here is: If a model can simulate the structural behavior of a masonry structure, that means it can predict the structural response of the building to anticipated loads while assessing the building's safety [1].

Today, there are more than one type of numerical methods. The finite element method (FEM), discrete element method (DEM), limit analysis and applied element method (AEM) are the first to come to mind. The choice of these methods depends entirely on the person solving the problem and how this problem will be solved. Different models used to solve problems may give different results, so no model can be called the most precise model [2]. For instance, according to [3], the most appropriate model depends in particular on the structure analyzed, the data used and the experience and skills of the analyst. Oliveira (2003) defines the most appropriate model as the one that provides the desired result at the lowest cost, within an acceptable error, and most importantly, reliably [4].

In this study, the numerical model of the single-layered stone wall was calibrated using the experimental data of the double-layered ashlar wall designed by [5] in his PhD thesis. In this context, the numerical analysis of the model of the single-layer and micro-sized sample, in which only lime mortar is used, was carried out using the Finite Element Method (FEM) and its in-plane behavior was examined. Within the scope of the numerical study, firstly, brief information about the finite element method is given and the stages of the formation of the numerical model are explained. Then, the in-plane behavior of the wall was compared with the experimental data after numerical analysis.

Material and Method

The Finite Element Method (FEM) in Engineering was originally developed for the analysis of problems in structural mechanics based on physical foundations. However, it was later discovered that this technique could also be successfully applied to solving problems in other classes [6]. Thus, this method has been used even in very complex problems such as the analysis of masonry structures, and with the development of computers, the use of this technique in this field has become more common. However, it has been stated that the use of the Finite Element Method in the analysis of masonry structures depends on the accepted fundamental relations, the continuity of the walls that determine the analysis subject, and an appropriate discretization [4].

The main purpose of numerical modeling is the design and analysis of the most accurate mathematical model to represent the real structure. Therefore, first of all, it is extremely important to create a model that will exhibit the behavior of the real structure [7]. In this study, within the scope of numerical analysis a simplified micro-modeling approach was preferred in the three-dimensional model. In the model, the stones are designed as a continuous element and their mechanical properties are defined with data obtained from experimental studies [5]. The 2 mm mortar used on the wall was not designed physically, but instead, discontinuous, and dimensionless elements were defined and used which is known as surface-based cohesive zone in the literature. The elastic and plastic behavior of the mortar is included in the model with the help of these discontinuous and dimensionless elements that connect the stones. Thus, the elastic and plastic behaviors of the joints of the hollow multi-layer natural stone walls are considered in the model.

Numerical Modeling of Stone Walls

In this study, SWLIS and SWLC specimens, which are micro-sized samples, were modeled in the Abaqus program and numerically analyzed. In the analysis, the initial shear strength and compressive strength of the specimens were determined using the finite element method and compared with the experimental results [5]. For both initial and comprehensive analysis the modeling process was as follows.

- In the first stage, the design of the individual elements used in the wall specimens was carried out. In this context, two individual elements, 100 x 100 x 100 and 100 x 200 x 100 mm in size, are defined as element type C3D8R. This element type, available in the Abaqus package program, is a continuous (continuum), three-dimensional (3D), 8-node element with reduced integration points.
- In the second step, the mechanical properties of the stone are defined. For this, first the elastic behavior of the stone and then the plastic behavior were determined using experimental and literature data. The elastic behavior of the stone was determined by entering the modulus of elasticity obtained from the experimental studies and the poisson ratio. Plastic behavior is defined with the CDP (Concrete Damaged Plasticity) model.
- In the 3rd stage, the model used in the analysis was formed from the combination of the individual elements produced in the 1st stage.
- In step 4, steps are defined that impose actions on the model as load or displacement control so that numerical analysis can be performed. In both cases, actions were imposed gradually. The general non-linear static procedure, which follows the Newton-Raphson algorithm, which recalculates the balance at each increment, is adopted in the model, considering the large displacements and non-linear effects of the geometry. In addition, the damage compensator parameter, which precisely simulates the fracture in the wall joints, is used to eliminate the numerical instability caused by the reduction of stiffness in the joints. This parameter is known as viscous regularity and is taken as 0.002.
- In step 5, a surface-based cohesive interface is defined for the mortar used between individual stone blocks. Four parameters are used in the definition of this interface. First, the tangential behavior parameter is the friction formulation penalty in this parameter, and the friction coefficient was determined as 0.65 using the data obtained from the experimental studies. Latter; is the normal behavior parameter. In normal behavior, rigid contact behavior, that is, contact between adjacent surfaces of wall units, is defined by the pressure-overclosure relationship. The reason for this is the mutual pressure applications during the contact of the individual stone units in the wall. In addition, when hard contact is selected, the penetration of the individual units and the transfer of tensile stresses are also prevented. The third parameter is cohesive behavior. Within the scope of this parameter, K_{nn} , K_{ss} and K_{tt} are defined. The fourth and last parameter is the initiation and development of the crack (damage). The initiation of the crack was defined by the shear strength of the wall sample obtained from the experimental data, and the development of the crack was defined by the fracture energy.
- Finally, the support condition for compressive and initial shear models were defined similar to experimental study and the finite elements suitable for the designed sample are divided. For this purpose, the individual elements are divided into 10 x 10 x 10 mm and the numerical model was analyzed and the results were compared with the experimental studies.

Results

The vertical load-displacement curve obtained as a result of the numerical analysis was compared with the curves obtained in the experimental studies which is given in Fig. 1. As shown in Fig. 1 the correlation of the experimental result with numeric analysis show that the model designed for numeric analysis is acceptable for evaluations. As a result of the numerical analyzes, it was seen that the results of the model overlapped with the experimental results.

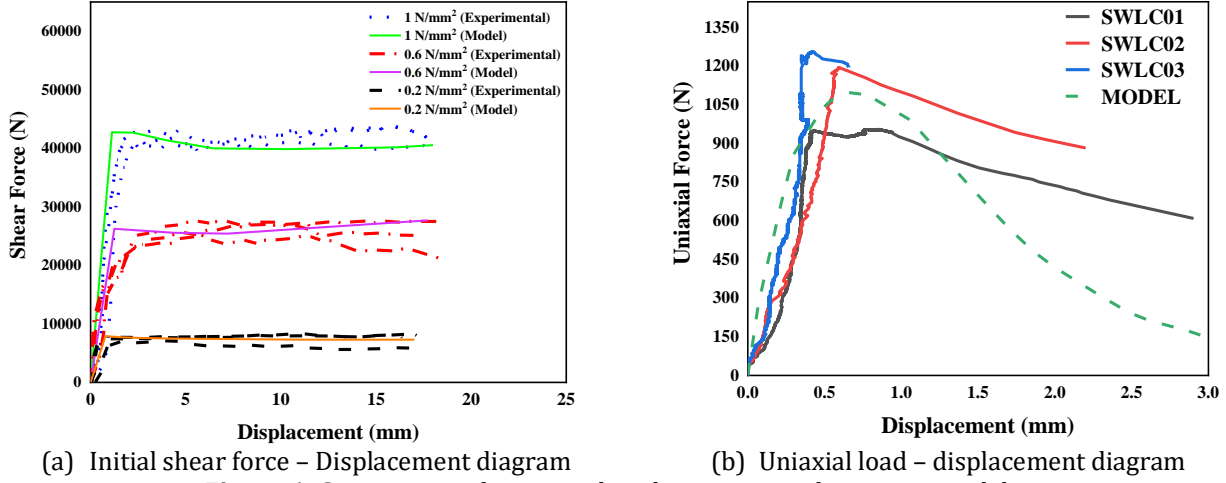


Figure 1. Comparison of numerical analysis curve with experimental data

Conclusion

This study is a part of Doctoral Thesis (ZIA).

Acknowledgement

Thanks to KTO Karatay University for the generous support for the Doctoral Thesis to be finished.

Funding:

This research received external funding from KTO Karatay University.

Author contributions:

Ahmad Javid ZIA: Conceptualization, Visualization, Investigation, Methodology, Software, Data curation, Writing-Original draft preparation, Validation. **Abdulkerim İLGÜN:** Writing-Reviewing and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Ghiassi, Bahman, and Gabriele Milani. *Numerical Modeling of Masonry and Historical Structures*. Edited by Bahman Ghiassi and Milani Gabriele, 1. Baskı, Woodhead Publishing, 2019.
- [2] Abdulla, Kurdo F., et al. "Simulating Masonry Wall Behaviour Using a Simplified Micro-Model Approach." *Engineering Structures*, vol. 151, Elsevier Ltd, 2017, pp. 349–65.
- [3] Lourenço, Paulo B. *Computational Strategies for Masonry Structures*. no. 08, Doktora tezi, Porto Üniversitesi, Mühendislik Fakültesi, Portekiz, 1996.
- [4] Demir, Cem. *Seismic Behaviour of Historical Stone Masonry Multi-Leaf Walls*. no. June, Doktora tezi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul, 2012.
- [5] ZIA, Ahmad Javid. *Kesme Taş İle Yapılan Katmanlı Duvarların Deneysel Olarak Araştırılması*. no. May, Doktora Tezi, KTO Karatay Üniversitesi, Lisansüstü Eğitim Enstitüsü, Konya, 2020.
- [6] Bathe, Klaus-Jürgen. *Finite Element Procedures*. 2. Baskı, Klaus-Jürgen Bathe, 2014.
- [7] Özen, Garip Önder. *Comparison of Elastic and Inelastic Behavior of Historic Masonry Structures at the Low Load Levels*. no. September, Yüksek lisans tezi, Orta Doğu Teknik Üniversitesi, Fen Bilimler Enstitüsü, Ankara, 2006.



Investigation of the effect of the burnishing applied to the Al2024 alloy on the surface roughness

Suleyman Cinar Cagan ^{*1}, Berat Baris Buldum ²

¹Mersin University, Engineering Faculty, Department of Mechanical Engineering, Mersin, Turkey
cinarcagan@mersin.edu.tr; barisbuldum@mersin.edu.tr

Cite this study: Cagan, S.C. & Buldum, B.B. (2021). Investigation of the effect of the burnishing applied to the Al2024 alloy on the surface roughness. 1st Advanced engineering Days, 17-19

Keywords

Burnishing
Aluminum alloys
Surface roughness
Taguchi method

ABSTRACT

Surface roughness is a very important factor in determining the quality of the product to be obtained, as it affects the production cost and performance of mechanical parts. Surface quality is primarily considered as a design parameter to determine functional properties such as corrosion resistance and fatigue strength of the part. Therefore, this study aims to improve the surface roughness of Al 2024 material, which is generally used in aerospace and defense industries. Ball burnishing unit is designed to reduce the surface roughness after the machining of the manufacturing parts and to save both time and cost. The effects of force, feed rate and number of passes on the surface roughness were investigated as finishing process parameters. As a result of the experiment, it was observed that the roughness value decreased with the increase of the force and the number of passes, and the roughness value increased with the increase of the feed rate.

Introduction

Aluminum and its alloys are metals that are widely used in industry due to their lightweight, strength and easy forming capabilities [1]. Due to the low densities of aluminum alloys (2.81 g/cm^3), the use of aluminum alloys in both the automotive and aviation sectors continues to increase day by day [2].

Surface roughness is a parameter that affects the mechanical properties, performance and production cost of machined parts [3]. After traditional machining methods such as turning and milling, characteristic irregularities (valleys and peaks) occur on the surface of the part [4]. Minimizing these irregularities is a critical problem for the manufacturer. Ball burnishing process is based on the principle of removing surface roughness by creating plastic deformation with the pressure applied to the workpiece surface using an apparatus [5]. This method is a fast, no-expertise, inexpensive mechanical surface improvement process. The parameters that affect the surface quality while the ball burnishing process is applied to the workpiece are as follows: burnishing force, the properties of the machine used, the material properties of the workpiece and ball, ball types and the environment are made in many studies [6].

The aim of this experimental study is to obtain the most suitable surface roughness values in Al-2024 different burnishing forces, feed rate and number of passes of the aluminum alloy, which has an important place in the industry.

Material and Method

2.1. Experimental design

Al2024 aluminum alloy was supplied from Seykoç Aluminum factory (Turkey) as workpiece in the experiments. In the experiments, $\varnothing 50 \times 300 \text{ mm}$ sized Al 2024 filled cylindrical workpiece was used. The chemical content of the Al 2024 alloy is presented in Table 1. Before starting the experiments, the roughness value of the

workpiece surface was measured as $R_a=0.915 \mu\text{m}$ and $R_z=5.049$. The burnishing process was performed on a universal lathe with the custom designed ball burnishing equipment. The test apparatus and burnishing equipment used in the study are shown in Figures 1. In addition, the Taguchi method was used in the experimental design. Table 2 shows the factors used in the experiments and their levels.

Table 1. Chemical composition of the workpiece used in the experiments.

Material	Fe	Si	Cu	Mn	Mg	Zn	Ti+Zi	Al
Al2024	0.5	0.5	4.35	0.6	1.5	0.25	0.15	Balance

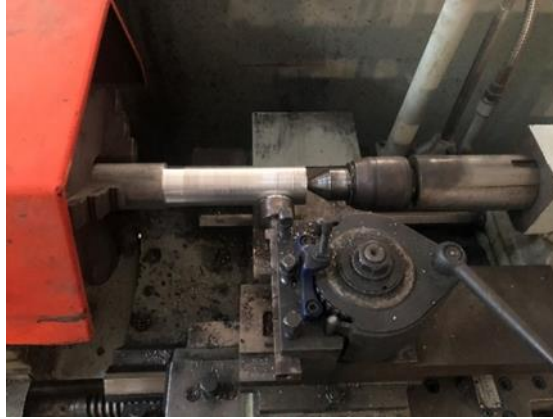


Figure 1. Experimental setup

Table 2. Process parameters and their limits

Code	Factors	Levels	
		1	2
A	Force (N)	100	200
B	Feed rate (mm/min)	0.625	1.25
C	Passes	1	2

2.2. Measurements

The surface roughness is used as a measure in determining the surface properties of the workpiece materials [7]. The surface roughness value is generally calculated by taking into account the arithmetic means values of the absolute values (R_a). The surface roughness data of the specimens are taken from three different parts of the Al 2024 workpiece material. Surface roughness tests were carried out using a surface profilometer.

Results and Discussion

The surface roughness values obtained after different burnishing parameters of the Al 2024 aluminum alloy and the S/N ratios calculated from these results are given in Table 3. In Figure 2, the effects of factors on surface roughness values are presented.

While interpreting the graphs regarding the factors affecting the surface quality of the Al 2024 alloy, the surface roughness value decreases while the force value increases from 100N to 200. The reason for this can be explained as the increase in pressure on the surface of the workpiece and the prevention of cavitation in the surface layer by compression. Likewise, an increase in the number of passes improves the surface quality. On the other hand, it is seen that increasing the feed rate decreases the surface quality and the experiments should be done at low feed rates to improve the surface quality.

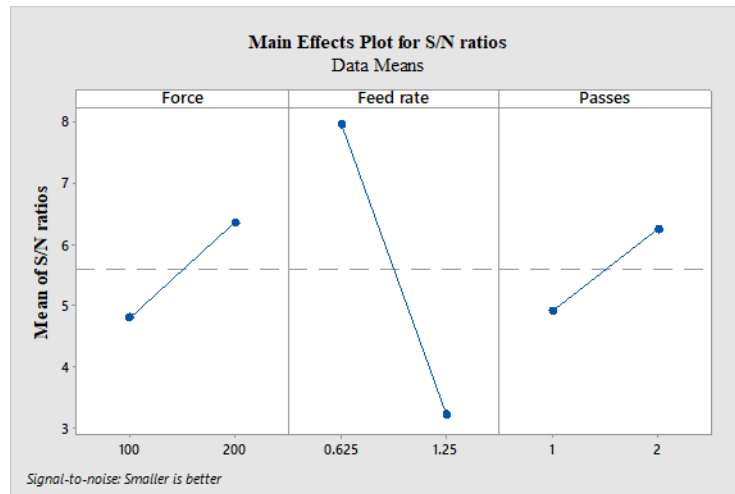
Conclusion

In this study, ball burnishing process was applied in different parameters to increase the surface quality of the Al 2024 workpiece. The results obtained are below.

- The surface roughness value increases with the increase of the force and the number of passes and decreases with the increase of the feed rate.
- The lowest surface roughness value was obtained in the parameter combination where the force was 200N, the feed rate was 0.625mm/min, and the number of passes was 2.

Table 3. Parameters and results after burnishing process

Experiments	Parameters			Results		
	Force	Feed rate	Passes	Ra (μm)	Rz (μm)	S/N Ra (μm)
1	100	0.625	1	0,435	2.111	7.230
2	100	0.625	2	0,407	1.745	7.808
3	100	1.25	1	0,802	3.744	1.916
4	100	1.25	2	0,772	3.512	2.247
5	200	0.625	1	0,447	2.702	6.993
6	200	0.625	2	0,326	2.904	9.735
7	200	1.25	1	0,668	3.002	3.504
8	200	1.25	2	0,550	3.142	5.192

**Figure 2.** Main effects graph for S/N ratios of surface roughness**Author contributions:**

Suleyman Cinar CAGAN: Experimental plan, experiments, conceptualization, methodology, data curation, Investigation, writing-reviewing and editing

Berat Baris BULDUM: Investigation, writing-reviewing and editing

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Shivalingappa, D. (2020). The influence of ball and roller burnishing process parameters on surface integrity of Al 2024 alloy. *Materials Today: Proceedings*, 27, 1337-1340.
- [2] Saud, H. M., & Abdulrazzaq, M. A. (2020). *Study the effect of cold working on the mechanical properties of aluminum alloy 2024 T4*. Paper presented at the IOP Conference Series: Materials Science and Engineering.
- [3] Aamir, M., Tolouei-Rad, M., Giasin, K., & Vafadar, A. (2020). Machinability of Al2024, Al6061, and Al5083 alloys using multi-hole simultaneous drilling approach. *journal of materials research and technology*, 9(5), 10991-11002.
- [4] Aamir, M., Tolouei-Rad, M., Vafadar, A., Raja, M. N. A., & Giasin, K. (2020). Performance analysis of multi-spindle drilling of Al2024 with TiN and TiCN coated drills using experimental and artificial neural networks technique. *Applied Sciences*, 10(23), 8633.
- [5] Cagan, S. C., Pruncu, C. I., & Buldum, B. B. (2020). An investigation into ball burnishing process of magnesium alloy on CNC lathe using different environments. *Journal of Magnesium and Alloys*, 8(4), 1061-1070.
- [6] Zhen-yu, Z., Qiu-yang, Z., Cong, D., Ju-yu, Y., & Zhong-yu, P. (2021). A review of the development of surface burnishing process technique based on bibliometric analysis and visualization. *The International Journal of Advanced Manufacturing Technology*, 1-45.
- [7] He, C., Zong, W., & Zhang, J. (2018). Influencing factors and theoretical modeling methods of surface roughness in turning process: State-of-the-art. *International Journal of Machine Tools and Manufacture*.



The effect of process and solution parameters on the size of nanofibers produced by the electrospinning method

Alper Gunoz¹, Yusuf Kepir², Bünyamin Demir³, Memduh Kara⁴, Uzay Gezer⁵

¹Mersin University, Faculty of Engineering, Department of Mechanical Engineering, Mersin, Turkey, alpergunoz@mersin.edu.tr; ykepir@mersin.edu.tr; bd@mersin.edu.tr; memduhkara@mersin.edu.tr; uzaygezer@mersin.edu.tr

Cite this study: Gunoz, A., Kepir, Y., Demir, B., Kara, M., & Gezer, U. (2021). The effect of process and solution parameters on the size of nanofibers produced by the electrospinning method. 1st Advanced engineering Days, 20-22

Keywords

Electrospinning
Nanofiber
Taylor cone

ABSTRACT

Today, electrospinning is one of the most preferred methods to create nanofiber surfaces. There are many environmental, process, and solution parameters that affect the morphology and size of nanofibers produced by the electrospinning method. It is of great importance to know the effects of these parameters on the nanofiber size. In this study, scientific literature examining the effect of process and solution parameters on the size of nanofibers produced by the electrospinning method and their results were included.

Introduction

The electrospinning method is one of the leading methods used for nanofiber production from polymer, ceramic or metallic solutions. With the electrospinning method, it is possible to produce various materials consisting of nanofibers with diameters ranging from a few microns to less than 100 nm [1]. Nanofibers produced by the electrospinning method are used in filtration, biomedical, drug release, defense industry, space, electrical and optical applications.

Changes in the size of nanofibers alter their mechanical, electrical, optical, and thermal properties. For this reason, the parameters affecting the size of nanofibers should be known and kept under control. In this study, the effects of process and solution parameters on the size of nanofibers were investigated.

Nanofiber production by electrospinning method

The process steps of the electrospinning method were shown schematically in Fig. 1 [2]. The electrospinning method has four basic components: a metal collector, high voltage power supply, syringe pump and syringe. In this method, the solution is first taken into syringes and placed in the syringe pump. The pump is operated by adjusting the desired spray speed. Then the high voltage supply is turned on. When the high voltage applied between the metal collector and the syringe pump reaches the critical value, the solution that comes to the tip of the syringe and remains as a suspended droplet moves towards the collector in jet form and electrically charged. The droplet suspended at the tip of the syringe during movement forms a shape called a Taylor cone just before the voltage reaches a critical value. The resulting Taylor cone cannot resist the electrical force and the jet shoots from the cone-shaped droplet towards the collector. Due to the electrostatic repulsive forces, a curling motion is observed in the jet emerging from the tip of the syringe. Then, the thinned jet with the curling motion and the evaporation of the solvent in the jet accumulates on the collector as nano-sized randomly fibers [3].

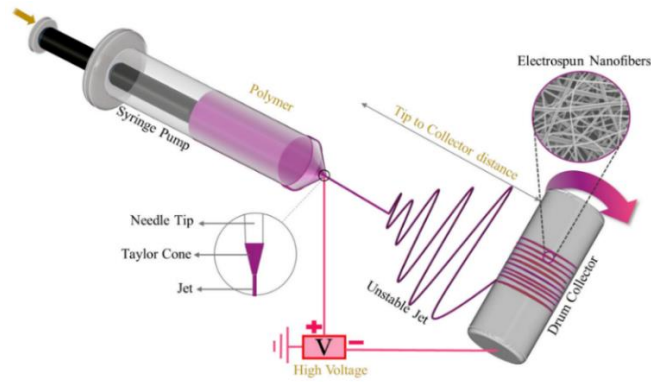


Fig. 1. Schematic representation of the electrospinning method [2]

The effect of process and solution parameters on the size of nanofibers

Electrospinning process is affected by many parameters, including solution, process and environmental parameters. While the solution includes parameters such as conductivity and concentration; The process includes parameters such as applied electric field, needle-to-collector distance, feed rate. These parameters, which significantly affect the size of the fibers obtained as a result of the electrospinning process, were given in Table 1. The results of the change in nanofiber diameter depending on the voltage obtained in the study conducted by Hussein et al. were shown in Fig. 2.

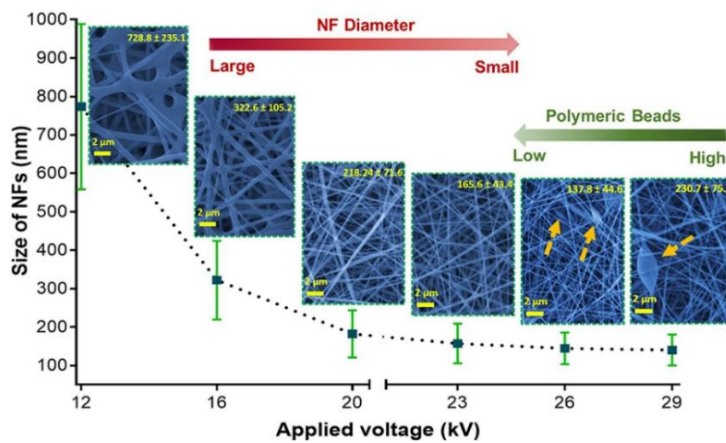


Fig. 2. The dependence of the nanofiber diameter and uniformity on the applied electrospinning voltage [4]

Table 1. Effects of electrospin parameters on fiber size

Parameter	Effect on fiber size	Reference
Solution conductivity	Fiber diameters decrease with increasing conductivity	[5-6]
Solution concentration	As the concentration increases, the fiber diameter increases and the bead formation decreases	[7-10]
Voltage	As the voltage increases, the fiber diameter decreases	[4,11-14]
Distance between needle tip and collector	As the distance increases, the fiber diameter decreases	[11,14]
Feed rate	As the feed rate increases, the fiber diameter increases	[7,9,13,14]

Conclusion

In this study, the effect of process and solution parameters on the size of nanofibers produced by electrospinning method was investigated. In studies examining the effects of solution parameters, it was concluded that fiber diameters decreased with increasing solution conductivity, while fiber diameters increased with increasing solution concentration. In studies examining the effects of process parameters, fiber diameters decreased with increasing voltage and distance between needle tip and collector; it was found that the fiber diameter increased with the increase of the feed rate.

Acknowledgement

The authors would like to thank Mersin University Scientific Research Projects Unit (project number: 2021-1-AP5-4322).

Author contributions:

Alper Gunoz: Conceptualization, Investigation, Methodology, Writing-Original draft preparation. **Yusuf Kepir:** Investigation, Visualization, Writing-Original draft preparation. **Bünyamin Demir:** Conceptualization, Visualization, Writing-Reviewing and Editing. **Memduh Kara:** Conceptualization, Methodology, Writing-Reviewing and Editing. **Uzay Gezer:** Investigation, Writing-Original draft preparation.

Conflicts of interest:




The authors declare no conflicts of interest.

References

- [1] Dinç, H. (2013). Polyvinyl borate synthesis; preparation of nanofiber by electrospinning technique and characterization of the prepared nanofiber. Master's Thesis, Selçuk University, Konya.
- [2] Salehi, M., Sharafoddinzadeh, D., Mokhtari, F., Esfandarani, M. S., & Karami, S. (2021). Electrospun nanofibers for efficient adsorption of heavy metals from water and wastewater. *Clean Technologies and Recycling*, 1(1), 1-33.
- [3] Arıcı, A. (2018). Investigation of the effect of MWCNT diameter and length on properties of polymer/MWCNT nanofiber prepared by electrospinning method. Master's Thesis, Necmettin Erbakan University, Konya.
- [4] Hussein, M. A. M., Ulag, S., Dena, A. S. A., Sahin, A., Grinholc, M., Gunduz, O., ... & Megahed, M. (2021). Chitosan/Gold Hybrid Nanoparticles Enriched Electrospun PVA Nanofibrous Mats for the Topical Delivery of Punica granatum L. Extract: Synthesis, Characterization, Biocompatibility and Antibacterial Properties. *International Journal of Nanomedicine*, 16, 5133.
- [5] Meyva-Zeybek, Y., & Kaynak, C. (2021). Electrospinning of PLA and PLA/POSS nanofibers: Use of Taguchi optimization for process parameters. *Journal of Applied Polymer Science*, 138(3), 49685.
- [6] Ponrasu, T., Chen, B. H., Chou, T. H., Wu, J. J., & Cheng, Y. S. (2021). Fast dissolving electrospun nanofibers fabricated from jelly fig polysaccharide/pullulan for drug delivery applications. *Polymers*, 13(2), 241.
- [7] Abdillah, U., Yazid, H., Ahmad, S., Makhtar, N., Zaubidah, S., Chen, R. S., & Syafiqaz, N. (2021, March). The effect of various electrospinning parameter on preparation of alumina nanofibers. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1106, No. 1, p. 012019). IOP Publishing.
- [8] Al-Dhahebi, A. M., Saheed, M. S. M., & Mustapha, M. (2021). Effects of solution concentration on the synthesis of polyvinylidene fluoride (PVDF) electrospun nanofibers. *Materials Today: Proceedings*.
- [9] Kim, W. T., Park, D. C., Yang, W. H., Cho, C. H., & Choi, W. Y. (2021). Effects of Electrospinning Parameters on the Microstructure of PVP/TiO₂ Nanofibers. *Nanomaterials*, 11(6), 1616.
- [10] Devadas, S., Al-Ajrash, S. M. N., Klosterman, D. A., Crosson, K. M., Crosson, G. S., & Vasquez, E. S. (2021). Fabrication and Characterization of Electrospun Poly (acrylonitrile-co-Methyl Acrylate)/Lignin Nanofibers: Effects of Lignin Type and Total Polymer Concentration. *Polymers*, 13(7), 992.
- [11] Fatahian, R., Mirjalili, M., Khajavi, R., Rahimi, M. K., & Nasirizadeh, N. (2021). Effect of electrospinning parameters on production of polyvinyl alcohol/poly(lactic acid) nanofiber using a mutual solvent. *Polymers and Polymer Composites*, 09673911211027126.
- [12] Topuz, F., & Uyar, T. (2020). Electrospinning of cyclodextrin nanofibers: The effect of process parameters. *Journal of Nanomaterials*, 2020.
- [13] Topuz, F., Abdulhamid, M. A., Holtzl, T., & Szekely, G. (2021). Nanofiber engineering of microporous polyimides through electrospinning: Influence of electrospinning parameters and salt addition. *Materials & Design*, 198, 109280.
- [14] Ziyadi, H., Baghali, M., Bagherianfar, M., Mehrali, F., & Faridi-Majidi, R. (2021). An investigation of factors affecting the electrospinning of poly (vinyl alcohol)/kefir composite nanofibers. *Advanced Composites and Hybrid Materials*, 1-12.



Effect of environmental conditions on the mechanical properties of composite tubes

Yusuf Kepir^{*1}, Alper Gunoz¹, Memduh Kara¹

¹ Mersin University, Engineering Faculty, Mechanical Engineering Department, Mersin, Turkey
ykepir@mersin.edu.tr; alpergunoz@mersin.edu.tr; memduhkara@mersin.edu.tr

Cite this study: Kepir, Y., Gunoz, A. & Kara, M. (2021). Effect of environmental conditions on the mechanical properties of composite tubes. 1st Advanced engineering Days, 23-25

Keywords

Polymer matrix composite
Hydrothermal aging
Hoop tensile test
Filament winding
Tangential tensile strength

ABSTRACT

Composite tubes are materials with a high strength-to-weight ratio. However, they can be exposed to hot and humid environmental conditions in working conditions. For this reason, the response of composite tubes to mechanical loading under environmental conditions should be investigated. In this study, the effect of hydrothermal aging on the tangential tensile strength of glass/epoxy and basalt/epoxy composite tube samples was investigated. After the samples were kept in distilled water at 70°C for 500 hours, hardness and hoop tensile tests were performed.

Introduction

Composite materials are widely used in oil and natural gas transmission lines, chemical transmission lines and geothermal applications [1]. In addition, its use in the defense, space and aviation sectors is gaining importance day by day. The use of composite materials is increasing rapidly due to many superior properties, especially in terms of strength/weight ratio compared to traditional materials such as metal and ceramics [2]. In addition to its superior features, it also has some negative features. The mechanical properties of composite materials exposed to humid and hot working environments deteriorate due to hydrothermal aging [3]. There is a need for studies on the effect of hydrothermal aging on composite materials in order to identify materials that are more resistant to environmental conditions and to predict the effects of existing materials against these conditions [4].

Filament wound composite pipes are generally exposed to tangential stresses due to their geometric shapes [5]. Therefore, it is important to investigate the tangential tensile strength of these materials. It is also very important to investigate the changes in the strength of composite materials, especially under environmental conditions. In order to determine the strength of the cylindrical samples, the hoop tensile test is applied to the samples [6].

In this study, basalt/epoxy and glass/epoxy composite materials were hydrothermally aged in distilled water at 70°C for 500 hours. At the end of the aging process, hardness and hoop tensile tests were performed on the samples.

Material and Method

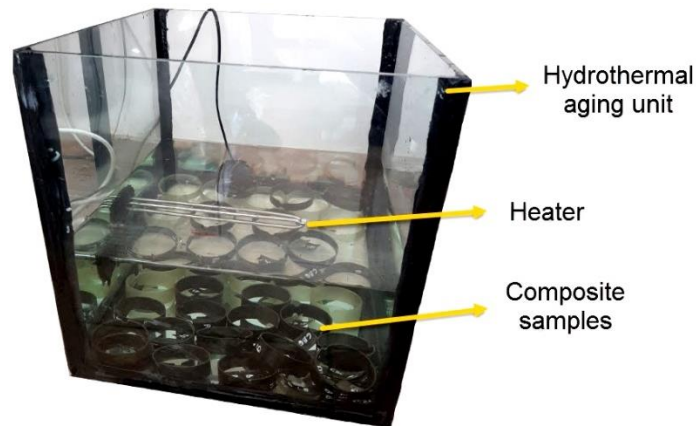
In this study, Araldite MY 740, bisphenol A diglycidyl ether epoxy resin, Aradur HY 918 hardener, and DY 062 accelerator were used in the epoxy system. In the production of composite pipes, basalt and glass fiber filaments were used. The average diameters of basalt and glass fiber are 13 and 17 μm , respectively. The mechanical characteristics of matrix and fibers are given in Table 1.

Table 1. Mechanical properties of the materials used in composite pipes

Material	Modulus of Elasticity	Tensile Strength	Density
	E (GPa)	σ_t (MPa)	ρ (g/cm ³)
Glass Fiber	73	2400	2.6
Basalt Fiber	90-95	2900-3200	2.48
Epoxy Resin	3.4	50-60	1.2

Composite pipes were produced by the filament winding method. The filament winding process was realized with a winding angle of $\pm 55^\circ$. Six-layered produced composite pipes have 72 mm inner diameter and 76 mm outer diameter. The prepared samples are shown in Fig. 1.

A 64 L aging unit made of 6 mm thick glass was used to perform the hydrothermal aging process shown in Fig. 2. The aging temperature was determined as 70 °C. The aging periods were determined as 500 hours.

**Figure 1.** a) Glass fiber/epoxy and b) basalt fiber/epoxy composite samples**Fig. 2.** Hydrothermal aging unit

Results and Discussion

Hoop tensile and hardness tests were performed on hydrothermally aged basalt/epoxy and glass/epoxy composite samples. As a consequence of the experiment, it was observed that the 500 hours aging process decreased the hoop tensile strengths of glass fiber/epoxy and basalt fiber/epoxy composite samples by 9.3% and 3.3%, respectively, and increased the hardness values by 4.2% and 5.9%, respectively. Hoop tensile and hardness test results are given in Table 2.

Table 2. Hardness and hoop tensile test results of the samples

Samples	Aging Time [hours]	Hardness [HRL]	Hoop Tensile Strength [MPa]
Glass fiber/epoxy	0	81.2	378.3
Glass fiber/epoxy	500	84.6	343.1
Basalt fiber/epoxy	0	106.0	398.1
Basalt fiber/epoxy	500	112.2	385.0

The main types of damage occurred as a consequence of hoop tensile test in composite samples were observed as fiber breakage, matrix cracking and delamination. In all samples, damage occurred in the fiber winding direction of $\pm 55^\circ$. The damage images taken from the front of the damaged areas after the hoop tensile test are presented in Fig. 3.

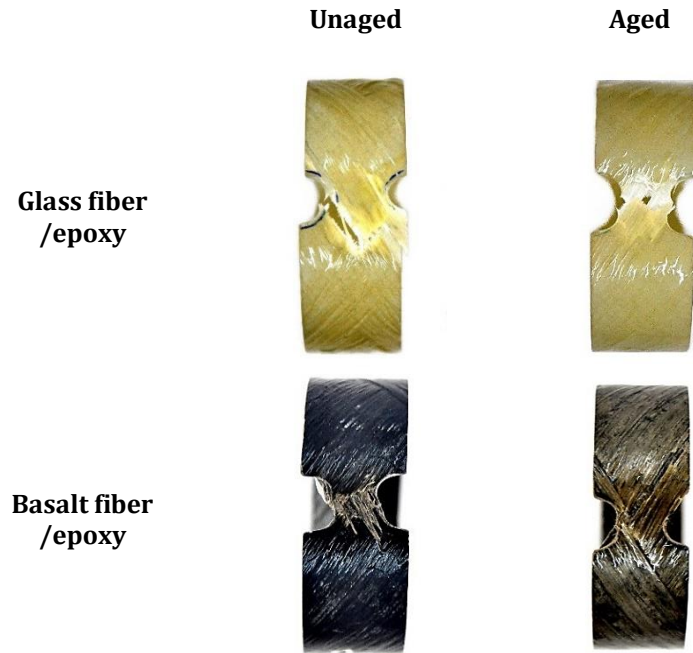


Figure 3. Damage images of composite samples after hoop tensile test

Conclusion

In this study, the effect of 500 hours hydrothermal aging on the mechanical strength of basalt fiber and glass fiber reinforced epoxy matrix composite materials was investigated. After the samples were kept in distilled water at 70°C for 500 hours, hardness and hoop tensile tests were performed. As a result of the study, there was a greater decrease in the hoop tensile strength of the glass fiber/epoxy composite samples compared to the basalt fiber epoxy samples. When the hardness of the samples was compared, it was seen that the hardness values of both samples increased at similar rates.

Acknowledgement

This study is part of the master's thesis carried out by Yusuf Kepir in the Graduate School of Natural and Applied Science at the University of Mersin. This study was supported by Mersin University Scientific Research Projects Unit with the project number 2019-3-TP2-3685.

Author contributions:

Yusuf Kepir: Writing-Original draft preparation, Data curation, Investigation, Visualization **Alper Günöz:** Data curation, Investigation, Visualization. **Memduh Kara:** Methodology, Validation, Writing-Reviewing and Editing.

References

- [1] Abdellah, M. Y., Alfattani, R., Alnaser, I. A., & Abdel-Jaber, G. T. (2021). Stress Distribution and Fracture Toughness of Underground Reinforced Plastic Pipe Composite. *Polymers*, 13(13), 2194.
- [2] Choi, J. S., Park, S. J., & Kim, Y. H. (2021). Comparison of Mechanical Properties on Helical/Hoop Hybrid Wound HNT Reinforced CFRP Pipe with Water Absorption Behavior. *Composites Research*, 34(3), 174-179.
- [3] Glaskova-Kuzmina, T., Zotti, A., Borriello, A., Zarrelli, M., & Aniskevich, A. (2021). Basalt Fibre Composite with Carbon Nanomodified Epoxy Matrix under Hydrothermal Ageing. *Polymers*, 13(4), 532.
- [4] Shao, Y., Dong, Y., & Yang, Y. (2021). Effect of Low-Cycle Fatigue and Hydrothermal Aging on Tensile Properties of Open-Hole Glass Fiber/Polycarbonate and Glass Fiber/Polyamide 6 Composites. *Fibers and Polymers*, 1-8.
- [5] Saghir, F., Gohari, S., Mozafari, F., Moslemi, N., Burvill, C., Smith, A., & Lucas, S. (2021). Mechanical characterization of particulated FRP composite pipes: A comprehensive experimental study. *Polymer Testing*, 93, 107001.
- [6] Sepetcioglu, H., Gunoz, A., & Kara, M. (2021). Effect of hydrothermal ageing on the mechanical behaviour of graphene nanoplatelets reinforced basalt fibre epoxy composite pipes. *Polymers and Polymer Composites*, 0967391121992939.



Different nozzle types in electrospinning applications

Uzay Gezer*¹, Bünyamin Demir ², Alper Günöz ³, Memduh Kara ⁴, Yusuf Kepir ⁵

¹Mersin University, Faculty of Engineering, Department of Mechanical Engineering, Mersin, Turkey

uzaygezer@mersin.edu.tr; bd@mersin.edu.tr; alpergunoz@mersin.edu.tr; memduhkara@mersin.edu.tr; ykepir@mersin.edu.tr

Cite this study: Gezer, U., Demir, B., Günöz, A., Kara, M., & Kepir, Y.. (2021). Different nozzle types in electrospinning applications. 1st Advanced engineering Days, 26-28

Keywords

Electrospinning
Nozzle Types
Coaxial
Multi-jet
Multi-hole

ABSTRACT

Electrospinning technique, which is the most common method in the production of nanofiber filament, has been used for a long time, and it continues to be developed and gained new features with the changes made day by day. The parameters affecting the production depend on the main topics of solution properties, ambient parameters and operating parameters. In this study, the types of nozzles used in the electrospinning technique and their usage patterns are examined as a part of the production conditions. General information about the nozzles is given by examining the studies in the literature.

Introduction

The most common method for nanofiber production is the electrospinning method. In this method, nanofiber jet formation is provided by using electrical charges. With the effect of electrical charges, these jets are depositing on a grounded surface, then a nanofiber surface is obtained [1].

Today, nanofiber-sized surfaces produced by using the electrospinning method are widely used in the filtration industry, biomedical fields, tissue engineering and textile fields. Since the desired properties can be obtained in a low volume, the usage area and the resulting need are increasing even more [2].

The traditional electrospinning method is applied using a syringe with a single chamber and a single nozzle. In this way, nanofiber surface production can be done with very low values such as 0.1g/h or 0.01g/h. In line with the increasing demand, different nozzle types are being researched and innovations are brought to the literature [3].

In this study, types of nozzles produced as an alternative to the traditional electrospinning method and their usage patterns were investigated.

Nozzle Types and Usage in Electrospinning Process

Nozzles have important roles such as increasing efficiency, adjusting process parameters and controlling fiber morphology [4]. In order to obtain nanofiber surfaces, where includes different solutions can be used and which can have different properties on a single surface, it is necessary to use multiple nozzles or coaxial nozzles. Since the production speed of nanofibers produced with using a single nozzle is low, multiple nozzles or multi-hole nozzles are used. It is difficult to prepare mixed solutions and ensure homogeneity, since the consumable chamber is single in multi-hole and single nozzle use. Single nozzle, parallel multiple nozzle, circular multiple nozzle, coaxial nozzle and triaxial nozzle, which were developed for use in many applications, are shown in Figure 1 [5-6].

Multi-chamber nozzle that is using in coaxial electrospin works is called coaxial nozzle. Although they are most commonly used with 2 chambers, they can be designed with more chambers. Using this type of nozzle allows the materials to be spun to form a surface by covering each other. In these fibers, the inner surface is called the core, and the outer surface is called the shell. Since the fibers formed by the use of coaxial nozzles provide the properties

of the materials used in fiber size, the desired nanofiber surface can be obtained more easily. Figure 2 and Figure 3 show schematically how electrospinning processes are applied relative to the nozzles [7].

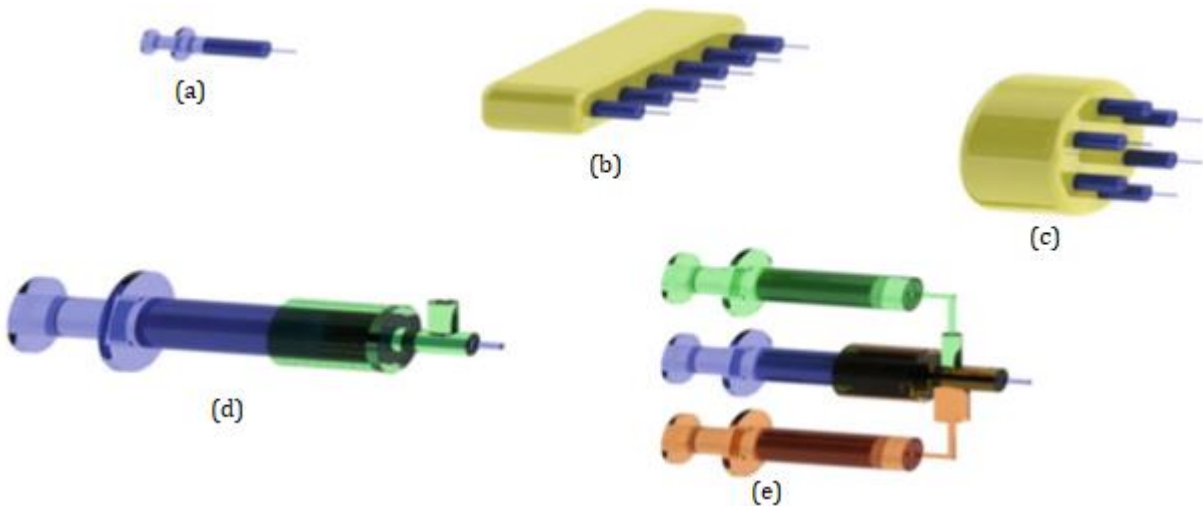


Figure 1. (a)single-nozzle, (b)parallel multi-nozzle, (c)circular multi-nozzle, (d)Co-Axial Nozzle, (e)Triaxial Nozzle [1]

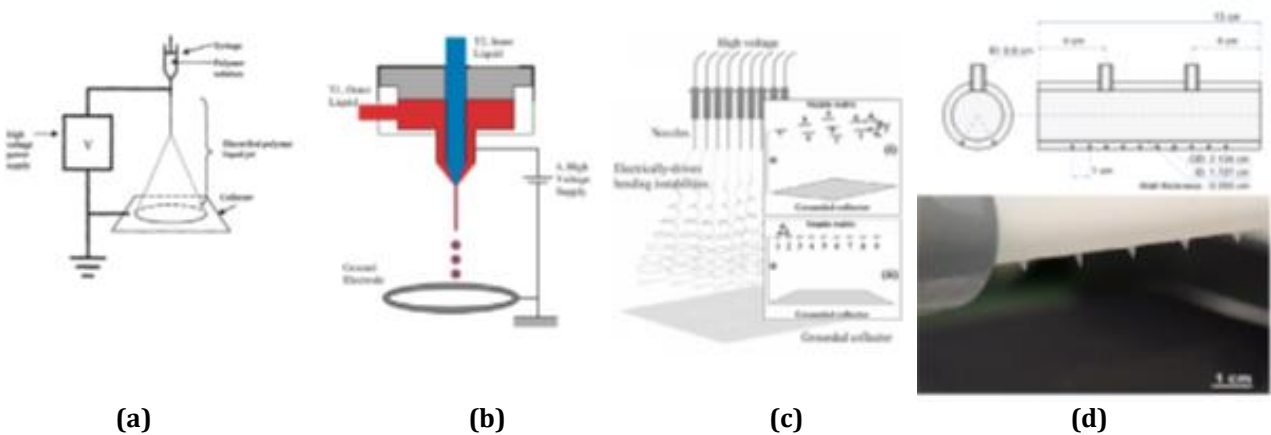


Figure 2. Evolution of the electrospinning system: **a)** single-jet electrospinning system; **b)** coaxial electrospinning; **c)** multi-nozzle electrospinning; **d)** multihole electrospinning; [9]

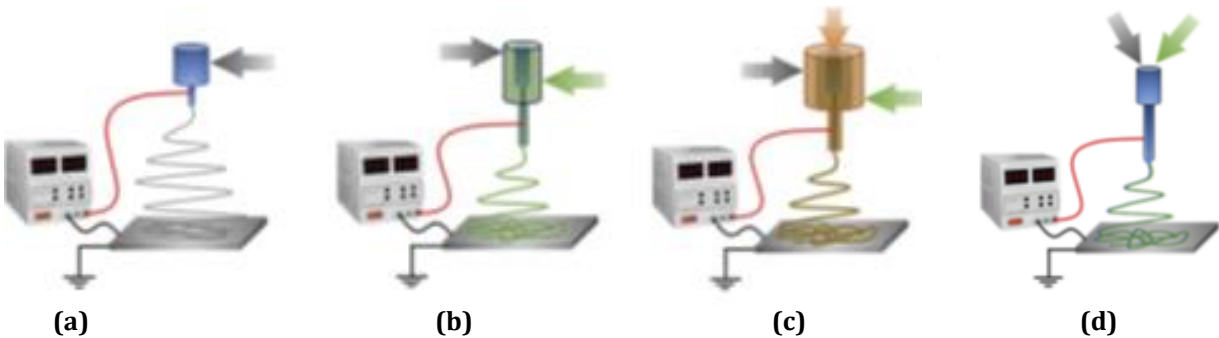


Figure 3. (a) Traditional electrospinning, (b) Co-axial electrospinning, (c) Triaxial electrospinning, (d) Multichannel electrospinning, [2]

Coaxial nozzle types are also divided into three groups, as seen in Figure 4. This grouping made according to the nozzle ends and changes the properties of the formed fiber and surface. Although not much work has been done on this subject yet, the most commonly used type is inward coaxial nozzle [8].

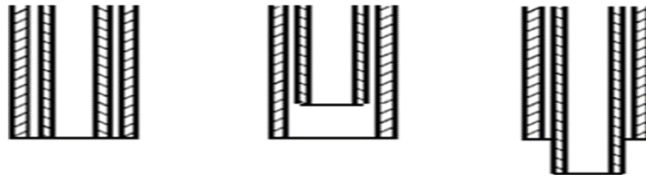


Figure 4. Coaxial Nozzle End [3]

Results and Discussion

With the use of multi-hole and multi-nozzle in electrospinning applications, the production has been accelerated, but the efficiency has decreased due to the repulsion of the formed jets as a result of electrical forces.

Conclusion

In nowadays electrospinning applications, using nozzle types that can meet multiple conditions for the needs, the production speed has been increased and the co-production of fiber-sized materials has been ensured.

Acknowledgement

All authors who carried out the study are happy to express their gratitude to the Mersin University Scientific Research Projects Unit (project number: 2021-1-AP5-4322).

Author contributions:

Uzay Gezer: Conceptualization, Investigation, Methodology, Writing-Original draft preparation. **Bünyamin Demir:** Investigation, Visualization, Writing-Original draft preparation. **Alper Günöz:** Visualization, Writing-Reviewing and Editing, Writing-Original draft preparation. **Memduh Kara:** Conceptualization, Methodology, Writing-Reviewing and Editing. **Yusuf Kepir:** Investigation, Writing-Original draft preparation.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Aslan, E., Almeida, H., Al-Deyab, S., El-Newehy, M., Bartolo, H., & Bártolo, P. J. (2021). The Electrospinning Process. In *Virtual Prototyping & Bio Manufacturing in Medical Applications* (pp. 153-185). Springer, Cham.
- [2] Davoodi, P., Gill, E. L., Wang, W., & Huang, Y. Y. S. (2021). Advances and innovations in electrospinning technology. In *Biomedical Applications of Electrospinning and Electrospaying* (pp. 45-81). Woodhead Publishing.
- [3] Jiang, G., Zhang, S., & Qin, X. (2013). High throughput of quality nanofibers via one stepped pyramid-shaped spinneret. *Materials Letters*, 106, 56-58.
- [4] Huang, Y., Bu, N., Duan, Y., Pan, Y., Liu, H., Yin, Z., & Xiong, Y. (2013). Electrohydrodynamic direct-writing. *Nanoscale*, 5(24), 12007-12017.
- [5] SalehHudin, H. S., Mohamad, E. N., Mahadi, W. N., & Afifi, A. M. (2021). Simulation and experimental study of parameters in multiple-nozzle electrospinning: Effects of nozzle arrangement on jet paths and fiber formation. *Journal of Manufacturing Processes*, 62, 440-449.
- [6] Sakuldao, S., Yoovidhya, T., & Wongsasulak, S. (2011). Coaxial electrospinning and sustained release properties of gelatin-cellulose acetate core-shell ultrafine fibres. *ScienceAsia*, 37(4), 335-343.
- [7] Moghe, A. K., & Gupta, B. S. (2008). Co-axial electrospinning for nanofiber structures: preparation and applications. *Polymer Reviews*, 48(2), 353-377.
- [8] Kaerkitcha, N., Chuangchote, S., & Sagawa, T. (2016). Control of physical properties of carbon nanofibers obtained from coaxial electrospinning of PMMA and PAN with adjustable inner/outer nozzle-ends. *Nanoscale research letters*, 11(1), 1-9.
- [9] Wojasinski, M., & Ciach, T. (2020). Production of nano- and microfibers from synthetic and natural polymers- Nanofibers technology. In *Workshop summary and conclusions, Wright Stephanie, Graham Uschi M., Moskal Arkadiusz Adres publikacji w Repozytorium URL/Publication address in Repository*.



Modelling of supercapacitor by using parameter estimation method for energy storage system

Gökhan Yüksek*¹, Yusuf Muratoğlu ², Alkan Alkaya ³

¹Mersin University, Engineering Faculty, Electrical and Electronics Engineering, Mersin, Turkey, gyuksekm@mersin.edu.tr

²Toros University, School of Occupational Higher Education, Mechatronics, Mersin, Turkey, yusuf.muratoglu@toros.edu.tr

³Mersin University, Engineering Faculty, Electrical and Electronics Engineering, Mersin, Turkey, alkanalkaya@mersin.edu.tr

Cite this study: Yüksek, G., Muratoglu, Y., & Alkaya, A (2021). Modelling of supercapacitor by using parameter estimation method for energy storage system. 1st Advanced engineering Days, 29-31

Keywords

Supercapacitor
Parameter Estimation
Renewable Energy
Modelling
Energy Storage

ABSTRACT

Researches to increase efficiency in renewable energy systems are increasing the interest in high power density (HPD) energy storage units' day by day. HPD units form a hybrid energy storage system (HESS) when used together with a high energy density (HED) energy storage system. Supercapacitors are the most frequently used storage units among HPD with their features such as low cost, low self-discharge rate and high lifecycle. When systems need high power, supercapacitors which is used to support HED units to ensure that the transmitted power's stability, efficiency, and high quality. The use of supercapacitors in HESS with the exact timing has a significant impact on its performance. For this reason, supercapacitors must be modeled correctly and well-integrated with the system. In this study, parameter estimation was made by using the data obtained from the simulation study and the supercapacitor was modeled. The supercapacitor model has been tested for charging and discharging at different currents and successful results have been obtained.

Introduction

Renewable energy sources (RES's) are seen as the greatest alternative to fossil fuels' depletion and environmental impacts [1]. It is anticipated that RES's will play a major role in the energy world of the future, as they offer sustainable and environmentally friendly energy [2]. However, in addition to these advantages, it has disadvantages such as not being continuous and insufficient in terms of power quality. In order to overcome this situation, RES's are used in integration with energy storage systems.

Energy storage systems are divided into two categories: high energy density and high-power density. High energy density storage units can provide continuous but low power. High power density storage units, on the other hand, can provide short-term but high power. By using the advantages of these two different types together, hybrid energy storage systems (HESS) are obtained [3]. Supercapacitors (SC) are the most commonly used storage systems that provide high power density [4]. SC are used as secondary or backup storage, due to their higher power density and faster dynamic response. Also, SC has very long-life cycle and lower self-discharge rate [5].

A model is needed to know in advance how the SC will behave in different operating conditions [6]. Also, while using in hybrid energy storage systems, the use of SC at the right time is of great importance in terms of system performance and efficiency. To decide the right time while designing the energy management system, the exact mathematical model of the SC must be known by designer.

Material and Method

SC model, given in Figure 1, is constructed using Debye polarization equivalent circuit.

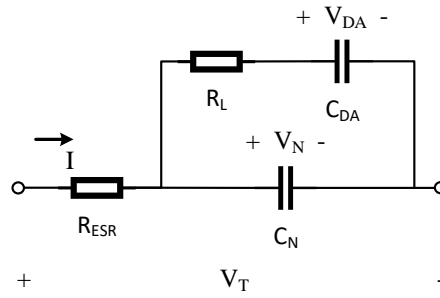


Figure 1. Debye polarization equivalent circuit model

where R_{ESR} is the equivalent series resistor, R_L is the leakage current resistance, C_{DA} is the Debye adsorption capacitance, and C_N is the nominal capacitance. The electrical behavior of the Debye polarization equivalent circuit model can be expressed as following equations:

$$\frac{dV_{DA}}{dt} = -\frac{1}{R_L C_{DA}} V_{DA} + \frac{1}{R_L C_{DA}} V_N \quad (1)$$

$$\frac{dV_N}{dt} = -\frac{1}{R_L C_N} V_{DA} + \frac{1}{R_L C_N} V_N - \frac{1}{C_N} I \quad (2)$$

$$V_T = V_N - I R_{ESR} \quad (3)$$

Parameter estimation toolbox was used in MATLAB/Simulink to determine the parameters representing the electrical behaviors in the Debye polarization equivalent circuit. The Simulink interface given in Figure 2 was created to verify the equivalent circuit model created after the parameter estimation.

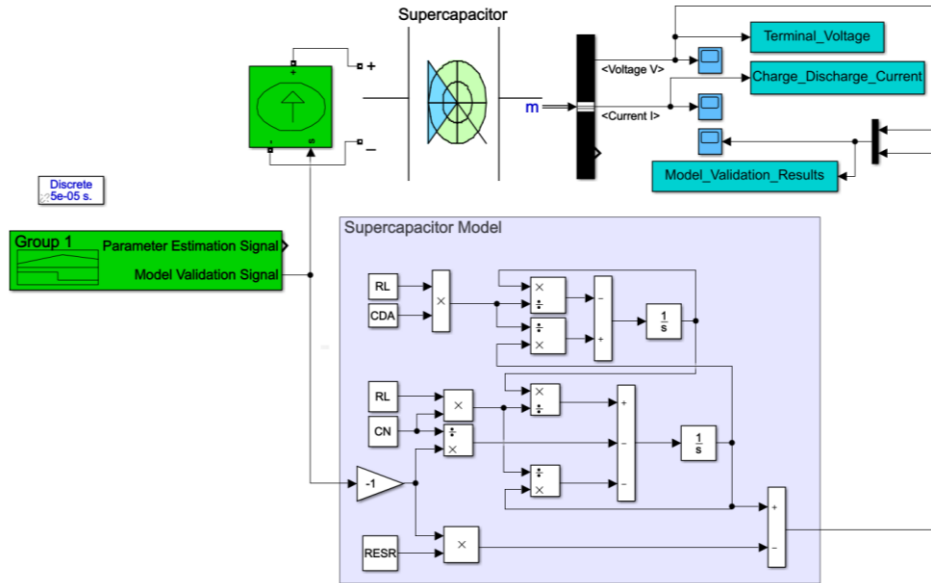


Figure 2. Validation of Debye polarization equivalent circuit model in MATLAB/Simulink

Results

Nonlinear Least Square method based on Trust Region Reflective algorithm was used for estimation of equivalent parameters. The input current given in Figure 3(a) was applied to the circuit model for parameter estimation. Comparison of model and actual terminal voltages as a result of parameter estimation is given in Figure 3(b). The estimation result was confirmed with a mean squared error of $1.7520e-04$.

Different charge and discharge currents were used to validate the equivalent circuit model. The current values given as input to the model created in Figure 4(a) are given. Comparison of actual and model terminal voltage with respect to this given input matched as seen in Figure 4(b).

The mean square error was calculated for the comparison of terminal voltages. The generated supercapacitor model accuracy was verified with a mean square error of 0.0028 in the comparison.

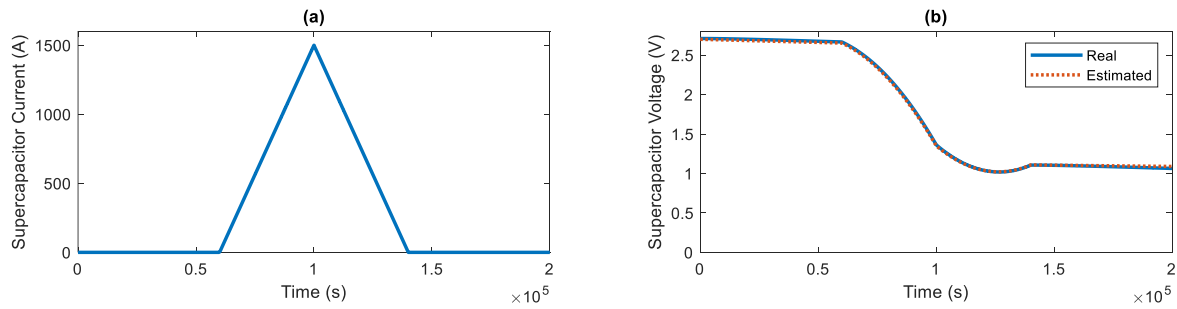


Figure 3. Parameter estimation results, (a) input current of Supercapacitor, (b) output voltage comparison

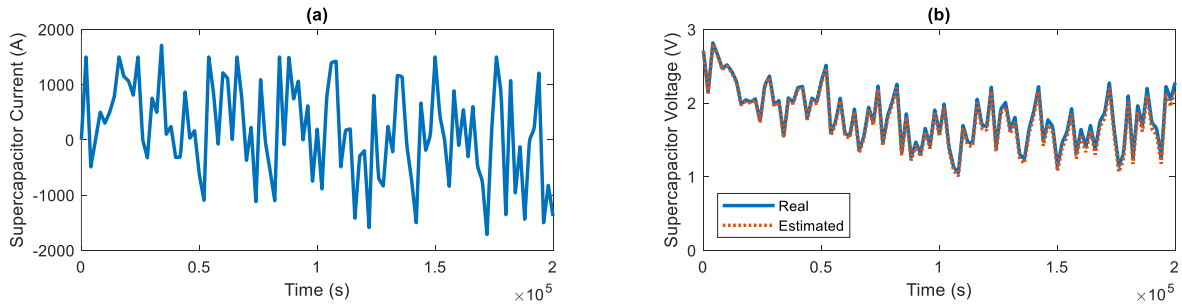


Figure 4. Model validation results, (a) input current of Supercapacitor, (b) output voltage comparison

Conclusion

In this study, mathematical model was determined by a suitable equivalent circuit. The estimation of the model parameters was determined in the MATLAB/Simulink parameter estimation toolbox with a maximum error rate of 0.17%. The accuracy of the model has been proven with a maximum error of 0.28% under different operating currents.

Author contributions:

Gökhan Yüksek: Writing-Original draft preparation, Presentation. **Yusuf Muratoğlu:** Software, Validation. **Alkan Alkaya:** Investigation, Reviewing and Editing.

References

- [1] Nair, U. R. (2020). *A Model Predictive Control-Based Energy Management Scheme for Hybrid Storage System in Islanded Microgrids*, 8, 97809–97822. <https://doi.org/10.1109/ACCESS.2020.2996434>
- [2] Blaabjerg, F., Teodorescu, R., Liserre, M., & Timbus, A. (2006). Overview of control and grid synchronization for distributed power generation systems. *IEEE Transaction on Industrial Electronics*, 53, 1398–1409.
- [3] Chen, H., Cong, T., Yang, W., Tan, C., Li, Y., & Ding, Y. (2009). Progress in electrical energy storage system: A critical review. *Prog. Natural Sci.*, 19(3), 291–312.
- [4] Stippich, A. (2017). Key Components of Modular Propulsion Systems for Next Generation Electric Vehicles. *CPSS Transactions on Power Electronics and Applications*, 2(4), 249–258. <https://doi.org/10.24295/cpsstpea.2017.00023>
- [5] Yang, H. (2018). Analysis of supercapacitor charge redistribution through constant power experiments. *IEEE Power and Energy Society General Meeting, 2018-Janua*, 1–5. <https://doi.org/10.1109/PESGM.2017.8274520>
- [6] Nikkhoo, M., Farjah, E., & Ghanbari, T. (2016). A simple method for parameters identification of three branches model of supercapacitors. *2016 24th Iranian Conference on Electrical Engineering, ICEE 2016*, 1586–1590. <https://doi.org/10.1109/IranianCEE.2016.7585774>



Advantages of slit-check dams in practice and investigation of bed slope effect

Mehmet Cihan Aydın*¹, H. Seda Aytumur², Ali Emre Ulu³

¹Bitlis Eren Univ., Engineering and Architecture Faculty, Department of Civil Engineering, Bitlis, Turkey, mcaydin@gmail.com

²State Hydraulic Works 17th Regional Directorate, Van, Turkey, aytemursed@gmail.com

³Bitlis Eren Univ., Engineering and Architecture Faculty, Department of Civil Engineering, Bitlis, Turkey, aliemreulu@gmail.com

Cite this study: Aydın, M.C., Aytumur, H.S. & Ulu, A.E. (2021). Application and Advantages of Slit Check Dams. 1st Advanced engineering Days, 32-34

Keywords

Slit-check dam
Flood control
River flow
Hydraulic structures

ABSTRACT

There are many types of check dams, which are flood control structures. Slit check dams, which is one of them, are especially preferred in rugged and high rainfall areas such as the Black Sea region of Turkey. The purpose of these dams is to hold back the large floating and drifting materials brought by the stream rather than preventing the floodwaters. Especially in the Black Sea region, the flood events that occurred in 2021 highlighted the necessity and importance of these structures. Branch logs and coarse stone materials brought by the rivers during the flood blocked narrow sections such as bridges and culverts in the settlements, causing the flood to damage larger areas. If these materials had been kept at the upstream of the settlements by using slit check dams, loss of life and property could have been prevented significantly. In this study, a general evaluation of slit check dams was made and their characteristics were discussed with examples in practice. Additionally, bed slope effects on the flow pattern downstream of slit-check dams were investigated by an experimental test.

Introduction

Check dams are effective hydraulic structures for flood control. Li et al [1] stated that check dams can be classified as closed-check dam and open-check dam, based on the literature [2-3]. Although closed check dams do not allow sediment passage and tend to fill up, open check dams allow sediment passage. While closed check dams do not allow sediment to pass through and tend to fill up, open check dams allow fine sediment to pass and only coarse materials are retained. For this reason, it is pointed out that these dams can maintain their efficiency for a much longer time [4-5].

Especially in recent years, researchers, such as Li et al. [1] focused the debris and sediment flows in slit and slot-check dams. However, there are not many studies on the hydraulics characteristics of such structures. Apart from flood times, these structures also have regulating and energy dissipating effects on normal flows. For this reason, it is important to examine the hydraulic performance of slit-check dams in clear water flow conditions. In this study, application examples of slit-check dams are presented and their hydraulic performances are discussed.

Slit Check Dams

In some cases, classical check-dams are insufficient to help maintain the natural balance in river basins. If fine material is required in the downstream part, permeable check dam can be preferred in these areas (in cases such as scouring in the downstream, etc.). Slit-check dams can be made with horizontal and vertical openings to filter coarse material. The downstream part is protected by using slit-check dams, as the coarse material will clog the water structures such as the bridge and culvert in the downstream. Especially in the years 2020-2021, the flood damages that occurred in the Black Sea region of Turkey were mostly caused by such reasons (Figure 1).

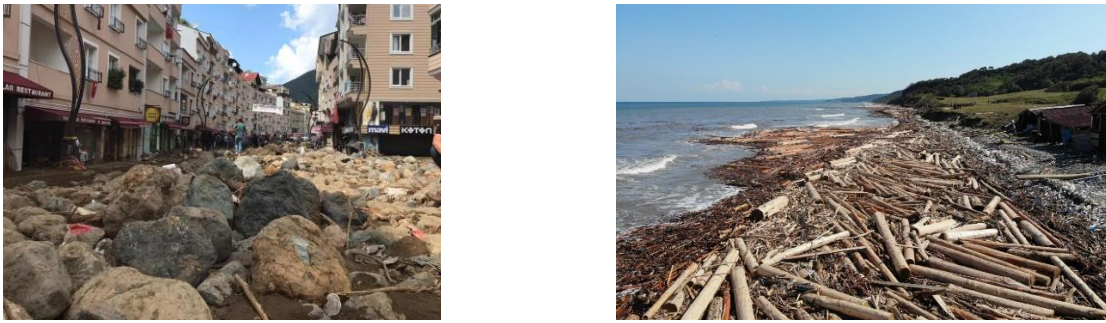


Figure 1. Images after the flood disaster in a) Giresun [6] and b) Sinop [7]

Slit-check dams built in forested and landslide areas such as the Black Sea protect the area from such damages by preventing the passage of tree pieces or large rock pieces downstream. Dynamic analyzes due to impact should be performed before these slid-check dams are constructed. In order to continue their functions in the next floods, the slid-check must be cleaned as they fill. Since there is no need for a fish passage, it does not prevent fish passages, thus the ecosystem is protected. It reduces the flow velocity during the flood and reduces the flood effect. It also has a regulatory effect thanks to its side walls. Slit-check dams constructed in different types are given in Figure 1.6(a-f).



(a)

(b)

(c)

Figure 2. Some slit-check dams species that: a) hold the woody overflow and regulate of flood water, b) regulate the bed load and adjust the amount of floodwater, c) to hold coarse sediment and break energy, [8].

Material and Method

Some experimental runs carried out for determination of slit-check dams with certain channel slope and relative slit rate. The experimental setup was illustrated in Fig. 3. Some pictures of the experiments study were given in Figs. 3.

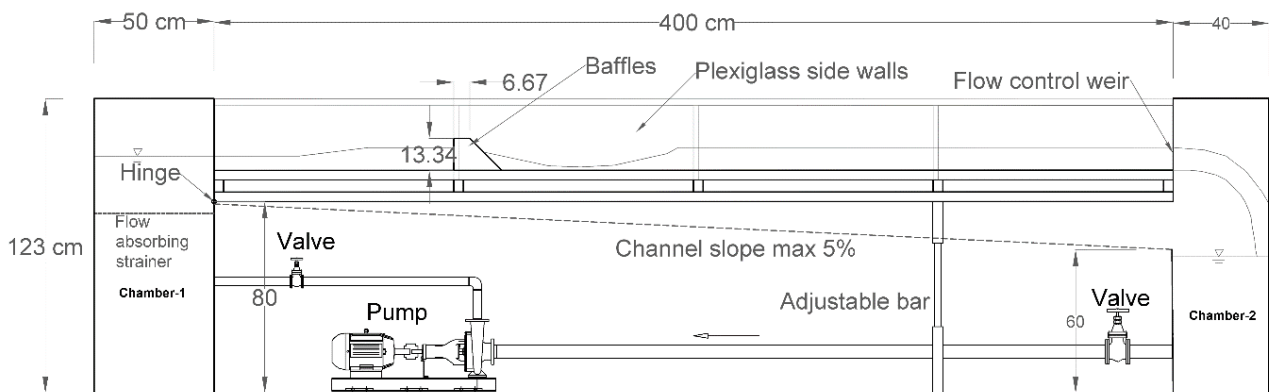
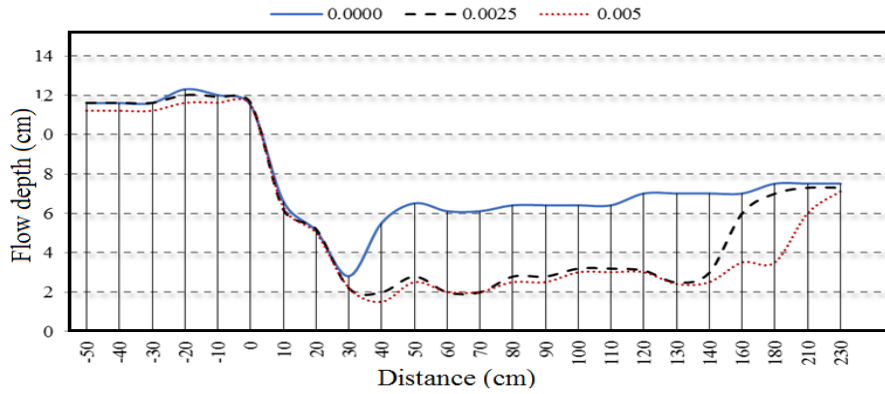


Figure 3. Experimental setup

Results

In this study, the effect of slit-check dams on free-surface flow profiles was investigated for different channel slopes. The graph in Fig. 5 shows the water surface profiles in three different channel slopes ($J=0, 0.0025$ and 0.005) for maximum discharge and $t/s=1.0$. The graphs show that as the channel slope increases, the length of the hydraulic jump also increases. The hydraulic jump after the check dam is to play an important role in energy

dissipation of the flow. However, this is the subject of a different study. Comprehensive results on the subject will be presented in further studies.



Conclusion

Slit-check dams are important protection structures, especially in rivers with high slopes and coarse solids transport. These structures also have a role in regulating the stream flow in normal times, apart from the solids transport. For the design of an effective slit-check dams, it is necessary to know the hydraulic behavior at different bed slopes as well as its type and dimensions. In this study, it has been observed that different channel bed slopes have a significant effect on the hydraulic jump occurring on the water surface. More comprehensive studies on the subject are in progress and will be presented in further studies.

Acknowledgement

This study has been derived from Aytemur's [9] master thesis.

Funding:

This study was supported by Scientific Research Projects Department of Bitlis Eren University, which Project Number BEBAP-2020-002.

Author contributions:

M. Cihan Aydın: Organization, Methodology, written **H. Seda Aytemur:** Data curation, Writing-Original draft preparation, experiments. **A. Emre Ulu:** Experiments and Editing.

Conflicts of interest:




The authors declare no conflicts of interest.

References

- [1] Li, S., You, Y., Chen, X., Liu, J., & Chen, J. (2019) Regulation effectiveness of a window-check dam on debris flows. *Engineering Geology*, 253: 205–213.
- [2] Armanini, A., Dellagiacomma, F., Ferrai, L. (1991) From the check dam to the development of functional check dams. *Fluvial Hydraul. Mt. Regions* 37, 331–344.
- [3] Chen, X.Q., Cui, P., You, Y., Chen, J.G., Li, D.J. (2015) Engineering measures for debris flow hazard mitigation in the Wenchuan earthquake area. *Eng. Geol.* 194, 73–85.
- [4] Chanson, H., 2004. Sabo check dams-Mountain protection systems in Japan. *Int. J. River Basin Manag.* 2 (4), 301–307.
- [5] Choi, S.K., Lee, J.M., Kwon, T.H., 2017. Effect of slit-type barrier on characteristics of water-dominant debris flows: small-scale physical modeling. *Landslides* 1–12.
- [6] Haberglobal (2020). <https://haberglobal.com.tr/gundem/kare-kare-giresun-daki-sel-felaketi-otomobiller-agac-dallarina-takildi-camur-balcik-tavanlara-dayandi-64901>. Date of access: 01.12.2021.
- [7] IHA (2021). <https://www.ih.com.tr/haber-karadeniz-tomruk-deniz-oldu-964248/>, Date of access: 01.12.2021.
- [8] Çelik, H.E., Selek, B., Dağdeviren, M., Demir, E., Büroğlu, İ. (2017). Havza Islah Önlemleri Kapsamında Yeni Bir Uygulama, Süzücü (Geçirgen) Tersip Bentleri.
- [9] Aytemur, H.S. (2021). Geçirimli Tersip Bentlerinin Hidrolik Analizi, Bitlis Eren Üniversitesi ve Dicle Üniversitesi, Lisansüstü Enstitüsü, Yüksek Lisans Tezi.



Effect of infill walls on limit states in reinforced-concrete frames

Ercan Işık¹, Mehmet Cihan Aydın¹, Ali Emre Ulu¹

¹Bitlis Eren University, Faculty of Engineering and Architecture, Department of Civil Engineering, Bitlis, Turkey
eisik@beu.edu.tr; mcaydin@beu.edu.tr; aeulu@beu.edu.tr

Cite this study: Işık, E., Aydın, M.C., & Ulu, A.E. (2021). Effect of infill walls on limit states in reinforced-concrete frames. 1st Advanced engineering Days, 35-38

Keywords

Infill
Limit state
Pushover
RC frame
Eigen value

ABSTRACT

In this study, the infill wall effect was investigated for a reinforced-concrete frame consisting of three different openings. Five different structural models have been created such as completely filled, gap in the corner, double gap and completely bare on the ground floor. The results of static pushover analysis and eigenvalue analysis, which were made by considering only the absence of infill wall as a variable, were compared. The target displacement for performance levels, period, base shear force, elastic and effective section stiffness's were obtained separately for each structural model. The study revealed once again that the amount of infill wall contributes significantly to the seismic capacity of the building.

Introduction

Infill walls are widely used in buildings to fill frame gaps or to separate residences [1]. In the current design of such structures, in most cases only the weight of the infill walls is taken into account and other strength parameters are ignored. The structural behavior of such frames is highly dependent on the dynamic properties of the respective laterally and vertically loaded infill walls, such as stiffness, bearing capacity, period and damping level [2-3]. It has been determined by experimental studies that the values obtained as a result of the calculations will not reflect the truth in cases where the infill walls are not placed appropriately and consciously and are not taken into account [4]. In the literature, the effect of the infill wall was investigated on different parameters by both experimental and numerical modeling. The capacity curves of infill walls, floor horizontal displacements, relative floor offsets, maximum plastic rotations in floors and the distribution of plasticized sections in the system in regular reinforced concrete structures were compared by [5]. In the study conducted by [6], the effects of the infill wall change on the capacity curve of the building, the first natural period, the target displacement request, the damage distribution of the first-floor columns, and the building performance level in residential type reinforced concrete buildings with different openings and number of floors were investigated. In a study by Paripour et al. [7] investigated the effect of infill walls on the risk of progressive collapse in reinforced-concrete (RC) frames. In this and similar studies, the positive contributions of the infill walls used in reinforced concrete structures to the earthquake behavior of the building have been revealed.

Within the scope of this study, the infill wall effect for a reinforced-concrete frame consisting of three different openings was tried to be revealed by static pushover and eigenvalue analysis on five different structural models. For each structural model, period, seismic capacity, elastic stiffness value and target displacement values for structural performance were obtained separately.

Material and Method

The limit states that given in Eurocode-8 (Part 3) (EN 1998-3) [8] were taken into consideration for damage estimation used worldwide in the structural analysis. These are near collapse (NC), significant damage (SD) and damage limitation (DL). These damage limit states were calculated for all the structural models, respectively. These limit states were given in Table 1.

Table 7. Limit states in Eurocode 8 (Part 3) (EN 1998-3) [8]

Limit State	Description	Return Period (year)	Probability of exceedance (in 50 years)
Limit state of damage limitation (DL)	Only lightly damaged, damage to non-structural components economically repairable	225	0.20
Limit state of significant damage (SD)	Significantly damaged, some residual strength and stiffness, non-structural components damaged, uneconomic to repair	475	0.10
Limit state of near collapse (NC)	Heavily damaged, very low residual strength & stiffness, large permanent drift but still standing	2475	0.02

The reference structural model and applied loads are shown in Figure 1. C25-S420 was taken into consideration for all RC buildings model. While the columns were chosen as 40*40 cm, the beams were taken into account as 25*50 cm.



Figure 1. The reference structural model and applied loads

Other structural models considered in this study are shown in Figure 2. The reference building was rated as Model 1. Structural models are shown in Figure 2. The target displacement was chosen as 0.10 m for comparison in all structural models.

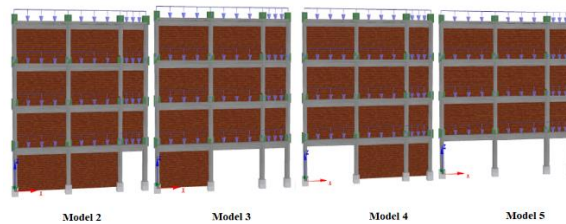


Figure 2. The structural models that used in this study

Results

The natural vibration period of buildings is an important parameter under seismic evaluation. The equivalent seismic lateral force is determined from a design spectrum which is a function of the fundamental vibration period of a building in the static design method [9-10]. The comparison of periods was given in Table 2 for all structural models. The comparison of base shear, elastic/effective stiffness's and target displacements for limit states for all structural models were given in Table 3.

Table 2. Comparison of periods for all structural models

Mode	Model 1	Model 2	Model 3	Model 4	Model 5
1	0.199634	0.208785	0.225426	0.228301	0.308856
2	0.069151	0.071214	0.074129	0.074455	0.08129
3	0.06244	0.062441	0.062452	0.062463	0.062476
4	0.05144	0.051469	0.051482	0.051442	0.051485
5	0.047596	0.047619	0.047668	0.047647	0.047815
6	0.044667	0.045209	0.045829	0.045872	0.046776
7	0.036328	0.036436	0.036547	0.036534	0.036694
8	0.033518	0.033533	0.033536	0.033521	0.033539
9	0.022823	0.022823	0.022827	0.02283	0.022834
10	0.022244	0.022293	0.022336	0.022369	0.022555

Table 3. Comparison of structural analysis

Model	Base Shear (kN)	Kelas (kN/m)	Keff (kN/m)	DL (m)	SD (m)	NC (m)
Model 1	913.61	193954.2	130170.6	0.003017	0.00387	0.009665
Model 2	881.71	173653.5	117333.4	0.003435	0.004406	0.010996
Model 3	554.87	145838.0	88925.6	0.004605	0.007061	0.015233
Model 4	524.43	143538.4	87404.39	0.007618	0.01079	0.021345
Model 5	396.36	62842.24	44267.62	0.014845	0.019238	0.033857

As the amount of infill wall decreased, the period value became higher. The lowest seismic capacity was obtained for the bare frame model. While the smallest values were obtained for Model 1 with a fully infill wall, the largest values were obtained for Model 5, which is a bare frame model.

Discussion

In most cases, only the weight of the infill walls is taken into account and other strength parameters are ignored. The investigation of the effect of type of infill wall material, the use of infill walls at different openings and heights, or the examination of the effects of door and window gaps will also be beneficial.

Conclusion

The results show once again that infill walls make very important contributions to the seismic behavior of reinforced concrete frames. Therefore, it is clear that considering the effect of infill walls in the calculations will allow the structural analyzes to be more realistic.

Funding:

This research received no external funding.

Author contributions:

Ercan Işık: Conceptualization, Methodology, Software **Mehmet Cihan Aydın:** Data curation, Writing-Original draft preparation, Validation. **Ali Emre Ulu:** Visualization, Investigation, Writing-Reviewing and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Timurağaoğlu, M.Ö., Doğangün, A., & Livaoğlu, R. (2019). Comparison and assessment of material models for simulation of infilled RC frames under lateral loads. *Građevinar*, 71(01.), 45-56
- [2] Pul, S., & Arslan, M.E. (2019). Cyclic behaviors of different type of hollow brick infill walls: A hinged rigid frame approach. *Construction and Building Materials*, 211, 899-908.
- [3] Choi, S. W., Park, S. W., & Park, H. S. (2017). Multi-objective design model for retrofit of reinforced concrete frames with infilled walls using FRP bracings. *Construction and Building Materials*, 140, 454-467.
- [4] Kaplan, S.A. (2008). Dolgu Duvarların Betonarme Taşıyıcı Sistem Performansına Etkisi. *TMH*, 452, 49-62.
- [5] Korkmaz, A., & Uçar, T., (2006). Betonarme binaların deprem davranışında dolgu duvar etkisinin incelenmesi. *Dokuz Eylül Üniversitesi Mühendislik Fakültesi Fen ve Mühendislik Dergisi*, 8(1), 101-108.
- [6] Akyürek, O., Tekeli, H., & Demir, F. (2018). Plandaki dolgu duvar yerleşiminin bina performansı üzerindeki etkisi. *International Journal of Engineering Research and Development*, 10(1), 42-55.
- [7] Paripour, M. B., Budak, A., & Düzgün, O. A. (2021). A parametric study on progressive collapse in reinforced concrete frames with infill walls. *Journal of Failure Analysis and Prevention*, 1-14.
- [8] EN 1998-3: Eurocode-8: Design of Structures for Earthquake Resistance-Part 3: Assessment and Retrofitting of Buildings; European Committee for Standardization: Bruxelles, Belgium (2005).
- [9] Aksoylu, C., & Arslan, M. H. (2019). Çerçeve türü betonarme binaların periyod hesaplarının farklı ampirik bağıntılara göre irdelenmesi. *Bitlis Eren Üniversitesi Fen Bilimleri Dergisi*, 8(2), 569-581.
- [10] Kutanis, M., Boru, E. O., & Işık, E. (2017). Alternative instrumentation schemes for the structural identification of the reinforced concrete field test structure by ambient vibration measurements. *KSCE Journal of Civil Engineering*, 21(5), 1793-1801.



A study on the flow velocities and energy dissipation potential of flow separator placed in spillway flip bucket

Ali Emre Ulu¹, Mehmet Cihan Aydın², Ercan Işık³

¹Bitlis Eren University, Engineering and Architecture Faculty, Department of Civil Engineering, Bitlis, Turkey, aliemreulu@gmail.com; mcaydin@gmail.com; ercanbitliseren@gmail.com

Cite this study: Ulu, A. E., Aydın, M. C., & Işık, E. (2021). A study on the flow velocities and energy dissipation potential of flow separator placed in spillway flip bucket. 1st Advanced Engineering Days, 38-40

Keywords

Spillway
CFD
Energy dissipater
Flow separator

ABSTRACT

The design of the energy dissipating pools at the downstream of the spillway is an important issue in terms of controlling the downstream flow regime, jet velocities and the scour problem that may occur in this region. In this context, there are many designs for flip-bucket pools for both energy dissipation and minimizing scour problems. In this study, the energy dissipation performance of a flow separator structure placed in an energy breaker pool was investigated numerically by increasing the shear stresses. The results obtained were interpreted and suggestions were made for future studies.

Introduction

Spillways are water structures that are widely used in hydraulic engineering. These structures are used to safely transfer the excess water accumulated in the dam reservoirs to the downstream part. In cases where the spillway design is not done correctly, at the downstream some problems may occur due to scouring, cavitation and energy breakdown at the downstream of the spillway and regulator [1-2]. There are a number of experimental and numerical studies in the literature to dissipate this energy of the high-speed flow that occurs just downstream of the spillway structures [3-7]. In this study, velocities, jets form and the energy dissipation potential of a flow separator structure placed in the flip bucket of a 2D Ogee-style spillway structure was investigated numerically. Possible scour in the downstream region was not taken into account in the study.

Material and Method

FLOW-3D, a powerful computational fluid dynamics (CFD) program, was used as a method in the study. Flow-3D is a widely used reliable method that can simulate fluid motions [8]. The program determines fluid motion by solving equations such as conservation of mass and momentum. The mass conservation equation used in Flow-3D is presented below [9].

$$V_F \frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x}(\rho u A_x) + R \frac{\partial}{\partial y}(\rho v A_y) + \frac{\partial}{\partial z}(\rho w A_z) + \xi \frac{\rho u A_x}{x} = R_{DIF} + R_{SOR} \quad (1)$$

Here; V_F : Volume ratio of the fluid, ρ : Density of the fluid, R_{dif} : Turbulent diffusion term, R_{sor} : Mass source, u, v, w are the velocity components in the coordinate directions (x, y, z).

Numerical modeling and analysis

In the study, a two-dimensional ogee type spillway with a crest elevation of 5.28 m and a flip-bucket diameter of 2.0 m was used. In the study, hexahedral 0.05 m cell size was used. Total mesh count is calculated as 130,000 (Figure 1). Analyzes were continued until the flow became completely stable (120 seconds). Analyzes performed using the Renormalized Group (RNG) turbulence model were solved by giving fluid elevation. As the fluid elevation, the water level started from 5.38 m and the fluid elevation was increased by 0.1 m to 6.48 m. Since the analyzes were carried out in two dimensions, the channel boundary conditions were determined as Symmetry. The channel floor boundary condition has been assigned as Wall, and the inlet and outlet parts have been assigned as Specified Pressure. 1 m downstream water inlet is defined in order to provide downstream conditions and to observe hydraulic jump.

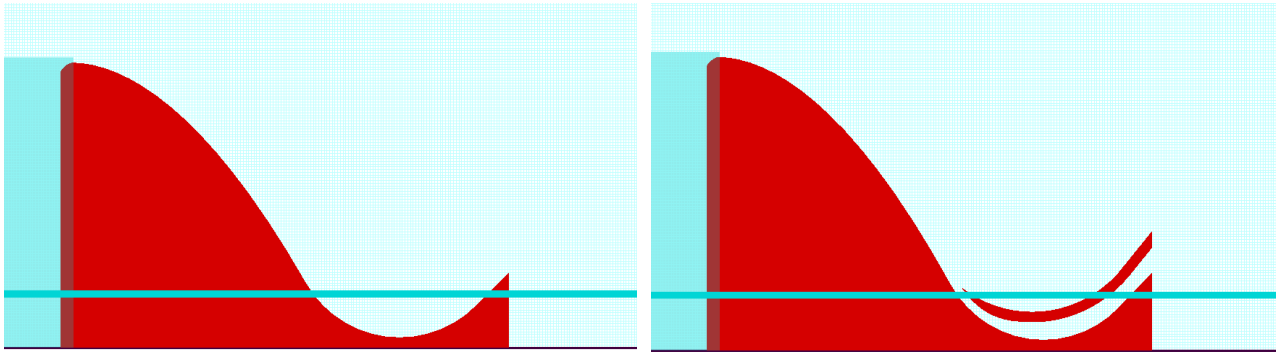


Figure 1. Mesh structures of the models

Results

In the study, the performance of a flow separator structure placed to increase the energy breaking potential of the spillway flip bucket at different upstream water loads was investigated in the numerical environment. From the results obtained, velocity contours with $H = 5.68$ m and $H = 6.38$ m water height, starting from the bottom of the spillway, are given in Figure 2. The head loads corresponding to these heights are $H_0 = 0.40$ m and $H_0 = 1.10$ m, respectively.

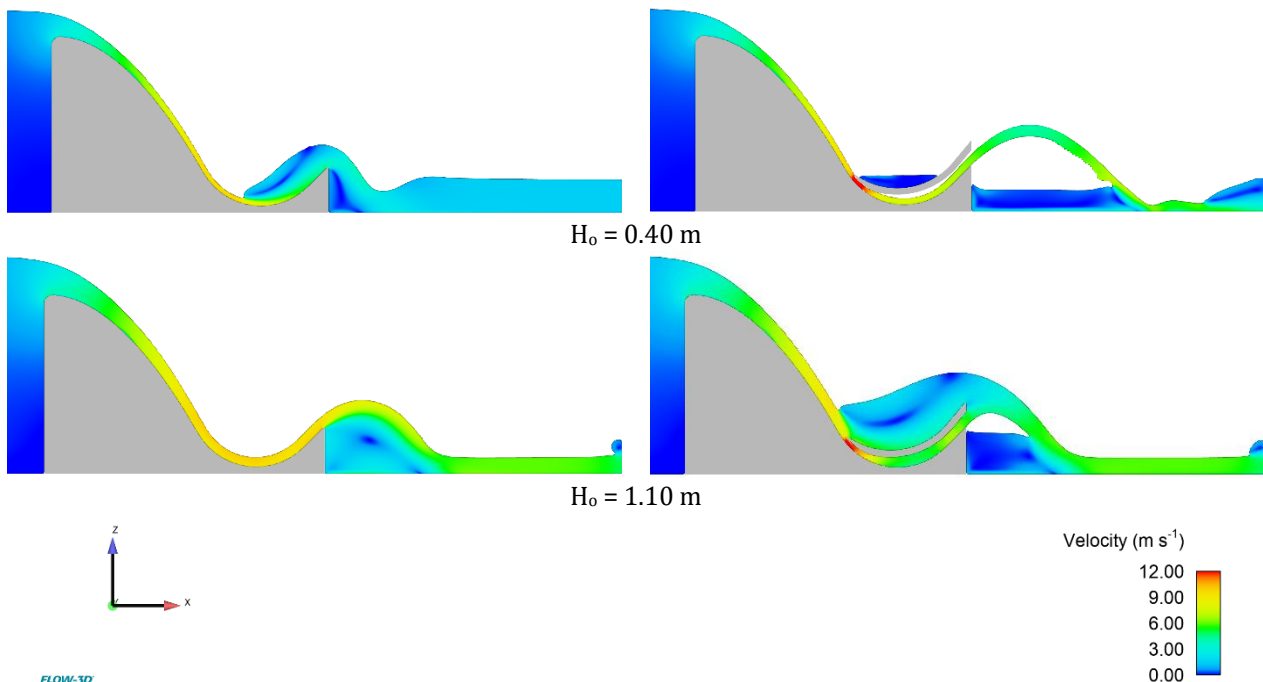


Figure 2. Velocity profiles of the flow

Discussion

In the light of the data and figures obtained from the study, it has been observed that the flow rises by jumping from the flip-bucket structure in the model using a flow separator at low weir loads. At low head loads, a hydraulic jump has occurred just after the jet throwing region of the model with the flow separator. This situation was not observed in the model without the separator. In the case where the head load is increased, while the energy dissipation potential is better in the case with a flow separator, it will be appropriate to make a cavitation calculation since an increase in velocity is detected at the end section where the separator starts.

Conclusion

In the study, the effect of a flow separator placed in the energy breaking pools of the spillway structures, which has an important place in the field of hydraulic engineering, on the flow velocities and energy dissipation status was investigated. In future studies, the performance of the flow separator can be evaluated by comparing the different dimensions, the cavitation risk it will create and how it will behave in case of a possible scour in the downstream region compared to the normal situation.

Acknowledgement

Acknowledgements of support for the paper are welcome.

Funding:

This research received no external funding.

Author contributions:

Ali Emre Ulu: Methodology, Software **M. Cihan Aydın:** Model design, Validation. **Ercan Işık:** Visualization, Writing-Reviewing and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Aydın, M. C., & Ulu, A. E. (2018). Effects of different shaped baffle blocks on the energy dissipation and the downstream scour of a regulator. *Bitlis Eren University Journal of Science and Technology*, 8(2), 69-74.
- [2] Aydın, M. C., Ulu, A.E., & Karaduman, Ç., (2017). Investigation of Energy Dissipation and Sediment Scour Over a Regulator Using CFD. *CEPPIS 2017*, Poland.
- [3] Chatila, J., & Tabbara, M. (2004). Computational modeling of flow over an ogee spillway. *Computers & structures*, 82(22), 1805-1812.
- [4] Daneshfaraz, R., & Ghaderi, A. (2017). Numerical investigation of inverse curvature ogee spillway. *Civ Eng J*, 3(11), 1146-1156.
- [5] Daneshfaraz, R., Ghaderi, A., Akhtari, A., & Di Francesco, S. (2020). On the effect of block roughness in ogee spillways with flip buckets. *Fluids*, 5(4), 182.
- [6] Hurtig, K., Croockewit, J., & Vasquez, J. A. (2013). Verification of CFD simulations of flip bucket spillway performance using physical model results. *CANADIAN DAM ASSOCIATION 2013 Annual Conference*, Montréal, Québec, Canada.
- [7] Yavuz, C., Dincer, A. E., & Aydın, I. (2016). Head Loss Estimation for Water Jets from Flip Buckets. *The International Journal of Engineering and Science (IJES)*, 5(11), 48-57.
- [8] Aydın, M. C., & Işık E. (2015). Using CFD in Hydraulic Structures. *International Journal of Scientific and Technological Research*. 1(5):7-13.
- [9] Flow 3D, (2014). Manual, Sediment Scour Model. *Flow-3D User Manual*, v11.0.3. Flow Science, Inc.



Investigation of failed node method to support healthy communication for linear wireless sensor networks

Musa Çibuk*¹, Davut Arı², Fikri Ağgün³, Ümit Budak⁴

¹Bitlis Eren University, Engineering and Architecture, Computer Engineering, Bitlis, Turkey, mcibuk@beu.edu.tr

²Bitlis Eren University, Engineering and Architecture, Computer Engineering, Bitlis, Turkey, dari@beu.edu.tr

³Bitlis Eren University, Adilcevaz Vocational School Department Of Computer Technology, Bitlis, Turkey, faggun@beu.edu.tr

⁴Bitlis Eren University, Engineering and Architecture, Electricity - Electronic Engineering, Bitlis, Turkey, ubudak@beu.edu.tr

Cite this study: Çibuk, M., Ari, Davut., Ağgün, Fikri., & Budak, Ü. (2021). Investigation of failed node method to support healthy communication for linear wireless sensor networks. 1st Advanced Engineering Days, 41-44

Keywords

WSN
LWSN
MAC Protocol
Linear Topology
Failed Node

ABSTRACT

Wireless Sensor Networks (WSNs) are used extensively in many natural environment research and observation applications in the world, and their popularity is increasing day by day. In parallel with these studies, Linear Wireless Sensor Network (LWSN), which is a type of WSNs application, is frequently encountered for reasons such as meeting the security requirements of highways, bridges, pipelines, and border lengths, determining and observing the needs. For this purpose, within the scope of a project, a new MAC protocol has been designed by us, which is effective in minimizing LWSN problems and can ensure the continuity of the network's connection in difficult physical conditions. With the failed node method, which is the main subject of our article and introduced in the protocol in question, an important study has been put forward to avoid situations that will disrupt the data transmission of the network.

Introduction

Recently, possibilities have emerged that allow the implementation of Linear Wireless Sensor Network (LWSN) applications with ease, which can consist of many sensor nodes and be used along linear lines. As seen in Fig. 1, LWSN is a specialized type for WSN applications that require linear topology characteristics. Thanks to its linear array feature, operations such as installation, maintenance, and routing are effortless. However, there are difficulties to be solved in such networks such as end-to-end latency, excessive data traffic at end nodes, network reliability, node failure, and link failure [1]. The linear nature of such networks can be an important motivation for designing custom protocols to increase reliability, efficiency, energy savings, and network lifetime [2-3].

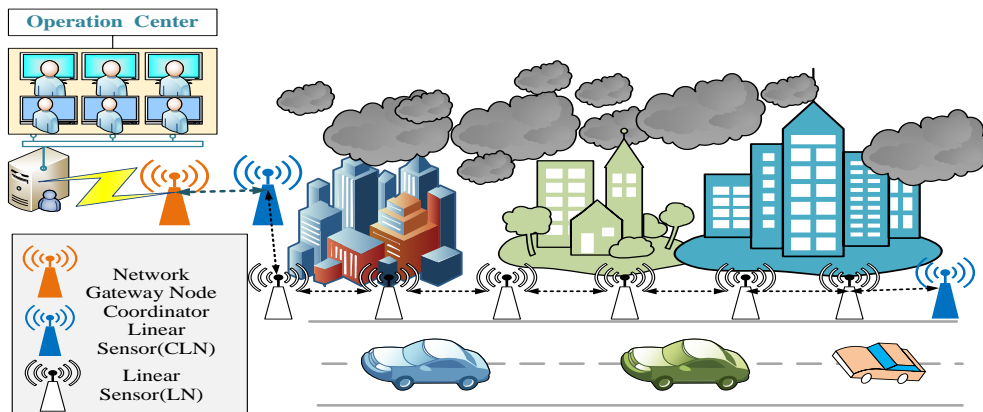


Figure 1. An example LWSN structure

Unlike traditional networks, sensor networks work on dense distribution and coordination. It has been seen that sensor network applications have many advantages over traditional networks, primarily in military applications, detection and surveillance of enemy activities [2].

LWSNs have been used in many applications such as pipeline [4-5], mine tunnel monitoring [6], traffic monitoring, and road safety [2,7].

Operations such as network setup and routing, which are difficult for most WSN types, are quite easy with LWSNs. Intensive studies are carried out on the development of MAC protocols, and they provide effective communication in networks. We have proposed a new MAC protocol that can be used in LWSNs, providing efficient, healthy, and lossless communication. In this protocol, a method is proposed that aims to prevent the communication between the nodes in the network from being interrupted. This method steps in when a node is disconnected from the network and contributes to the continuity of the network even if a node on the transmission line is disconnected from the network. The success of the proposed method has been demonstrated by the simulation and the performance analysis has been made. The results show that the method activated in the node failure scenario in the proposed MAC protocol is a highly effective method that can eliminate the disconnection in the network and maintain communication smoothly.

LWSN networks continue to increase in popularity day by day. Well-designed MAC protocols and the methods used in them have a salient place among the chief factors affecting the efficient use of resources by sensor nodes with low features and limited sources.

LWSN is created by arranging sensor nodes one after another along a line. In fact, as the number of nodes increases, many network parameters such as end-to-end latency, network connection success, energy savings, and network lifetime are adversely affected.

Energy-efficient node placement research is among the main design considerations for all WSNs and especially for LWSNs spread over large areas [3].

In our study, it is thought that the proposed method to optimize the topology and feel the network disconnection as little as possible will support the topology optimization approach. With these aspects, it is thought that the method in the proposed protocol will make an effective contribution to the literature.

Material and Method

The Node Failure method in the developed MAC protocol, which ensures the continuity of the network by maintaining the communication in the network despite the nodes disconnected from the network, and significantly affects the protocol performance in this respect, has the mechanism whose diagram is given in Fig. 2.

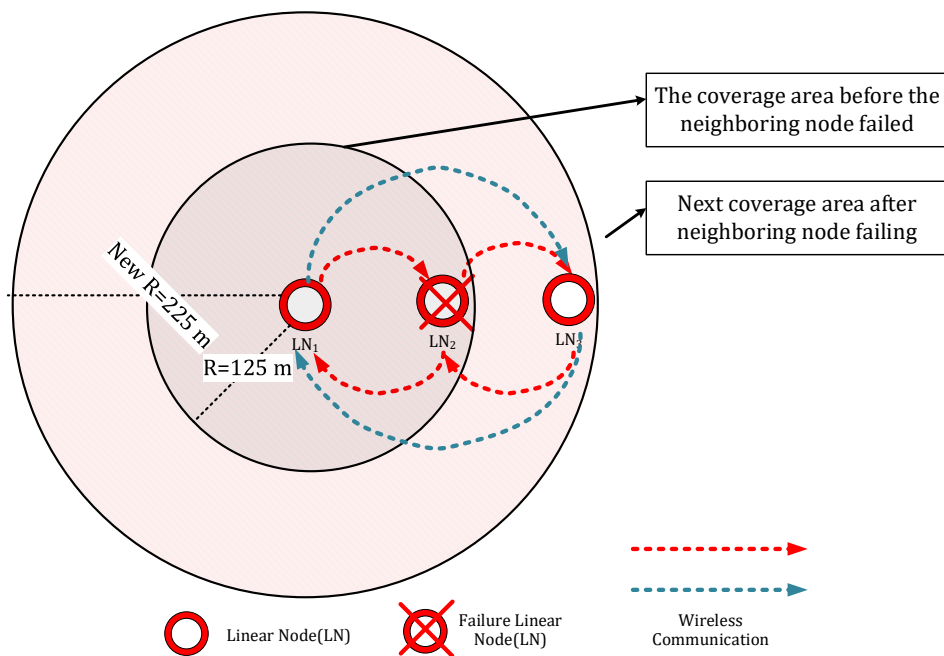


Figure 2. Behavior of Failed Node Mechanism

Thanks to this structure defined in the MAC protocol, the node, which decides that its neighbor has dropped from the network, increases its coverage area, scans the distance of two hops instead of one hop, and communicates with its neighbor at two hops distance and can ensure the continuation of the network over themselves. Thus, this

mechanism ensures the continuity of the communication line. In the example simulation scenarios, in the first case, neighboring nodes communicate in the area with a radius of 125m. However, depending on the disconnection from the network, the communication distance radius increases up to 225m.

The Riverbed Modeler program was preferred for the performance evaluation of the proposed MAC protocol within the scope of this study. There are three types of nodes in the prepared Network Project environment: Sensor (LN), Coordinator (CLN) and Sink. The simulation parameters are given in Table 1.

Table 1. Simulation parameters

Parameter	Value(s)
Radio propagation delay model	dra_propdel
Modulation	qam64_ber_snr
Radio propagation Range	125m & 225m
Transmit Power	SR_tx = 0.027w
Receive Power	Sr_rx = 0.0366w
LN Count	10, 20, 30, 40, 50
CLN Count	2
Sink Count	1
Node Layout	Linear
Used Channel Count	1
Distance Between Nodes	100m
Simulation time	25sn

Connecting LWSN nodes to the network and performing their duties without disconnecting from the network is of great importance in terms of network performance. Under this title, the responsiveness and behavior of the protocol, due to the relevant method, in case a node disconnects from the network for any reason, is examined.

Results

The example scenario applied to show the response of the nodes and the continuation status of the network in case of node failure is shown in Fig. 3.

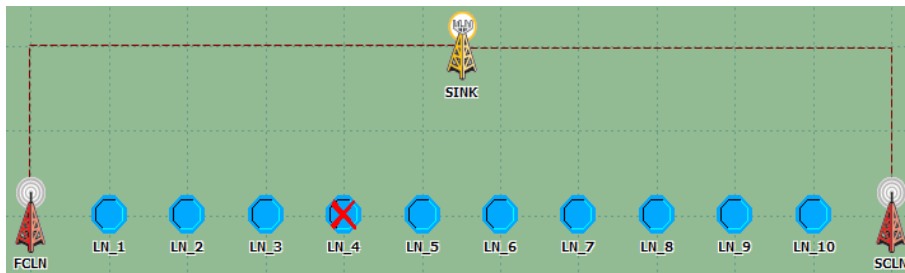


Figure 3. Failed node example scenario

A node (LN4) was disconnected from the network in a certain period of time and after a while, the disconnected node was allowed to join the network again. The total number of active nodes in the network is shown in the graph in Fig. 4(a), and the graph showing the number of data packets transmitted in the network in case of a change in the number of nodes is shown in Fig. 4(b).

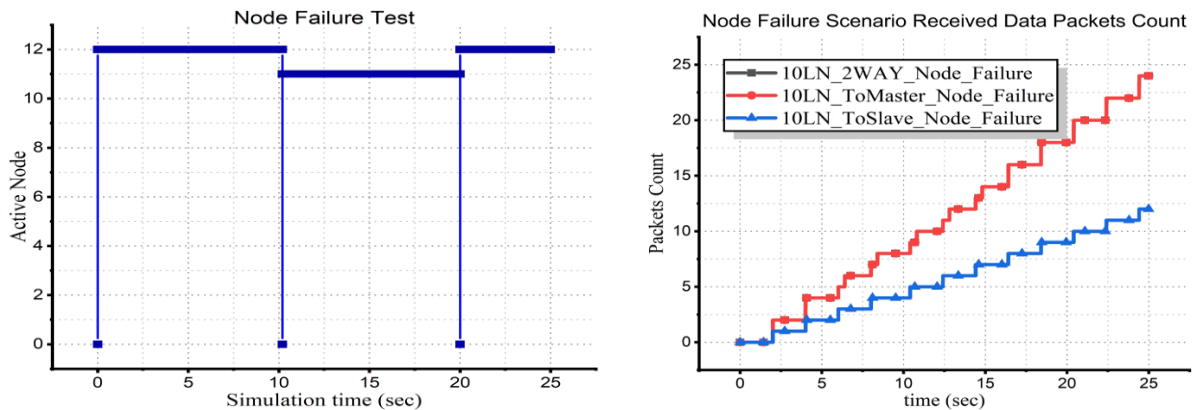


Figure 4. Failed node graphic (left), Number of data packets transmitted in case of the failed node (right)

Discussion

When Fig. 4(b) is examined, it is seen that although a node is disconnected from the network, data packet communication continues in that process. In this case, with the node falling from the network, the neighboring nodes doubled their coverage area, ensuring continuous communication and connection continuity in the network. It is seen that the same number of packets reached the destination in all three data transmission models. The results show that the failed node method in the proposed protocol works and the transmission continues without packet loss in the network, proving the success of the method.

Conclusion

LWSN application simulation shows that the proposed protocol in the simulation environment and the node failure method in the protocol work successfully, and this success also shows that our proposed method has an important place among the precautions to be taken against breaks in the network.

In the node failure method, the neighboring node fulfills the task of the node that has fallen from the network by expanding its coverage area, and the continuity of data communication is ensured without disturbing the communication of the network.

Within the scope of this study, only one node disconnection from the network is studied; the method's behavior in case of disconnection in more than one consecutive node is left to later studies.

Funding and Acknowledgement

This project study was supported by Bitlis Eren University Scientific Research Projects Unit with project number BEBAP2019.006. We thank Bitlis Eren University Scientific Research Projects Unit for her contribution and support.

Author contributions

Musa Çibuk and Davut Ari: Conceptualization, Methodology, Software. **Fikri Ağgun:** Data curation, Writing-Original draft preparation, Software, Validation. **Ümit Budak:** Visualization, Investigation, Writing-Reviewing and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Chen, H., Tse, C. K., & Feng, J. (2009). Impact of topology on performance and energy efficiency in wireless sensor networks for source extraction. *IEEE Transactions on Parallel and Distributed Systems*, 20(6), 886–897. <https://doi.org/10.1109/TPDS.2009.14>
- [2] Jawhar, I., & Mohamed, N. (2009). A hierarchical and topological classification of linear sensor networks. *2009 Wireless Telecommunications Symposium, WTS 2009*. <https://doi.org/10.1109/WTS.2009.5068941>
- [3] Varshney, S., Kumar, C., & Swaroop, A. (2015). Linear sensor networks: Applications, issues and major research trends. *International Conference on Computing, Communication and Automation, ICCCA 2015*, 446–451. <https://doi.org/10.1109/CCAA.2015.7148418>
- [4] Lai, T. T. Te, Chen, W. J., Li, K. H., Huang, P., & Chu, H. H. (2012). TriopusNet: Automating wireless sensor network deployment and replacement in pipeline monitoring. *IPSN'12 - Proceedings of the 11th International Conference on Information Processing in Sensor Networks*, 61–71. <https://doi.org/10.1145/2185677.2185686>
- [5] Saeed, H., Ali, S., Rashid, S., Qaisar, S., & Felemban, E. (2014). Reliable monitoring of oil and gas pipelines using wireless sensor network (WSN) - REMONG. *Proceedings of the 9th International Conference on System of Systems Engineering: The Socio-Technical Perspective, SoSE 2014*, 230–235. <https://doi.org/10.1109/SYSOSE.2014.6892493>
- [6] Jiang, H., Wu, J., Chen, L., Chen, S., & Leung, H. (2009). A Reliable and High-Bandwidth Multihop Wireless Sensor Network for Mine Tunnel Monitoring. *IEEE Sensors Journal*, 9(11), 1511–1517. <https://doi.org/10.1109/JSEN.2009.2022878>
- [7] Low, K. S., & Talampas, M. C. R. (2017). Wireless sensor networks for intelligent transportation applications: A survey. *Industrial Wireless Sensor Networks: Applications, Protocols, and Standards*, 47–78. <https://doi.org/10.1201/b14072>



Advanced Engineering Days

aed.mersin.edu.tr



The effect of the geometric features of the road on traffic accidents

Sümeyra Kaya Arman 

¹Bitlis Eren University, Faculty of Engineering, Civil Engineering, Bitlis, Turkey, skarman@beu.edu.tr

Cite this study: Kaya Arman, S., (2021). The effect of the geometric features of the road on traffic accidents. 1st Advanced Engineering Days, 45-47

Keywords

Highway
Traffic Safety
Road Design
Traffic Accident

ABSTRACT

In our developing country, as a result of the disruptions in both urban and intercity road planning and construction, there is a lack of function and irregular roads. The road structure that cannot meet the expected performance according to the service class it belongs to causes an increase in road operating costs and a decrease in traffic safety. In addition to the direct negative reflection of the effect of the defective road structure on the traffic, it also has a secondary negative effect as it causes stress on the drivers. Traffic safety should be the priority goal of decision-makers in the road planning and construction phase. In this study, the negative effects of road defects on traffic safety are mentioned. The data used includes the part of KGM arising from the geometric structure of the road in 2020. These data constitute 0,27% of the accidents.

Introduction

Transportation can be expressed as the displacement of human or human belongings [1]. The parameters that are generally taken into account when choosing the mode of transportation are cheap, safe, comfortable, environmental compatibility, speed, etc. [2]. We can examine the types of transportation used to transport people and goods under 5 headings. Road Transportation, Airline Transportation, Railroad Transportation, Sea Transportation, Boat Line Transportation Road transportation is the most used mode of transportation in our country as well as all over the world [3]. The reason why it is the most preferred mode of transportation is the advanced road network structure, the relatively more economical transportation of passengers and cargo compared to other transportation types, etc. The reasons were effective. While road transportation is preferred, this has led to some disadvantages. For example, the increasing number of vehicles has increased the traffic density. Increasing traffic density necessitated the construction of a continuous road and the maintenance of the existing roads. Human factors (pedestrian, passenger), vehicle and road are important in road transportation. The fact that these factors are in a harmonious relationship both among themselves and with each other has been effective in preventing traffic accidents, which are a result of traffic density. Traffic accidents can occur with the unusual action of one of these three factors.

Material and method

In this study, the effect of road geometric structure on traffic accidents will be examined by using data from the General Directorate of Highways (KGM) and the Turkish Statistical Institute (TUIK).

Road geometric standards

Geometry standards of a road; platform width (lane and shoulder width) horizontal and vertical radii of the curves longitudinal and transverse slopes expropriation width. Factors considered in the selection of geometric standards during the road design phase [4]: Project speed, Geological and Topographical Structure of the Land Road Carrying Capability Types of Vehicles in Motion in Traffic Service Level of the Road Security Traffic Safety

Financial Opportunities Local Factors (weather, transit route, etc.) The purpose of the geometric design of the road; should be to increase safety and efficiency while minimizing cost and environmental damage. The geometric design of the road built with this goal can be examined under three headings: alignment, profile, and cross-section. Combined, they provide a three-dimensional layout for a path. In alignment; horizontal tangents and alignment of curves are involved. The path, including the profile crest and sag curves and the straight grade lines connecting them, is a vertical direction. The cross-section shows the location and number of vehicles and bike lanes and sidewalks along with their transverse slope. Sections also show drainage features, pavement structure, and other elements outside the geometric design category, Unfortunately, mistakes made in the calculation of these elements during the road design and construction phase of the application of the project cause traffic accidents.

When the traffic data of TUIK and KGM for the year 2020 are examined, the causes of the accidents are shown in the graphic below.

As can be seen from Figure 1 the main cause of accidents is driver errors, followed by pedestrian errors, vehicle errors, passenger errors, and road design errors. Although errors due to road design appear as 0,27% in accidents, when it comes to human life, the values should be taken into account regardless [5].

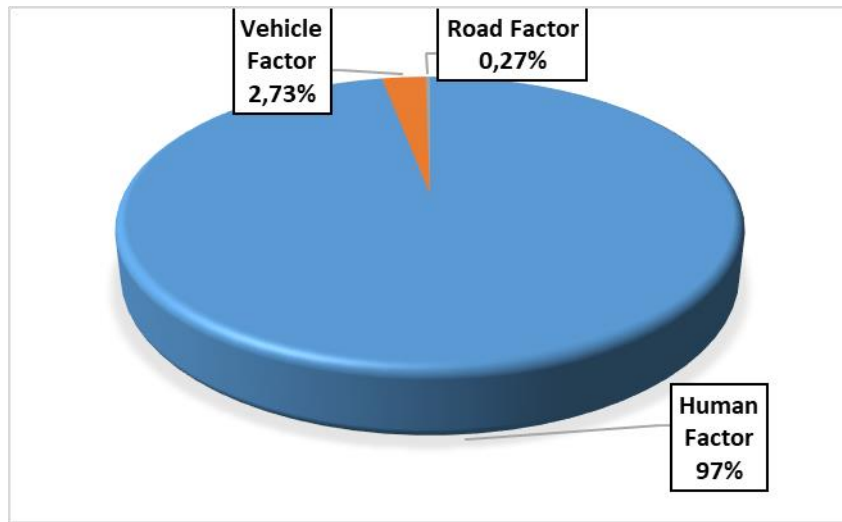


Figure 1. Faults Causing Road Traffic Accident Involving Death or Injury 2020

When the accidents with the effect of the geometric design of the road were examined, the following results were obtained.

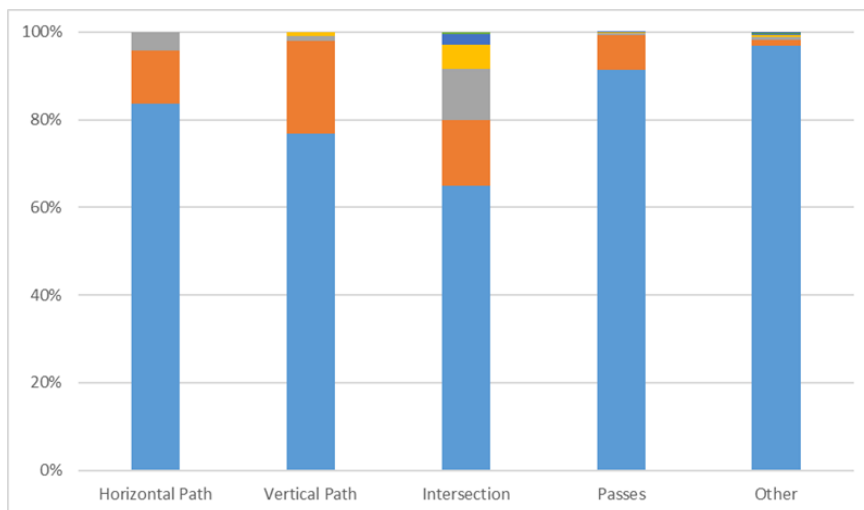


Figure 2. The Rate of The Geometric Feature of The Road in Traffic Accidents

When the horizontal route in the road structure is examined, it is seen that the straight road structure is the main reason for the accident rates with a rate of 83.7%. The straight road increases the accident rate by causing the focus of the drivers to shift from the road.

When the vertical route in the road structure is examined, it is seen that the non-sloping road structure is the main reason with a rate of 77.18%. The transverse slope given for the self-evacuation of rain water falling on the road platform allows vehicles to move safely.

The main purpose of the intersections in the road structure is to regulate the vehicle and pedestrian traffic on the main and secondary roads. Intersections are built in order to ensure a continuous traffic flow and traffic safety at the intersections of two, three or more roads, to eliminate negative situations such as reduced speed at intersections, increased waiting queues and an increase in extra operating costs. From this point of view, the absence of the required intersection puts traffic safety at risk.

Crossings made to avoid interrupting the traffic flow always create a safe traffic flow for pedestrians and vehicles on the road.

Conclusion

When the data obtained are examined, a total of 150,275 accidents were caused by human, vehicle, and road factors. Of this number, 38,358 were caused by the road component, resulting in 2530 deaths and 73139 casualties. When the road geometry is examined, the factors that cause the most accidents are; It has been observed that it occurs on straight, no slopes, no intersections, no passages.

References

- [1] Kurt, Cihan (2010). The Place and Importance of Logistics in the Transportation Sector in Turkey. Unpublished Master Thesis, Istanbul University Institute of Social Sciences, Istanbul.
- [2] Doğan, Zeki. Beller D., Beyhan (2018). Comparison Of Transportation Sector and Types of Transportation In Turkey. International Journal of Social Studies / The Journal of International Social Research 2018 Volume: 11 Issue: 56 April 2018
- [3] Yumak, Ahmet (2019). Investigation of Highways Geometric Standards and Road Safety: The Case of Şırnak City Cente. Master Thesis, Şırnak University, Institute of Science and Technology, Şırnak.
- [4] Yayla, Nadir (2015). Highway Engineering Book.
- [5] General Directorate of Highways Traffic Information in 2020



The superiorities of concrete roads over asphalt roads

Muhammed Tanyıldızı*¹, Erden Ozan Karaca ¹

¹Bitlis Eren University, Engineering and Architecture Faculty, Civil Engineering Department, Bitlis, Turkey, mtanyildizi@beu.edu.tr; eokaraca@beu.edu.tr

Cite this study: Tanyıldızı, M., & Karaca, E. O. (2021). The superiorities of concrete roads over asphalt roads. 1st Advanced engineering Days, 48-50

Keywords

Highway
Concrete Road
Asphalt Road
Bitumen
Cement

ABSTRACT

Roads are vital for the human being to travel and reach goods safely, comfortably and economically. Every year, thousands of kilometers of roads are covered with asphalt or concrete. The selection of the pavement type is very important at the project stage. It should be designed in accordance with socio-economic needs. In addition, they are expected to safely distribute the loads acting on them to the subfloor and withstand detrimental environmental effects. Roads are named according to the material used as a binder in their construction, and when bitumen and cement are used as binder materials, respectively, they are called asphalt and concrete roads. Asphalt has been used as the main paving material for years. However, lately, concrete has emerged as a strong competitor to asphalt in road construction. This study reveals the superiorities of concrete roads over asphalt roads by considering them in terms of technical, economic, safety and environmental aspects.

Introduction

Transportation is the transfer of persons or goods from one location to another for a specific purpose, arising from a specific need [1]. It is desired that an ideal transportation service should be economical, safe, and have features such as comfortable, fast and environmentally friendly at the same time. As a general perception, the level of development of countries is related to the desired level and quality of transportation routes. With the increasing population and increasing industrialization, the importance of road in freight and passenger transportation is increasing day by day and it is known that highway use comes first in terms of both freight and passenger transportation. Due to the increase in heavy vehicle traffic, significant problems may arise in the road structure when all design criteria are not fully taken into account. For this reason, it is possible to create more economical, comfortable and environmentally friendly structures that can serve for many years with the right material selection at the project stage before the construction of the highway [2].

Roads are structures that safely transmit the loads acting on them to the sub-base and can effectively withstand detrimental environmental effects efficiently. A road is categorized according to the material used as binder during its construction. The type of road that uses asphalt as a binder is called asphalt roads (flexible superstructures) and the type that uses cement is called concrete roads (rigid superstructures). The asphalt roads consist of 3 main parts: sub-base, foundation and pavement. The construction of the pavement layer differs on high and low standard roads. It is applied as a single or double-layer surface coating on low standard roads. The concrete roads, on the other hand, is formed by the concrete pavement built on the substructure. If the daily number of commercial vehicles in one direction on a road is more than 5000, it is recommended by many institutions to build a concrete road [3]. This study presented here deals with the superiorities of concrete roads over asphalt roads.

Since the selection of road superstructure is based on some criteria and standards, it has high importance both in construction a new road and repairment the existing roads. Today, with the increase in heavy vehicle traffic, it is necessary that the works should be performed to renew existing road structures in accordance with the request, rather than building a new road [4].

Advantages of concrete roads compared to asphalt roads

Concrete roads are more rigid

Concrete roads have significant advantages over asphalt roads. One of them is that concrete roads spread the loads acting on them over a wider area than asphalt roads by acting as a beam. Since the bearing capacity is not dependent on the ground, it can also be built on soils with low bearing capacity. However, since the point load model is valid on asphalt roads, the ground and sub-floor are subjected to much more load and the bearing capacity of asphalt roads depends on the stiffness of the ground as depicted in Figure 1 [5]. Thereby, if there is a low-bearing capacity soil under asphalt roads, the roads could be deformed easily in the direction of load profile. Concrete road application may be more suitable for roads under heavy traffic as it is more durable.

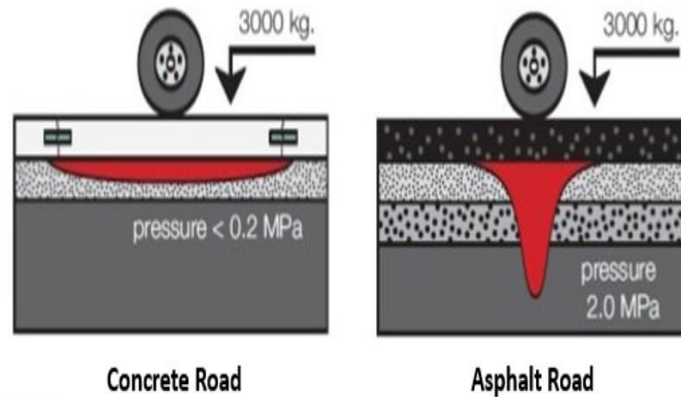


Figure 1. Load distribution of concrete and asphalt roads

Concrete roads are more economical

Concrete roads are more economical compared to asphalt roads. They need less maintenance in their service life. In a fifty years period, maintenance expenses could be decreased up to 66% with concrete roads. Considering the initial cost, it is seen that concrete roads are generally built at less cost [1]. Also, they could save fuel up to a level of 3.2% and 4.5% for vehicles and loaded trucks respectively. Under heavy traffics, asphalt roads show more deformation. So, the deteriorations on the upper face of the pavement absorb a part of the energy of the vehicle and result in more fuel consumption [6].

Concrete roads are safer

Concrete roads have a high coefficient of sliding friction which is important for factors of safety, thus providing a shorter stopping distance. Also on rainy days, the decrease in this sliding friction coefficient could be less compared to asphalt roads, providing more driving safety. Since the surface of the concrete roads is smoother, the surface waters flow more easily. Thus, the risk of icing could be minimized in cold weather. Also, the surface smoothness results in less accumulation of water and the deteriorating effect of water the surface of the road in the cold season decreases [7].

While concrete roads are light-colored, asphalt roads are dark-colored. Because of being light-colored, concrete roads reflect the vehicle's light much more compared to the asphalt roads, providing in the enhancement of the night-sight of drivers [8]. Also, it is possible to save on the cost of lighting streets and highways owing to the high light reflectivity of concrete roads. Figure 2 demonstrates the night-sight of concrete and asphalt roads [9].



Figure 2. The night-sight of asphalt and concrete roads

Concrete roads are more environmentally friendly

Heating bitumen during the construction of asphalt roads causes environmental pollution. However, this is not the case in concrete roads construction. Concrete is a material that can be 100 % recycled. And, the waste materials such as fly ash, ceramic and eggshell wastes could be easily utilized in concrete. With these superiorities, the chance of preventing the pollution of the environment arises. Since the concrete roads require less repair and maintenance, it results in faster traffic flow and consequently less exhaust fumes emission to nature. Thus, the environment would be less polluted [4].

Conclusion

In the construction of a road, the most profitable and efficient road type should be chosen in line with the needs of countries by choosing the best option suitable for the purpose. Taken into consideration of rigidity, environment, economic, sustainability and safe and rigidity, concrete roads come into view as a good solution. It seems that the majority of countries are convinced with superiorities of concrete roads over asphalt roads, so most of the new projects are being planned as concrete roads. However, today's studies performed on concrete roads should be much more supported and it is important to demonstrate the beneficial of concrete roads to the public.

Author contributions:

Muhammed Tanyıldızı: Conceptualization, Methodology, Validation, Visualization, Writing-Original draft preparation. **Erden Ozan Karaca:** Data curation, Writing-Original draft preparation, Validation.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Kozak, M. (2011). Concrete roads and investigations of construction of concrete roads. *Electronic Journal of Construction Technologies*, 7(1), (89-99).
- [2] Arslan, M., Durmuş, G., Subası, S., Can, Ö., Yıldız, K., (2010). The Application of Vacuum-Processed Coatings Concrete Road: In A Study. *Tübav Bilim Dergisi*, 3(3), (215-223).
- [3] Bakis, A., Hattatoglu, F. (2016). Cost comparison of asphalt pavement and industrial waste steel fibrous reactive powder concrete pavement. *Dicle University Journal of Engineering*, 7, (421-432).
- [4] Agar, E., Sütas, I., Oztas, G. (1996). Comparison of Asphalt Paving and Concrete Road, Turkish Ready Mixed Concrete Association, Concrete Roads Special Attachment.
- [5] Iyınam, Ş, & Agar, E. (2004). Ready-Mix Concretes on Highways. Turkish Ready Mixed Concrete Association, Concrete 2004 Congress Proceedings
- [6] Bienvenu, M., Jiao, X. (2013). Comparison of fuel consumption on rigid versus flexible pavements along I-95 in Florida, Florida International University.
- [7] ECPA, 2009. Concrete Roads: A Smart and Sustainable Choice, European Concrete Paving Association.
- [8] Macit, S. (2009). An Investigation on The Use of Self Compacting Concrete in Concrete Road Construction. Doctoral Thesis, Karadeniz Technical University, Trabzon, Turkey.
- [9] TRMCA, 2002. One more option (in Turkish), Turkish Ready Mixed Concrete Association.



Regeneration application in Bitlis city multi-storey housing construction

Veda Seven Biçen*¹ 

¹Bitlis Eren University, Engineering and Architecture Faculty, Architecture Department, Bitlis, Turkey, vsbicen@beu.edu.tr

Cite this study: Biçen, V. S. (2021). Regeneration application in Bitlis city multi-storey housing construction. 1st Advanced Engineering Days, 51-53

Keywords

Bitlis City
Regeneration
Urban Renewal
Multi-story housing

ABSTRACT

Regeneration (Urban renewal) is one of the policies carried out in order to meet the housing needs in the cities, to rehabilitate the collapse areas or to improve the building areas at risk of disaster. The urban building stock can be increased by regenerating existing urban lands. With the regeneration, the socio-economic and physical aspects of the region differ with disadvantages such as the emergence of land rent, and it can be a method for housing needs. Urban renewal-regeneration has revealed effective and intensive construction in the city of Bitlis. With the application made after 2015, the building stock of the city has increased. In this study, the project-specific features of the multi-storey housing construction were determined by evaluating the urban renewal example implemented after 2015. The area where the disaster houses were built as a single storey with the masonry building technique was unearthed.

Introduction

“Regeneration”, which is defined as “creation of a new texture in destroyed, degraded and collapsed areas [1]” within the urban renewal strategies, is expressed as the meaning of urban renewal.

Perouse mentions at least four different positions of urban renewal in practice. According to this classification; a) Urban renewal in historical districts based on Law 5366 on the Renewal, Protection and Use of Worn Historical and Cultural Immovable Assets., b) Urban renewal for the rehabilitation of structures at risk of disaster, c) Urban renewal based on “demands to end the illegality of the urban fabric” for illegal housing areas, d) Urban renewal to create more profitable areas such as the deindustrialization - service sector [2]. The targets planned to be achieved in accordance with the objectives of the urban renewal are the economic targets based on physical/environmental improvement, aimed at creating employment, commercial areas, social targets for solving social problems, and cultural targets for preserving the historical/natural texture [3]. Urban renewal projects are implemented in order to meet the building needs by reorganizing the urban parcels in areas with disaster risk, due to the improvement of the statically insufficient housing texture and/or the insufficient building stock. Regeneration policies are implemented to improve environmental and housing conditions and to attract the population to certain areas [1]. With the Law of 5393 on Municipalities and Law of 6306 on Conversion of Areas with Disaster Risk, municipalities have also become more effective and authorized [4]. Urban renewal projects implemented to clean the designated area and then rebuild it have an important share in meeting the housing need in the city of Bitlis. Bitlis city center, which has historical and natural sites, is in a disadvantageous position for the housing requirement of the increasing population. In addition, topographic and climatic factors of the city; the areas within the advantageous areas of the city, which develops within the framework of the rough terrain and harsh rainy seasonal conditions, consist of single-storey and masonry structures. In order to reduce regional imbalances in the urbanization process, regional development policies should be implemented [5]. In the urbanization process of Bitlis, the area where the disaster houses are located among the new development areas is less comfortable in the general texture. For this reason, urban renewal can provide a relative balance between residential units. Along with this situation, with the multi-storey housing structuring becoming the dominant building culture throughout the country, the apartment-type multi-block and multi-storey housing structuring in

the city of Bitlis also gained speed. In urban renewal areas, housing development in the city continues as multi-storey housing construction with factors such as development in construction technologies, economy, and ease of production. In this study, the housing construction in the determined region was evaluated on the scale of settlement and building.

Material and Method

On-site observation and literature review were made. By using online maps and the parcel inquiry application of the general directorate of land registry and cadastre, the parcel information on which urban renewal applications are located was accessed. The plot information was examined by photographing the determined area. Hüsrevpaşa District, where urban renewal applications and mass housing applications are intense, has been determined as the study area. The region where single-storey houses built as disaster houses with masonry construction technique in the early 1980s are located is an urban renewal area. The houses in this region were demolished and the multi-storey houses built with the urban renewal were evaluated. It has been tried to reveal the characteristic situation at the settlement and the building scale.

Results and Discussion

In the district of Hüsrevpaşa, whose urban renewal continues (Figure, 1), the use of the block/plot at the settlement scale, the limiting elements of the settlement unit, the situation of being open/closed to the outside and the physical facilities are evaluated. The area numbered 675 block, 200 plot, selected as a sample in Hüsrevpaşa neighborhood, was shaped by combining six parcels (Table 1). Demolition of the single-storey residences on the island 675 started in 2015 (Table 1).



Figure 1. District of Hüsrevpaşa regeneration area [6]

Table 1. Number of block and plots [7]

Block	Plot	Application	Control Approval	Destruction
675	174	12.10.2015	03.11.2015	10.11.2015
675	170	12.10.2015	03.11.2015	10.11.2015
675	173	12.10.2015	03.11.2015	10.11.2015
675	172	12.10.2015	03.11.2015	10.11.2015
675	179	13.10.2015	04.11.2015	10.11.2015
675	178	13.10.2015	03.11.2015	10.11.2015
675	177	13.10.2015	03.11.2015	10.11.2015
675	175	13.10.2015	03.11.2015	10.11.2015

When the characteristics at the settlement scale are evaluated, it is seen that the physical environment of the region has changed as well as the socio-cultural aspect of the region (Table 2). Settlement units, which were built as adjacent or separate before urban renewal, are on the middle or side plots on the island. It is separated from the road by the garden located at the front and/or rear entrances. The garden wall limits the owned area. However, it can be said that the adjacent arrangement of the houses or the lack of distance between the houses and the fact that the borders are below eye level are effective in the communication of the residents. In this case, it is possible to talk about the existence of street and neighborhood culture. With the merging of the parcels after the urban renewal, the housing units were built in the middle and side parcels in a separate order. The housing units are limited by the boundary wall and are closed to the outside. Six of the multi-storey residential units built on the

parcel border of the units are used as commercial areas. In the urban renewal application, the area between the parcels is planned as green area, but there is only parking facility within the borders of the units. When the characteristics at the building scale were evaluated, it was observed that the masonry housing units were built with the reinforced concrete construction technique after the renewal (Figure 2). Multi-storey residential structures built as two or three-block units are 5 floors and above. Each floor is generally planned as 3-4 flats. The old masonry plans, which are in the range of about 60-90 m², are between 120-170 m² in multi-storey houses. The residences are generally planned to have at least 4 rooms. The single-storey houses, which were shaped according to the building materials of the period, leave their place to multiple blocks in which different building materials are used.

Table 2. Characteristics before and after regeneration (urban renewal)

	Before regeneration/urban renewal	After regeneration/urban renewal
Block/plot use case	At the edge/middle-Contiguous/split	At the edge/middle-split
Limiting Elements	Garden wall	Boundary wall
State of being open/closed outside	Closed	Closed
Physical facilities	Garden	Car park
Zoning status	Residential	Residential + Commercial



Figure 2. Example of housing before and after regeneration [8]

Conclusion

Regeneration is one of the policies carried out to meet the need for housing in cities, to rehabilitate the depressed areas or to improve the building areas that are at risk of disaster. Urban building stock can be increased by the reproduction of existing urban lands. Regeneration with disadvantages such as the emergence of land rent, the socio-economic and physical aspect of the region also differentiates and can be a method for housing needs. Urban renewal-reproduction has revealed effective and intensive construction in the city of Bitlis. After 2015, the building stock of the city increased with the implementation. Projects that have a socio-economic effect on the change of the city should also be evaluated from a physical point of view. In practices that change the street-neighborhood culture, the fact that the buildings are closed to the outside and their physical facilities are limited contradicts the purpose of urban renewal. The work should be carried out by considering the environmental objectives of urban renewal, such as improving the comfort conditions in the infrastructure and residences and bringing the active green areas into compliance with the standards.

References

- [1] Özden, P. P., (2008), Kentsel Yenileme, İmge Kitabevi
- [2] Perouse, J. F., (2006). Kentsel Dönüşüm halleri hakkında birkaç saptama. Aman, İstanbul Miami olmasın! (Quelques remarques à propos de la Régénération Urbaine dans tous ses états. Par pitié, qu'Istanbul ne devienne pas Miami!), İstanbul Dergisi, 57, 28-32.
- [3] Göz A.C., (2008). Kentsel dönüşümün esasları ve İskoçya Whitfield örneği. Yerel Siyaset, 31(10), 8-12.
- [4] Yaman, M. (2014). Türkiye’de Kentsel Dönüşüm Uygulamaları Kapsamında Kütahya Kenti Osmangazi Kentsel Dönüşüm Uygulamasına Bir Bakış . Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, Kütahya özel sayısı, 13-20.
- [5] Keleş, R. (2006). Kentleşme Politikası (Vol. 10). İmge Kitabevi.
- [6] Tapu Kadastro Parsel Sorgulama, (2021)
- [7] Directorate of Environment and Urbanization Archives, 2021.
- [8] Biçen, V. S., (2021), Photo Archive.



Investigation of the existing situation of the Surp Ağpırig (Déra Spî) Monastery

Enes Arkan*¹, Fatih Avcil²

¹Bitlis Eren University, Engineering-Architecture Faculty, Civil Engineering Department, Bitlis, Turkey, earkan@beu.edu.tr; favcil@beu.edu.tr

Cite this study: Arkan, E., & Avcil, F. (2021). Investigation of the existing situation of the Surp Ağpırig (Déra Spî) Monastery. 1st Advanced Engineering Days, 54-56

Keywords

Monastery
Historical buildings
Strengthening

ABSTRACT

Preserving historical buildings and transferring them to future generations is both a human duty and a social need. In order to contribute to this goal, the Surp Ağpırig Monastery, located in the Mutki district of Bitlis, will be discussed in the study. First of all, the current situation of the monastery and then the strengthening works to be done in order to bring the monastery to tourism will be mentioned.

Introduction

Historical buildings have been built to meet the needs of people since human beings. In such structures, generally regional materials were used, they were built with the workmanship of the people of the region, and some of them have survived to the present. Many studies have been investigated on these historical buildings, which have high cultural value [1-3].

The province of Bitlis has a very important place because it contains many historical and cultural heritages. With this study, it is aimed to evaluate the state of the structural system of the Surp Ağpırig Monastery, which has an important place for the cultural heritage of Bitlis and is known to belong to the Armenians, and to include suggestions for improvement. It is stated that the monastery, which has been used with different names in various sources since the 12th century, was built and used in the 10th century. There are some studies examining the historical process of the monastery [4-5]. Although it has an important place in the history of Bitlis, no study has been found by civil engineers about this monastery, which reflects the current state of the building and includes suggestions for strengthening the structural system. By filling the gap in this area with the evaluations to be made, the first step will be taken to bring the monastery to tourism.

Material and Method

First of all, the current situation of the monastery was reported. In the report, the damage of the structural system, the excavations made in the monastery and the interventions that ruined the original state of the monastery were mentioned.

In order to determine the current state of the monastery, it was examined in detail and the entire monastery and its surroundings, especially the structural performance, were documented with photographs. The current state of the historical structure is shown in Figure 1. The situation of the monastery and the wrong interventions in the monastery are presented in the results section. As a result of the observations, the current status of the building was interpreted and the steps that could be made to the historical monastery were specified.



Figure 1. General view of the monastery (photo by author)

Results

The monastery, which developed with the additions made at different times, was used as the episcopacy center of the region until the end of the 19th century. A large part of the monastery, which consists of two churches, two jamatuns, a bell tower and a large number of monks' rooms, is in ruins today. The plan we prepared for the Monastery after the survey work is shown in Figure 2.



Figure 2. The plan of the Surp Ağpırig (Déra Spî) Monastery (drawn by author)

As a result of the investigation, it was observed that the monastery was in a very bad condition. The neglect of the monastery and leaving it alone caused the people of the region unconsciously to intervene in the monastery. Also, treasure hunters excavated in many parts of the monastery, resulting in large pits in the ground. These negativities and damages will be mentioned in the relevant sections of the study.

Deep pits were dug by treasure hunters in many parts of the monastery floor and this caused emptying on the ground. As can be seen in Figure 3, the interior walls, rooms and arches of the monastery were partially or completely destroyed. Due to these mortars and stones accumulated in the building, the ground floor level has risen and the entrances to some rooms have been closed. This has caused the historical structure to move away from its originality.



Figure 3. Pits in the ground and damaged walls (photo by author)

The mortars on the dome and arches have eroded and largely disappeared. Therefore, some domes and arches were partially or completely destroyed. It was observed that columns in the historical building were heavily damaged and some parts were destroyed. Images of collapsed domes, arches and columns are given in Figure 4. It also poses a great danger to those who enter such a damaged monastery.



Figure 4. Damaged domes, arches and columns (photo by author)

Conclusion

The objectives to be achieved as a result of the observations and investigations can be listed as follows:

- 1) This structure, which is a work of art and a historical document, needs to be conserved in order to prevent further damage.
- 2) Strengthening works should be carried out to restore the monastery's lost strength and resistance to harsh weather conditions, the area should be re-examined with an interdisciplinary team and a work program should be prepared.
- 3) For a complete evaluation of the historical building, first of all, the material properties should be known. For this purpose, after getting permission, without damaging the structure, material specimen should be taken and experimental test should be carried out to determine its physical and mechanical properties in the laboratory.
- 4) The damaged parts of the building should be rebuilt and restored by choosing materials suitable for the historical structure instead of segregated materials.
- 5) The behavior of the structure under self-weight and earthquake effects should be determined by modeling the structure with the finite element method.

Funding:

This research received no external funding.

Author contributions:

Enes Arkan: Data collection, Drawing, Visualization, Literature review and Editing. **Fatih Avcil:** Study concept and design, Manuscript preparation and Visualization.

Conflicts of interest:

The authors declare no conflicts of interest.

REFERENCES

- [1] Jorquera, N., Misseri, G., Palazzi, N., Rovero, L., & Tonietti, U. (2017). Structural characterization and seismic performance of San Francisco church, the most ancient monument in Santiago, Chile. *International Journal of Architectural Heritage*, 11(8), 1061-1085.
- [2] Illampas, R., Ioannou, I., & Lourenço, P. B. (2020). Seismic appraisal of heritage ruins: The case study of the St. Mary of Carmel church in Cyprus. *Engineering Structures*, 224, 111209.
- [3] Izol, R., Avcil, F. & Gurel, M.A. (2021). Tarihi Germuş Kilisesinin (Şanlıurfa) Mevcut Durumu ve Güçlendirme Önerileri. 7th International Congress on Engineering, Architecture and Design, 81-88, Istanbul, Turkey.
- [4] Thierry, J.M., (1992), "Sasun, Voyages Archeologiques", *Revue des Études Arméniennes*, 23, 315-391
- [5] Ulucam, A., (2002), "Ortaçağ ve Sonrasında Van Gölü Çevresi Mimarlığı-II-Bitlis", *Kültür Bakanlığı Yayınları*, Ankara. p. 288-292



The investigation of on-site generation of disinfectant by electrochemical methods

Alper Erdem Yılmaz¹, Yeşim Dede Sağsöz², Beyhan Kocadağistan³

¹Ataturk University, Engineering Faculty, Environmental Engineering Department, Erzurum, Turkey
aerdem@atauni.edu.tr; yesim.dede25@gmail.com.tr; beyhank@atauni.edu.tr

Cite this study: Yılmaz, A. E., & Dede Sağsöz, Y., Kocadağistan, B. (2021). The Investigation of On-Site Generation of Disinfectant by Electrochemical Methods. 1st Advanced Engineering Days, 57-59

Keywords

Electrooxidation
Disinfectant
On-site Generation
Chlorine

ABSTRACT

In the on-site disinfectant generation, chlorine is produced when a sodium chloride solution is passed through an electrolytic cell and electricity is added. It is safer than conventional chlorination systems, provides higher quality disinfection, and energy savings, therefore, the on-site disinfectant generation process has been started to be preferred in treatment plants. In the study, a continuous flow electrochemical reactor and as the anode material IrO₂/RuO₂ coated titanium, and as cathode material, pure titanium sieve plates have been used. For electrical energy supply, a direct current power has been used. In the study, the initial pH value was 7 and the current intensity has been chosen as 20 A. The variable parameters have been examined in the study and the examined ranges of these parameters are as follows; flow rate 40,50,100 ml/min, and salt solution concentration (1, 2, 3, 4, and 5M). It has been observed that the pH value of the investigated solution has not been having significant effects on the disinfectant concentration. The increase in the flow rate has been affected the disinfectant production as negative. It has been concluded that high concentrations of disinfectant can be produced electrochemically under optimum conditions.

Introduction

One of the most important requirements of the water purification process is water disinfection processes [1]. The main goal of the disinfection process is to remove pathogenic microorganisms that can be transported with water, encountered in drinking water systems and at the outlet of treated water [2]. Chlorine and its compounds, which are chemical disinfectants, are the most widely used disinfectants among water and wastewater disinfection applications [3-5]. This is due to the high disinfectant efficiency of chlorine, and the easy availability of chlorine is that it can be applied with simple techniques and at a low cost. However, considering the transportation and storage hazards of chlorine and its compounds, it would be most appropriate to produce disinfectants on-site to minimize transportation and storage from a safety perspective. On-site disinfectant production will minimize the hazards mentioned and increase human and environmental safety [6-7].

The study covers the generation of disinfectant on-site by electrooxidation using a concentrated brine concentration and the development of this process. In this context, the disinfection process, which has become one of the most important processes in water and wastewater treatment, both for the decrease of water-borne diseases and for ensuring the high efficiency required in treatment; an on-site disinfectant generation with electrooxidation will be brought to the fore by improving its use with more reliable, easier operating parameters and more efficient use. This process, which works under optimum conditions, is also aimed to reduce operating and storage costs in water and wastewater treatment, and to bring a more reliable and sustainable process into use.

Material and Method

In the study, a continuous flow electrochemical reactor with dimensions of 20*10*10 cm made of plexiglass material has been used. IrO₂/RuO₂ coated titanium with the size of 18*8 cm has been used as the anode material, and the same size pure titanium sieve plates have been used as the cathode material. 6 anode and 6 cathode electrodes have been used. 5 mm has been left between the electrodes. For electrical energy supply, a direct current power supply with 40 V 120 A power has been used. The study has been carried out at a current intensity of 20 A and initial pH 7. The variable parameters have been examined in the study and the examined ranges of these parameters are as follows; flow rate 40,50,100 ml/min, and salt solution concentration (1, 2, 3, 4, and 5M). A portable ion-selective device has been used to determine the active and total chlorine amounts.

Effect of Flow Rate and Salt Concentration on Disinfectant Generation

The effects of salt concentration and flow rate on disinfectant production have been investigated using 1, 2, 3, 4, and 5 M NaCl with variable parameters of 1, 2, 3, 4, and 5 M NaCl at the initial value at flow rates of 40, 50 and 100 ml/min. The reaction times were determined as 30 min for 40 ml/min, 24 min for 50 ml/min, and 12 min for 100 ml/min, considering the complete cycle of the reactor. These experiments have been carried out at pH 7 and a constant current of 20 A. The solution concentration has been adjusted by adding the molar equivalent of NaCl to distilled water by mass. The salt concentration required for each trial has been prepared and used just before the trials. The pH, temperature, and energy consumption values obtained in each trial are given in the “Table 1.”

Table 1. Output pH values at the end of the reaction times for different salt concentrations

Salt Concentrations	1 M	2 M	3 M	4 M	5 M
40 ml/min	11,12	11,3	11,06	11,33	8,35
50 ml/min	11,06	11,25	11,39	11,05	11,15
100 ml/min	11,68	10,78	9,53	11,28	10,75

The outlet pH has shown a similar trend for all salt concentrations studied. The output pH value indicates that the hypochlorite ion (OCl⁻) is higher than the hypochlorous acid. The disinfectant effectiveness of hypochlorous acid is much higher than that of hypochlorite. It has been observed that the pH value of the effluent water has not changed much depending on the salt concentration.

Figure 1 includes a graphical representation of the disinfectant production results obtained experimentally.

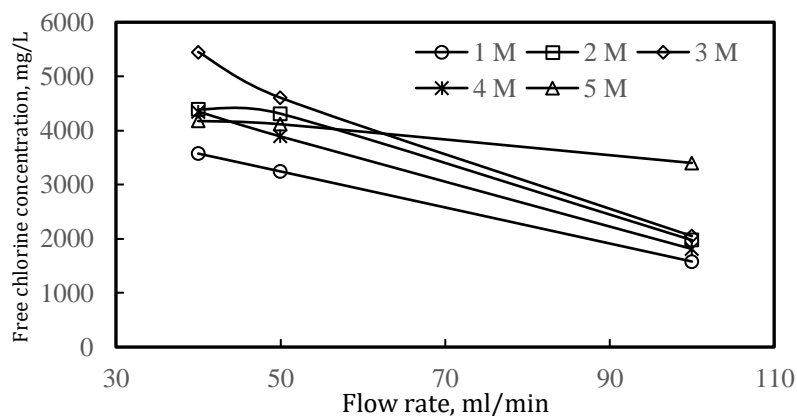


Figure 1. Effect of salt concentration and flow rate on disinfectant concentration at 20 A, pH 7

When Figure 1 is examined, increasing salt concentration from 1 M to 3 M caused an increase in disinfectant concentration to show the same trend for each flow rate. Increasing the 3 M salt concentration up to the 5 M salt concentration relatively reduced the free chlorine formation. In the experiments carried out with the more saturated 5 M solution, it is seen that the effect of the flow rate decreases as much as possible, and free chlorine concentrations close to each other are reached for almost all three flow rates. This is a positive effect as relatively high free chlorine production is achieved at high flow rates. The energy consumption values calculated based on the potential difference values that emerged in the trials in which the effects of salt concentration on free chlorine production were examined are given in Table 2.

As can be seen from Table 3, the change in salt concentration did not cause any change in energy consumption. Since even the lowest added salt concentration creates high electrical conductivity values, the potential difference values in the system showed a similar trend.

Table 2. Energy consumption values at the end of the reaction times for different salt concentrations

Salt Concentrations	1 M	2 M	3 M	4 M	5 M
40 ml/min	33,25 W	32,92 W	32,75 W	32,33 W	31,87 W
50 ml/min	27,33 W	26,93 W	26,73 W	26,65 W	26,59 W
100 ml/min	13,67 W	13,59 W	13,55 W	13,53 W	13,51 W

Discussion

The flow rate of the feed solution is considered as a parameter that needs to be examined as it determines the residence time in the reactor. The flow rate parameter has been selected as 40, 50, and 100 ml/min. The increasing flow rate has decreased the residence time in the reactor. As a result of this situation, significant decreases have been observed in the amount of disinfectant depending on the increased flow rate. Energy consumption values also have differed depending on the change in flow rate. The increase in flow rate led to a decrease in energy consumption values. Since both the highest disinfectant amount and low energy consumption values should be considered, a flow rate of 40 ml/min was determined as the optimum flow. One of the most important operating costs of disinfectant generation by on-site electrochemical methods is salt concentration. To keep this value in the lowest range, the salt concentration was chosen as 1, 2, 3, 4, and 5 M. The increase in salt concentration has caused an increase in the amount of disinfectant produced at the same flow rate up to 3 M. There was no increase in the amount of disinfectant at higher salt concentrations.

Conclusion

The study has been shown that a product containing approximately 5500 mg/L disinfectants can be obtained when the initial pH value is 7, the flow rate is 40 ml/min, the current intensity is 20 A, and the salt concentration is 3 M. This value has been chosen as the optimum operating condition for these operating parameters.

References

- [1] Unver, A., Aksu, F. (2011). Disinfection, and Sanitation in Industry, *ABMYO Journal of Water Safety*. 21, 17-29.
- [2] Yılmaz, Ö. (2017). Plague, Cholera, and Epidemics: Public Health and Health Institutions in Trabzon (1804-1895). *Blue Atlas*, 5(1) /2017: 172-200.
- [3] Kerwick, M.I., Reddy, S.M., Chamberlain, A.H.L., Holt, D.M. (2005). Electrochemical disinfection, an environmentally acceptable method of drinking water disinfection. *Electrochemical Acta* 50, 5270–5277.
- [4] Ozel Celik, E., Ozel Akdemir, U., Celik, H. (2017). Liquid, Gas Chlorine and On-site Generation in Drinking Water Facilities Design Consideration and Comparison of Operating Costs, *Journal of Çukurova University Faculty of Engineering and Architecture*, 32(3), p. 81-89.
- [5] Jeong, J., Kim, J.Y., Cho, M. Choi, W., Yoon, J., (2007). Inactivation of Escherichia Coli in The Electrochemical Disinfection Process Using A Pt Anode. *Chemosphere* 67, 652–659.
- [6] Hobro, S., Mourad, A. K. (2019). Developing Chlorine -Based Antiseptic by Electrolysis. *Science of the Total Environment*. S0048-9697(19)36104-2.
- [7] Isa, M. H., Kutty, S. R. M., Yusoff, H. A. M., Bashir, M. J.K., Farooqi, I. H., (2009). Electrochemical Production of Free Available Chlorine. *International Conference on Emerging Technologies in Environmental Science and Engineering* October 26-28 (2009). Aligarh Muslim University, Aligarh, India.



Adsorption of Astrazon red GTLN (AR) with volcanic tuff Bayburt Stone

Beyhan Kocadağistan *¹, Erdem Kocadağistan ¹

¹Atatürk University, Faculty of Engineering, Department of Environmental Engineering, Erzurum, Turkey, beyhank@atauni.edu.tr; kocadagistan@atauni.edu.tr

Cite this study: Kocadağistan, B., & Kocadağistan, E. (2021). Adsorption of Astrazon red GTLN (AR) with Volcanic Tuff Bayburt Stone. 1st Advanced Engineering Days, 60-62

Keywords

Adsorption
Volcanic tuff
Removal efficiency

ABSTRACT

Adsorption is a very effective, widespread, easy and inexpensive method used for textile dye removal from wastewater. Bayburt stone powders were used as adsorbent and Astrazon red GTLN textile dye was used as adsorbate. According to the results of the study, the optimum pH value was 10, the initial dye concentration was 10 mg/L, the mixing speed was 200 rpm and the adsorbent amount was 10 g/L. Langmuir, Freundlich and Temkin isotherms were used to evaluate the adsorption dynamics. Langmuir isotherm was best fit and Astrazon Red removal efficiency was found to be 85% by using Bayburt stone under optimum conditions.

Introduction

Along with industrialization, the textile industry is developing rapidly. Finishing processes such as dyeing, printing, washing and drying are commonly used in textile fabrics. Since textile dyes pollute the receiving water environment, they must be treated before being discharged [1]. For this purpose, various methods such as coagulation, flocculation, electrochemical processes, chemical oxidation, reverse osmosis, electrochemical filtration, aerobic and anaerobic treatment are used for dye removal. More economical and more suitable operating conditions are preferred in terms of the applicability and efficiency of the treatment methods used in dyestuff removal [2]. Akbal [3] investigated the adsorption of methylene blue dyestuff in aqueous solutions with pumice powder and revealed that adsorption increased as the amount of adsorbent and time increased, and the adsorption rate of basic dye decreased with increasing concentration. Adsorption studies are carried out by changing conditions such as different organic and inorganic materials and different pH, temperature, concentration, adsorbent amounts, and optimum conditions for adsorption are determined. Adsorption continues until a balance is established between the concentration of the substance deposited on the surface of the adsorbent and the concentration of the substance remaining in the solution. At this equilibrium moment, the relationship between the amount of substance adsorbed at constant temperature and the equilibrium pressure or concentration is called "adsorption isotherm" and gives information about the characterization of the experiment. Sawasdee et al. [4] used rice husk as an adsorbent material for dye removal from aqueous solution and observed that the adsorption process reached equilibrium at pH 7.87 and within 90 minutes.

Material and Method

The yellow Bayburt stone, which was used as an adsorbent in the study, was first cleaned by washing several times with the help of distilled water and left to dry in an oven at 105 °C for 24 hours and then ground into powder. In order to investigate the zeta potential values, potential measurements were made at different pH values between 2 and 12 and the maximum value was obtained at pH 10 as -29.8 mV. The chemical formula of Astrazon Red, the textile dye used in the study, is C₁₉H₂₅ClN₅O₂. Different inlet concentration, temperature and contact time values were tried to determine the optimum conditions. SEM photographs of Bayburt stone before and after adsorption are shown in Figure 1 and Figure 2. 1 N hydrochloric acid (HCl) and 1 N sodium hydroxide (NaOH) solution were used to bring the pH value to the desired values.

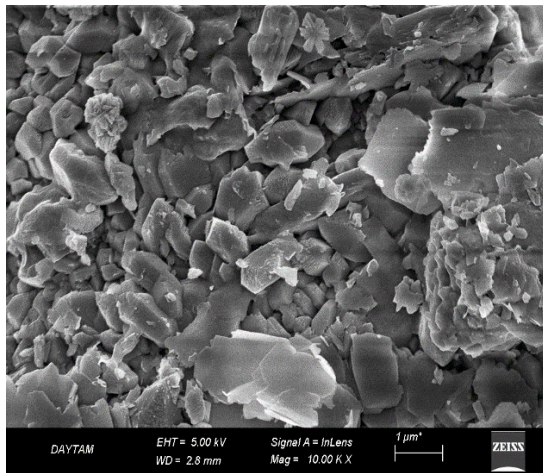


Figure 1. Before adsorption

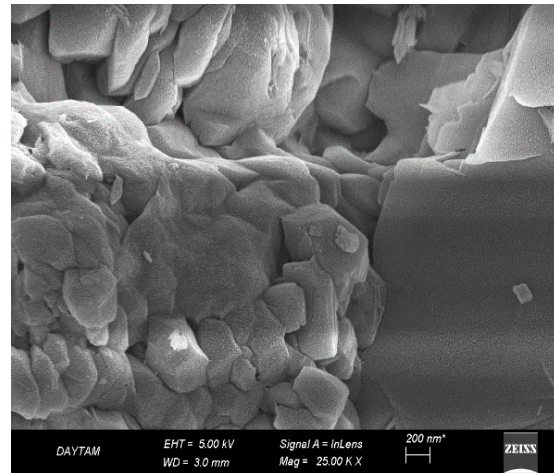


Figure 2. After adsorption

The equilibrium amount (q_e) of adsorbed substances and removal efficiency was calculated with the following equations:

$$q_e = \frac{C_o - C_e}{m} \cdot V \quad (1)$$

$$\%R = \frac{C_o - C_e}{C_e} \cdot 100 \quad (2)$$

where C_o and C_e are the liquid-phase concentrations of dye (mg/L) at initial and equilibrium state, respectively, V is the volume of the solution (L) and m is the mass of dry sorbent(g) [5].

Results

The study was carried out at 25°C, 30°C, 35°C conditions. According to the results of the adsorption study, it was determined that the highest dye removal efficiency was at 35°C (Figure 3). The following experiments were carried out under different temperature and inlet concentration conditions and the dye removal efficiencies were investigated. It was observed that the adsorption efficiency decreased as the inlet concentration increased (Figure 4). In order to determine the adsorption efficiency and concentration change in the adsorption process, experiments were carried out up to 90 minutes and the first 30 minutes were found to be the effective time.

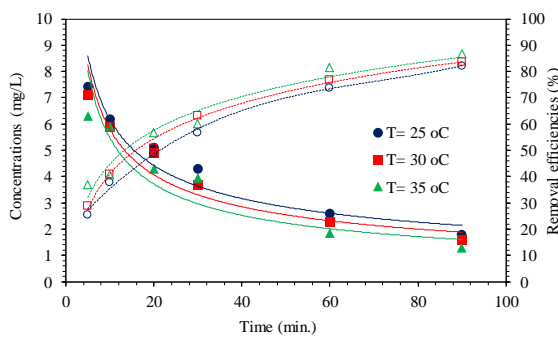


Figure 3. Concentrations with time for different temperatures

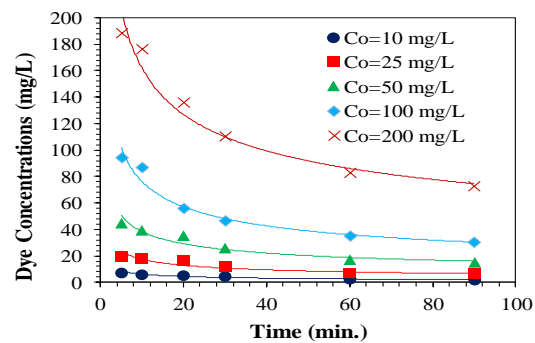


Figure 4. Concentrations with time for different initial dye concentrations

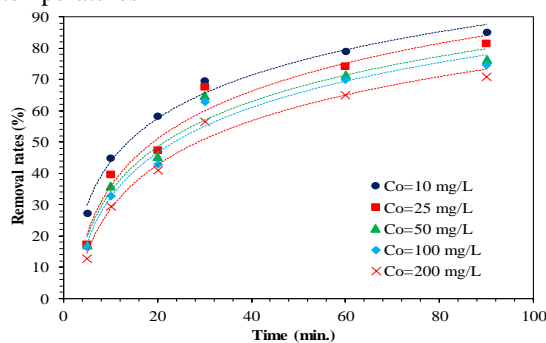


Figure 5. Removal rates for different initial dye concentrations

When the dye removal efficiency values were examined against different initial concentrations, as can be seen in Figure 5, the adsorption efficiency decreased as the concentration value increased.

Discussion

The results obtained in this study revealed that Bayburt stone, which is very cheap and easy to find, is an effective adsorbent material.

Conclusion

In order to determine the optimum dye concentration, experiments were carried out with concentrations of 10 mg/L, 25 mg/L, 50 mg/L, 100 mg/L and 200 mg/L. As the initial dye concentration increased, the removal efficiency decreased and the optimum value was determined as 25 mg/L. In addition, 1 g/L, 2 g/L, 5 g/L and 10 g/L adsorbent amounts were used to determine the most suitable adsorbent amount, and it was determined that 10 g/L adsorbent substance amount was the most appropriate. In the study; 85% adsorption efficiency was obtained by taking the temperature 35°C, inlet dye concentration 10 mg/L, stirring speed 200 rpm and adsorbent concentration 10 g/L. As a result, the results of the study showed that Bayburt stone is an economical, effective and suitable adsorbent that can be used in the adsorption method.

Author contributions:

Erdem Kocadağistan: Writing-Original drafting, Software, Validation. **Beyhan Kocadağistan:** Visualization, Analysis, Writing-Review and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Gazigil, L., 2014. Investigation of dyestuff removal by sunflower kernel shell from low cost industrial wastes. Master's Thesis, Institute of Science and Technology, Atatürk University, Erzurum
- [2] Yagub, M. T. Sen, T. K. Afroze, S. and Ang, H. M., 2014. Dye and its removal from aqueous solution by adsorption: A review. *Advances in Colloid and Interface Science*, 209, 172-184.
- [3] Akbal, F., 2005. Adsorption of basic dyes from aqueous solution onto pumice powder. *Journal of Colloid and Interface Science*, 286(2), 455-458.
- [4] Sawasdee, S. Jankerd, H. and Watcharabundit, P., 2017. Adsorption of dyestuff in households dyeing onto rice husk. *Energy Procedia*, 138, 1159-1164.
- [5] Nsami, J. N., Mbadcam, J. K., (2013) Adsorption efficiency of chemically prepared activated carbon from cola nut shells by ZnCl₂ on methylene blue. *Journal of Chemistry*, 469170, 7.



Construction stages of gold mining waste storage facility, Gümüşhane Mastra Koza Mining

Volkan Emre Demir^{*1}, Beyhan Kocadagistan²

¹Koza Gold Corporation, Gümüşhane, Turkey, v.e.dmr@hotmail.com

²Atatürk University, Faculty of Engineering, Department of Environmental Engineering, Erzurum, Turkey, beyhank@atauni.edu.tr

Cite this study: Kocadagistan,B., & Demir, V.E. (2021). Construction stages of gold mining waste storage facility, Gümüşhane Koza Mastra Mining. 1st Advanced Engineering Days, 63-65

Keywords

Waste storage facility
Gold mining
Coating materials
ADT

ABSTRACT

Gümüşhane Koza Mastra Gold Factory waste storage facility (ADT) has been examined as an example of its construction in accordance with environmental conditions and standards. The site selection, planning, construction and inspection of waste storage facilities are carried out in accordance with legal regulations in a way that will cause the least damage to the ecological structure and living life. During the construction of Mastra ADT, slope and threshold excavations, fillings, slope surface preparation, drainage systems, soil clay fillings, laying of all coating systems, observation wells, support channel excavations and filling operations were carried out. After the completion of these studies, it is aimed to use the landfills safely and finally to bring them back to nature. In this study, the control and measurements of the construction stages of the waste storage facilities were made.

Introduction

With the rapid population growth, technological developments and industrialization, underground natural resources were needed and the extraction, processing and use of these resources is a sector that has become important for humanity [1]. This sector is gathered under the name of mining. Mining refers to the collection of techniques and operations related to the exploration, extraction and operation of reserves of all kinds of minerals, mineral ores, industrial raw materials, coal and oil, precious or semi-precious metals. Extracted mines are used in many areas of industry as a raw material, especially as fuel, according to their intended use [2]. The most extracted metals in our country are gold, silver, copper, zinc, iron, boron and lead. Especially gold is a valuable element and is accepted as the first metal benefited by humanity [3]. In this study, the construction of a waste storage facility, which will ensure that the process wastes generated during the constantly developing gold mining activities are stored in accordance with the legal regulations without causing negative effects on the environment (human, nature, vegetation, all kinds of living things, soil, water resources, groundwater) has been examined.

Material and Method

Having a total waste storage capacity of 550,000 m³, ADT has an area of 4.5 hectares [4]. The open pit converted into a waste storage facility was examined in the design, and studies were carried out in accordance with the criteria specified in the regulation for the design of ADT by examining the literature data [5]. During the construction of ADT, slope storage area and fence excavations, bonded fillings and preparation of the slope surface, drainage systems, foundation clay filling, laying of coating systems, channel arrangement are carried out. A storage area prior to the ADT excavation is given in Figure 1. After the excavation material is taken from the bottom of the storage area and a solid natural ground is found, the filling process is started. The total filling amount in the project

is 400,000 m³. The screen thickness is applied as 60 cm. A sub-drainage system is designed for the water that will accumulate under the impermeability system during periodic rises in underground and surface water levels. In this system, water is collected at the lowest possible level by means of trench and gravel filters created with perforated drainage pipes (Figure 2). A 2 mm thick rough-edged HDPE geomembrane was then used and the top drainage geocomposite system shown in Figure 3 and Figure 4 was laid.

The Anchor trench shown in Figure 5 acts as an anchor for the paved area.



Figure 1. Before the storage area



Figure 2. Images from the drainage system and landfill cover layer.

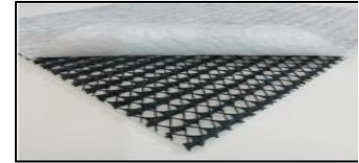


Figure 3. Geocomposite system



Figure 4. Geotextile layer



Figure 5. The anchor trenches



The containment channel was built to protect the ADT from water coming from the mountainside. The excavation of the containment channel was carried out with a slope of 0.5%. The total length of this channel, shown in Figure 6, is approximately 290 m [6]. The coating system (Geosynthetic Clay Cover, Geomembrane, Geocomposite) used on slopes and floors is as shown in Figure 7.



Figure 6. Containment channel

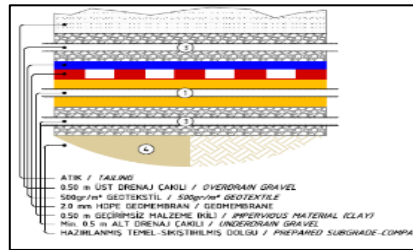
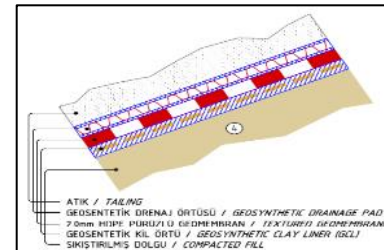


Figure 7. Applied coating materials



Results

In order to ensure floor sealing, the compression value in the technical specification should be 85% in the filling works performed in ADT. Analysis values of 3903.05 grams of filling material are given in Table 1.

Table 1. Sample filling material sieve analysis results

Sieve no (inch)	Openness(mm)	Remain(gr)	Remain (%)	Total Remain(gr)	Total Remain (%)	Total pass (%)
No: 4"	100	155,02	3,97	155,02	3,97	96,03
No: 3"	75,0	444,22	11,38	599,24	15,35	84,65
No: 2.5"	63,5	217,10	5,56	816,34	20,92	79,08
No: 2"	5,0	403,14	10,33	1219,48	31,24	68,76
No: 1 1/2"	38,1	439,76	11,27	1659,24	42,51	57,49
No: 1"	25,40	328,12	8,41	1987,36	50,92	49,08
No:(3/4)"	19,05	209,69	5,37	2197,05	56,29	43,71
No: (3/8)"	9,53	296,14	7,59	2493,19	63,88	36,12
No:4	4,76	226,06	5,79	2719,25	69,67	30,33
No: 10	2,00	256,23	6,56	2975,48	76,23	23,77
No: 40	0,425	293,64	7,52	3269,12	83,76	16,24
No: 140	0,106	477,84	12,24	3746,96	96,00	4,00
No: 200	0,075	42,16	1,08	3789,12	97,08	2,92

The permeability value of the permeable filling material is required to be $1 \cdot 10^{-4}$ m/s and above. Table 2. shows the permeability laboratory results of sample 1 filling material.

Table 2. Permeability laboratory results of sample 1 filling material

	First value	Last value	Water temp. (°C)	time t (s)	DH (cm)	kt (cm/s)	$m_t \cdot 10^{-6}$ Nsm	k_{20} $k_1(m_t/m_{20})$	
								cm/s	m/s
1	29.00	33.00	20	10	248	$1.68 \cdot 10^{-02}$	60.0000	$1.00 \cdot 10^{10}$	$1.00 \cdot 10^{-02}$
2	33.00	37.00	20	10	251	$1.83 \cdot 10^{-02}$	60.0000	$1.09 \cdot 10^{10}$	$1.09 \cdot 10^{-02}$
3	41.00	45.00	20	10	255	$2.15 \cdot 10^{-02}$	60.0000	$1.29 \cdot 10^{10}$	$1.29 \cdot 10^{-02}$
						$1.89 \cdot 10^{-02}$	Average	$1.13 \cdot 10^{10}$	$1.13 \cdot 10^{-02}$

After all the experiments, the geomembrane thickness used in the project was measured as 2 mm, and its suitability for use was examined, and vacuum and air tests were carried out to measure the durability of the coating materials.

Discussion

During the construction and operation of the mine sites, it is implemented by the regulations to take measures in a way that will cause the least damage to the environment.

It has been observed that all required field and laboratory tests have been carried out in order to prevent any leakage or leakage from the area where the process wastewater is stored in the examined Mastra 3rd ADT.

Conclusion

It has been determined that the values found as a result of all controls are in accordance with the standards. The compression ratio of the filling material used in the project is desired to be 85%, and results above this value were obtained in the compression test results. It is stated in the results that the permeability value obtained in the results of the basic clay analysis is $3.5 \cdot 10^{-10}$ m/sec. According to the regulation, the permeability of the clayey material to be used on the base should be 9 to 10 m/s at the most. The values obtained in the coating systems used in ADT, the values obtained in the tensile and shear tests, were tested up to 1129 kN in the 543 kN minimum shear test. The minimum limit values of the European Institute of Geosynthetics should be 530-701 kN. With the restructuring of ADT, it is considered as a great ecological benefit as it will ensure that a virgin land is not used and will eliminate many environmental risk sources such as groundwater pollution, air pollution caused by various climatic factors, pollution of surface water resources and agriculture.

Funding:

This research received no external funding.

Author contributions:

Volkan Emre Demir: Data curation, Writing-Original draft preparation. **Beyhan Kocadağistan:** Visualization, Investigation, Writing-Reviewing and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

REFERENCES

- [1] <https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=13887&MevzuatTur=7&MevzuatTertip=5> (8.12.2021)
- [2] Marsden, J., & House, I. (2006). The chemistry of gold extraction. SME.
- [3] Küçük, S., (2012). Development of International Financial Markets and Forex Markets: The Situation in Turkey, Master Thesis, Çukurova University, Institute of Social Sciences, Adana
- [4] Koza Mastra gold mine operation datas, (2019)
- [5] Karaca, E., (2010). Storage of process wastes of metallic mineral enrichment plants in tailings dams, Specialization Thesis, Ministry of Environment and Forestry.
- [6] Regulation on Regular Storage of Waste (2010). <https://www.mevzuat.gov.tr/mevzuat> Legislation No = 13887 & Legislation Tur = 7 & Legislation Arrangement = 5 (8.12.2021).



Investigation of temporal changes of green field changes using image processing and geographic information systems: The case of Bayburt Province

Mustafa Alptekin Engin*¹, Sinan Kul ²

¹Bayburt University, Engineering Faculty, Department of Electrical and Electronics Engineering, Bayburt, Turkey, maengin@bayburt.edu.tr

²Bayburt University, Faculty of Applied Sciences, Department of Emergency Aid and Disaster Management, Bayburt, Turkey, sinankul@bayburt.edu.tr

Cite this study: Engin, M. A., & Kul, S. (2021). Investigation of temporal changes of green field changes using image processing and geographic information systems: The case of Bayburt Province. 1st Advanced Engineering Days, 66-68

Keywords

Image Processing
Geographic Information Systems
Temporal Change
Flora
Color Tresholding

ABSTRACT

Today, the environment is moving away from its natural structure mainly as a result of human-induced effects and environmental resources continue to be depleted rapidly. These human-induced changes in the environment should be determined and necessary precautions should be taken. Contrary to other time-consuming methods, Geographic Information Systems used for this purpose provide great convenience in determining these changes in the environment. In this study, basic image processing techniques were used to determine the changes in the land cover in Bayburt province and its surroundings. The temporal change in the land structure was determined by using Landsat satellite images obtained every 5 years between 2000 and 2020. The change in the multi-time Landsat satellite images has been interpreted with the help of the prepared software, and in this context, various suggestions for the future have been listed.

Introduction

In addition to the rapid population growth in the last century, agricultural activities, industrial production, etc., in order to meet the needs of the increasing population, is growing and diversifying rapidly. As a result, the environment we live in is moving away from its natural structure as a result of human-induced effects and environmental resources are rapidly depleted [1-2]. In Turkey, where land use changes very rapidly, lands are irreversibly destroyed as a result of the destruction of forests and pastures and the uncontrolled and uncontrolled use of fertile agricultural lands [3-5]. Today, in order to meet the basic food needs of the increasing population, forest areas are opened to agriculture, meadow and pasture areas are under uncontrolled pressure with the increase in the number of animals, and ecological destructions often occur in the lands with the proliferation of residential areas. As a result of this sequence of events, ecological stress increases and the rate of renewal of forests decreases and the yield of grass decreases [2,6]. Knowing what form this change will take will help determine the population and its needs in the future. Therefore, it is necessary to monitor these changes on the land and take the necessary precautions [7]. For this purpose, when compared to classical methods, monitoring studies using satellite images give more successful results in a shorter time [8]. In this study, Landsat satellite images were used and it was aimed to determine the temporal change in the land structure with the help of image processing. The change in the multi-time Landsat satellite images has been determined with the help of the prepared software, and various suggestions for the future have been listed in this context.

Material and method

Location and climatic conditions of the study area

Bayburt is located between latitudes 40° 37' north and 39° 52' south and longitudes 40° 45' east and 39° 37' west, and the study area is shown in Figure 1. In Bayburt, a transitional climate prevails between the Eastern Black

Sea climate and the Eastern Anatolian climate, dominated by terrestrial characteristics. For this reason, summers are hot and dry, and winters are cold and rainy. However, the climate is mild compared to Eastern Anatolia, thanks to the low average altitude and the microclimate created by the valleys system. Summer days usually appear between May and September. The number of rainy days in Bayburt is 102, and the average precipitation is 433.4 mm. The highest temperature is 36.2°C and the lowest temperature is -26.2°C, and the average temperature is 7°C. Although Bayburt is diverse in terms of vegetation, it is not rich. 27% of the provincial land is arable land, 2% is meadow, 3% is forest, 49% is pasture and plateau, and 19% is rocky and steppe [9].



Figure 1. Location of the study area

Evaluation of the Study Area

Satellite images obtained from the Landsat satellite program were used in the study. Satellite images were taken from the same location at five-year intervals in the same month between 2000 and 2020. Matlab 2020b version was used to process the obtained images.

Results

In the study, satellite images obtained for every 5 years between the years 2000-2020 were obtained. Using satellite images, the study area in which Bayburt and its surroundings are located was determined as 6879 km². Then, the images obtained were used in the image processing stage by using the codes prepared in the Matlab 2020b program. In the image processing stage, firstly, satellite images obtained using RGB (red, green, blue) color space were converted to HSV (hue, saturation, value) color space for ease of operations. Then, the process of determining the green areas in Bayburt province and its surroundings by Color Tresholding method was carried out. This process was carried out by applying a mask to all colors except the color components in green tones. Then the images were converted to black and white to ensure the separation of green and other colors. In this way, the total number of pixels representing green areas was calculated. In addition, the original, masked and black and white transformed images by years are shown in Table 1.

Discussion

After the image processing stage, the amount of green and non-green areas obtained by years and the percentage distribution of green areas are given in Table 2.

When Table 2 is examined, 5246 km² of green areas and 1633 km² of non-green areas were calculated in 2000. When these figures are calculated, it is seen that green areas accounted for 76.26% of the total working area in 2000. In the following years, this rate is seen to be 75.35%, 74.59% and 72.21% in 2005, 2010 and 2015, respectively. By 2020, this rate was calculated as 73.90%. From 2000 to 2020, the total green area decreased from 5246 km² to 5084 km².

Conclusion

When the results obtained in the study are examined, it is seen that the green areas in Bayburt province and its surroundings have been in a continuous downward trend for the last twenty years. In order to prevent or slow down this decline, in summary, factors that may cause climate change should be reduced and uncontrolled meadow pasture grazing should not be done.

Acknowledgement: We would like to thank Bayburt University and its staff, where the study was conducted.

Author contributions: **Mustafa Alptekin Engin:** Visualization, Conceptualization, Software **Sinan Kul:** Methodology, Investigation, Writing-Reviewing and Editing.

Conflicts of interest: The authors declare no conflicts of interest.

Table 1. Original, masked and black and white satellite images by year















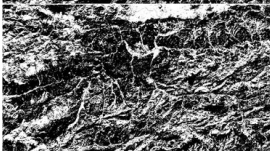
Years	Satellite Images	Color Treshold (Masked Image)	Binary Image
2000			
2005			
2010			
2015			
2020			

Table 2. The amount of green and non-green areas obtained by years and the percentage distribution of green areas

Years	Green Zones (km ²)	Non-Green Zones (km ²)	Green Zones (%)
2000	5246	1633	76.26
2005	5183	1696	75.35
2010	5131	1748	74.59
2015	5105	1774	74.21
2020	5084	1795	73.90

References

- [1] Aliefendiođlu, Y., & Tanrıvermiş, H. (2011). Türkiye’de Çevre Koruma Alanlarında Arazi Kullanımı ve Koruma Kararlarının Arazi Piyasalarına Etkileri: Gökova Özel Çevre Koruma Bölgesi Örneđi. Üçüncü Sektör Kooperatifçilik, 46(1), 64-102.
- [2] Koday, S., & Kızılkın, Y. (2019). Çok Zamanlı Landsat Uydu Görüntülerinin LULC ve NDVI Analizleri ile Ünye İlçesinde Arazi Kullanımı Deđişimlerinin Belirlenmesi. Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 23(3), 1301-1312.
- [3] Aydın, G., Avşar, E. Ö., & Akçay, Ö. (2018). Uydu Görüntülerinden Zamansal Deđişim Analizi İçin Matlab Tabanlı Bir Ara Yüz Tasarımı. VII. Uzaktan Algılama-CBS Sempozyumu (UZAL-CBS), 1-8, Eskişehir, Turkey.
- [4] Cangir, C., Kapur, S., Boyraz, D., & Akça, E. (1998). Türkiye’de arazi kullanımı, tarım topraklarının sorunları ve optimum arazi kullanım politikaları. M. Şefik Yeşilsoy International Symposium on Arid Region Soil, Menemen-İzmir, Turkey.
- [5] Dengiz, O., Mustafa, U., & Keçeci, M. (2006). Atatürk Orman Çiftliđi Arazilerinin Tarımsal Kullanım Durumlarının Deđerlendirilmesi. Anadolu Tarım Bilimleri Dergisi, 21(1), 55-64.
- [6] Sever, R. (2002). Sürdürülebilirlik Bakımından Şavşat Ormanları. Dođu Cođrafya Dergisi, 7(8), 76-97.
- [7] Öztürk, D., Şişman, A., Maraş, E. E., Şişman, Y. (2010), Samsun-Atakum’da Arazi Kullanımı/Arazi Örtüsündeki Deđişimlerin Uzaktan Algılama ve CBS ile Belirlenmesi. VI. Ulusal Cođrafya Sempozyumu, Ankara, Turkey.
- [8] Tunay, M. & Ateşođlu, A. (2004), Uzaktan Algılama Tekniđi ve CBS Kullanılarak Bartın Çevresindeki Dođal Olmayan Deđişikliklerin Belirlenmesi. III. Cođrafi Bilgi Sistemleri Bilişim Günleri Sempozyumu, İstanbul.
- [9] Anonymous. (2021). Bayburt İl Kültür ve Turizm Müdürlüđü, “Bayburt”, erişim:19 Aralık 2021, <https://bayburt.ktb.gov.tr/>.



Determination and modelling of PM_{2.5} level in summer time in Selcuk University Shopping Centre Konya, Turkey

Sukru Dursun ^{*1}, Mina Naseer Qasim ²

¹Konya Technical University, Environmental engineering Department, Konya, Turkey, sdursun@ktun.edu.tr

²Konya Technical University, Environmental engineering Department, Konya, Turkey, mineenviro@gmail.com

Cite this study: Dursun, S., & Naseer Qasim, M. (2021). Determination and Modelling of PM_{2.5} Level in Summer time in Selcuk University Shopping Centre Konya, Turkey. 1st Advanced Engineering Days, 69-71

Keywords

Air quality
Indoors
Measuring
Modelling
Particulate matters
PM_{2.5}
Shopping centers

ABSTRACT

Most of the people spend their most more the time in closed environments during their life. The quality of living atmosphere is really important because of this long contact time period. In inhaled respiration air is contain particle matters pollutant sources in the atmospheric environment, like volatile organic compounds, dusts and different sizes of particulate matters. The health impact of these substances has been investigated in recent years on may scientifically research. In this investigation, particulate matter PM_{2.5} size dimension, which is one of the indoor air pollutants, was carried out in Selcuk University public shopping center and the data were compared according to seasons, weekday and weekends. For the preparing 3-dimensional mapping, Surfer v.16 computer packed program was used and data modelling was investigated. Certain intervals were measured during three seasons. The measured shopping center is located in the Alaeddin Keykubat campus of Selcuk University. Measurement PM_{2.5} values in the center of Gökkuşağı shopping center exceed the standards of WHO, and it was observed that summer values were lower than winter seasons. Higher values were observed in the winter season. In terms of measurement area, higher PM concentrations were found in Gökkuşağı shopping center than in similar shopping malls.

Introduction

Many of the epidemiological studies on particulate matter in the world have shown that the high air pollution caused by these substances, respiratory tract diseases, cardio vascular system and lung problems are great importance on human health [1]. The fact that people generally spend about 90% of their time indoors is clear how important the air quality of these environments is. However, most of the studies to determine the amount of particulate matter in the world have been carried out outdoors, and the studies carried out in closed environments are limited. Particulate matter, which is a mixture of organic and inorganic compounds, is defined as an important source of air pollution. These particles, which are generally divided into two groups in terms of mass; defined as coarse particles (above 10 µm) and fine particles (below 2.5 µm). The residence time of the particles in the air depends on the particle size, the smaller the size of the particles, the longer the residence time in the air [2]. PM_{2.5} exposure threshold has not been defined to provide an unequivocally safe and complete level of protection against all adverse health effects [3]. However, in order to limit the health effects of fine particle pollution, the World Health Organization (WHO) has proposed guidelines for annual and short-term (24 hours) human exposure to PM_{2.5}. In addition to these global standards, WHO encourages governments to define and implement national standards [4]. Along with the guideline levels, WHO has defined three intermediate exposure levels to gradually reduce PM_{2.5} concentrations. In addition, WHO recommends an annual average, with priority over the 24-hour average, as high PM_{2.5} events are generally less harmful than annual exposure to high PM_{2.5} levels. The current WHO's annual average air quality guide (AQG) is 10 µg/m³. Australia and the Canadian province of British Columbia are national jurisdictions that introduced a lower standard of 8 µg/m³.

Material and method

Study area

In this study, which was started on the basis of shopping centres located in Selçuklu district of Konya province, it was chosen as the appropriate location for measurements. This place, which was chosen by paying attention to its indoor environment, is located on the campus of Selçuk University. Social facilities serving students and staff in Selçuk University Alâeddin Keykubat Campus were deemed suitable as a location for carrying out measurements and collecting data. Rainbow is located in front of the medical faculty, approximately 400 meters from the campus entrance. This building, which covers an area of approximately 13000 m², consists of 63 stores, stationery, bookstores and restaurants.

It consists of map types such as contour, calculation, 3D surfaces, colour relief, etc., and provides tools to visualize and model all types of data. The type of map obtained in this study is contour map. After making all the statistical calculations by turning the 3D data loaded on the worksheet into a grid, the map is created by selecting the desired map type. In order to make the map more meaningful and readable, the map can be personalized with various customization options, thanks to the window in the lower left corner of the screen. These options include sections, magnifiers, scale bars and edits such as multi-axis, linear or logarithmic color scales, combining multiple maps, text, line, fill, and symbol properties.

Particulate matter PM_{2.5} measurement method

In the researches carried out to determine the particulate matter concentrations, the pollutant sources in the external environment were examined. By comparison, there is little information on indoor particulate matter pollution, its concentrations, sources, and exposure levels to people who spend most of their time in various indoor environments [5]. In this study, which was started to determine the effect of seasonal changes on particulate matter, summer, autumn and winter seasons were selected to take measurements, and two-day measurements were made on weekdays and weekends. The total measurement period was completed as 4 days in each period.

In all three seasons when the measurements were made, the daily measurement program lasted for 10 hours, depending on the working hours of the venues. Measurements were repeated 6 times a day with an interval of 2 hours. After taking the coordinates of the measurement points, the data collected at the end of each season are listed in the Excel program in such a way that daily, weekly and hourly averages are taken. X and Y coordinates and Z coordinate represented the measured PM_{2.5} values. A worksheet was created by transferring X,Y coordinates and measurement values to the SURFER-16 program. Statistical calculations were made by converting the prepared data into tables. Then, contour map is selected from the map options in order to show the contour lines. The customization window is used to clearly show high and low concentrations and dispersion lines on the map.

Results and discussion

Particulate matter measurements were carried out in three different seasons in the rainbow shopping center of Selçuk University Alaeddin Keykubat campus, an important shopping center in Konya. The sampling period was carried out between 21.05.2018 - 03.06.2018. During the measurement periods, measurements were made for one week. Weekly average distributions of particulate matter PM_{2.5} were prepared with Surfer 16 by measuring 6 times a day. Within the scope of the research, it was arranged to be close to the opening and closing hours of the shopping center between the hours of weekdays and weekends (09-19). As a result of the study, the average values of PM_{2.5} obtained from the examination of all data during the week and at the weekend are shown in Table 1.

Table 1. Seasonal weekday and weekend averages of particulate matter PM_{2.5} in Gökkuşığı shopping center

Sampling period	Weekday average PM _{2.5} µg/m ³	Weekend average PM _{2.5} µg/m ³
Summer	600	528

According to the summer period data, the average of PM_{2.5} at 9:00 in the morning was 580 µg/m³ on weekdays and 720 µg/m³ on weekends. While the most intense point of pollution was at point B on weekdays, it was seen intensely at points B and C on weekends. point B; it is in a narrow and closed corridor with cooking stoves, hairdressers, tailors and locksmiths. Thanks to these shops that are actively working, there is not much difference between weekday and weekend values. Point C, on the other hand, corresponds to the aforementioned corridor in the shopping mall, on the west side of the building. There is a restaurant material entrance area, a medical equipment sales point and a clothing store door opening to this corridor. The value seen over the weekend appears to have increased due to the material loading in the corridor. The modelling results are shown in Figure 2.

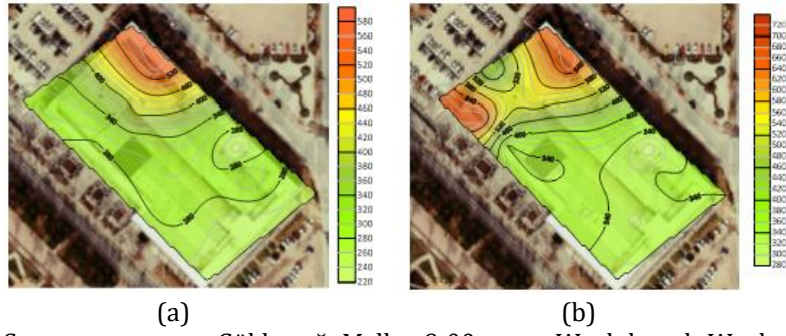


Figure 2. Summer season at Gökkuşuğu Mall at 9:00 a.m. a-Weekdays, b-Weekend average

As the middle of the day approaches, the values increase slightly and the measurements made around 11:00 reflect the modelling in both weekday and weekend averages. The average of PM_{2.5} at 11 o'clock was found to be 1040 µg/m³ on weekdays, and very close values were obtained as 1050 µg/m³ at the end of the week. The intense pollution zone seen on weekdays exactly coincides with the middle parts of the building, some of the corridors and restaurants. With a general interpretation, as a result of the measurements made in the summer period, the lowest PM_{2.5} value is 370 µg/m³. This value exceeds the hourly 25 µg/m³ limit set by WHO, EEA and EPA for PM_{2.5}. In the outdoor air quality assessment management and regulation updated in 2008 in Turkey, the standard value for PM_{2.5} is 200 µg/m³. While the indoor air should be lower than these values, the results obtained exceed the HKDYY limit value.

Conclusions and Recommendations

In this study, indoor air quality, the importance of which has started to be noticed in Turkey in recent years, has been examined. In this study, which was started in Konya, one of the most important industrial cities of the country, based on shopping centers, particulate matter PM_{2.5} measurements, which carry serious risk factors on human health and which is in the second rank among air pollutants by the World Health Organization, were made. Two different environments were selected for the measurements. Rainbow shopping center located on Selçuk University Alaeddin Keykubat campus was chosen as the first location for measurements. Measurements were made in three separate periods. Sampling was carried out during the summer season between 09:00 and 19:00 between 21.05.2018 – 03.06.2018. When investigated how particulate matter PM_{2.5} affects indoor air quality throughout the season and what causes it. The results were mapped and modelled using the Surfer 16 program. While modelling, the results were interpreted as weekday and weekend averages. As a result, measurement PM_{2.5} values in the center of Gökkuşuğu Mall did not exceed WHO's standards.

Acknowledgement

This paper has been prepared a part of Mina Naseer Qasım MSc. Thesis.

Funding:

This research has been funded by Selcuk University, Scientific Research Found, Project no:18201117.

Author contributions:

Sukru Dursun: Conceptualization, Methodology, -Reviewing and Editing; **Mina Naseer Qasım:** Investigation, Data curation, Writing-Original draft preparation, Modelling.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Brunekreef, B., Holgate, S. T., (2002), Air pollution and health, *The lancet*, 360 (9341), 1233-1242.
- [2] Kaya, D. & Öztürk, H., (2012), *Hava Kalitesi Yönetimi*, Ankara, p. 352.
- [3] Kiesewetter, G., Schoepp, W., Heyes, C., Amann, M., (2015), Modelling PM_{2.5} impact indicators in Europe: health effects and legal compliance, *Environmental Modelling & Software*, 74, 201-211.
- [4] WHO, (2013), World Health Organization (2013). Review of evidence on health aspects of air pollution
- [5] Challoner, A. ve Gill, L., (2014), Indoor/outdoor air pollution relationships in ten commercial buildings: PM_{2.5} and NO₂, *Building and Environment*, 80, 159-173.



PM_{2.5} Concentration Measurements and Mapping at Gökkuşığı Mall for Autumn 2018, in Konya, Turkey

Sukru Dursun ^{*1}, Mina Naseer Qasim¹

¹Konya Technical University, Environmental engineering Department, Konya, Turkey,
sdursun@ktun.edu.tr; mineenviro@gmail.com

Cite this study: Dursun, S., & Naseer Qasim, M. (2021). PM_{2.5} Concentration Measurements and Mapping at Gökkuşığı Mall for Summer 2018, in Konya, Turkey, 72-74

Keywords

Air quality
Indoors
Measuring
Modelling
Particulate matters
PM_{2.5}
Shopping centers

ABSTRACT

The majority of people living in urban areas spend a significant part of their lives indoors such as homes, schools and workplaces. Therefore, the air quality of indoor or indoor environments is very important. As in Turkey, while improving the outdoor air quality first, regulations on indoor air quality have been started to be developed recently, or lower pollutant concentrations are determined by lowering the air quality standards by certain ratios for acceptable limit values for indoor environments. Ventilation systems and air quality are very important especially for Shopping Centers, which are visited by people from different walks of life and have many different business lines. Gökkuşığı Shopping Center also causes thousands of patients and their relatives to visit because of the fact that the Faculty of Medicine has more than 100 personnel, together with around 100 thousand students belonging to Selçuk University. Gökkuşığı Shopping Center, which was established to meet the needs of these people, serves around 100 people with its cafes, restaurants and many workplaces. This service is concentrated at certain hours, especially when there is a need for food. In this study, which was carried out during the university education period, the measurements of the particle size (PM_{2.5}) pollution reaching the human lungs and remaining there to a large extent were made at 6 different hours between the opening-closing hours of the shopping mall. The distribution of the pollutant in the space was modelled using the Surfer16 package program and the distribution map was drawn. The values obtained in the measurements were above the international standards.

Introduction

Industrialized societies also want a modern living space in modern life and living spaces. These vehicle demands bring along motor vehicles and industrialization close to city centers and this poses a danger to human and environmental health. Gases belonging to air sources, and their life span in nature and nature are important due to their nature. Among the world climate, one of the world's weathers has been determined in relation to the world climate in 1992 (as from Uno climate, 2003). Indoor air circuit from 2 main sources. Designs consisting of interior design and design, interior designs consisting of interior designs. Indoor PM uses are affected by drinking, cooking, home, etc., first of all, outdoor-indoor atmosphere-indoor ventilation such as resuspension and ventilation, and removal from outdoor-indoor air such as hand precipitation [1-2] (Quackenboss et al., 1989; Moriske et al, 1996). In this study, PM_{2.5} concentrations were measured at different times during the day in the closed environment of the closed social area Gökkuşığı Shopping Center at Selçuk University, one of the campuses with the highest number of students in Turkey, and three-dimensional pollution maps were obtained by modeling the indoor distribution.

Material and Method

Study area

In this study, which was started on the basis of shopping centers located in Selçuklu district of Konya province, suitable measurement points were determined for making measurements. This place, which was chosen by paying

attention to its indoor environment, was chosen as the place where people visit the most on the campus of Selçuk University.

It was carried out in the social facilities that serve students-employees and those who come to the hospital in the Alâeddin Keykubat campus of Selçuk University, and the locations for the data were determined. The details of the study area are given in Naseer Qasim (2019). There are two corridors with a width of approximately 2 m in the north, east and west parts of the shopping center. Some business entrances lead to these corridors. These corridors, which consist of a ceiling structure that cannot be high as a structure, cause the air pollutants circulating in a narrow area to be trapped in a narrow area and close to the respiratory level. Although existing workplaces have ventilation systems, they are not sufficient in common areas. In previous years, the air blowing system was out of use due to technical malfunctions. Although the Gökkuşığı Shopping Center, which was built and put into operation in the past years, has undergone simple renovations over time, there has not been sufficient improvement from its opening to the working period. 13 measurement points were determined to represent the space for your measurements in the rainbow Shopping center.

Atmospheric Particulate Matter Measurement Method

Atmospheric particulate matter measurement methods vary according to the size and purpose of the particles. Thanks to electronic systems, a laser particle counter and dust measuring device "Particle Counter PCE-PC01" configured to determine the concentration of particles in the atmosphere can be determined. This device is used in non-polluted environments, indoor air quality or exposure to cigarette smoke and other harmful air pollutants, and for monitoring dust levels in the air. Detailed information for measurement can be obtained from Naseer Qasim (2019) and [3].

Modelling and graphics program Surfer-16

Golden software 16 is a program capable of modeling and creating a 3D graphic preparation system that includes basic statistics. It is used for creating contour maps and obtaining 3D images by processing complex data obtained from different processes and making grids [4-5]. Since the eighties, more than 100,000 scientists and engineers around the world This program, which transforms the collected data into information, visualizes the data in high quality while preserving its accuracy and precision (Bresnahan and Dickenson, 2002). Along with Surfer's extensive modeling tools, interpolation and grating parameters can be adjusted, define errors and breaks, or perform grid calculations such as volumes, transformations, smoothing or filtering [7].

Particulate matter PM2.5 measurement method

In the researches carried out to determine the particulate matter concentrations, the pollutant sources in the external environment were examined. By comparison, there is less information about indoor particulate matter pollution, its concentrations, sources, and exposure levels to people who spend most of their time in various indoor environments [6]. In order to determine the interaction of particulate matter values with seasonal changes, studies are carried out in different seasons to take measurements in the study. In this study, autumn was chosen as the opening period of schools, and in the study, two-day measurement intervals were determined on weekdays and weekends. The periodical measurement period was completed as 4 days.

Results and Discussion

Particulate matter 2.5 micrometer size measurements were carried out in the autumn period in the rainbow shopping center of Selçuk University Alaeddin Keykubat campus, which is one of the important shopping centers in Konya. The sampling period, the second sampling period, was carried out between 24.09.2018 - 07.10.2018. During the measurement period, measurements were made for one week. Weekly average distributions of particulate matter PM_{2.5} were prepared for Surfer 16 by measuring 6 times a day.

Within the scope of the research, it was arranged to cover the opening and closing hours of the shopping center between the hours of weekdays and weekends (09.00 - 19.00) at the Gökkuşığı AVM at the university. As a result of the study, the average values of PM_{2.5} obtained from the examination of all data during the week and at the weekend are shown in Table 1.

Average PM_{2.5} concentrations in the autumn 2018 period were found to be 693.65 µg/m³ and 495.75 µg/m³ on weekdays. Measurement times were made between 09.00-19.00 hours. The 7-day measurement period, which started right after the official semester registration of Selçuk University, started on 24.09.2018 and continued until 30.09.2018.

Table 1. Autumn season weekday and weekend particulate matter PM_{2.5} averages in Rainbow shopping mall.

Sampling period	Weekday average PM _{2.5} µg/m ³	Weekend average PM _{2.5} µg/m ³
autumn	693	496

The weekday average was found to be 1400 $\mu\text{g}/\text{m}^3$ even in the early hours of the day thanks to the pollution that occurred at point F (west entrance gate) and exceeded 1000. It affects the entrance point of the restaurant chimneys located on both sides of the entrance door. Values not exceeding 700 $\mu\text{g}/\text{m}^3$ were observed during weekdays in other parts of Gökkuşuğu Shopping Center. Low $\text{PM}_{2.5}$ concentration was found to be 760 $\mu\text{g}/\text{m}^3$, resulting from quieter weekends and fewer visits. The modelling results of the first average $\text{PM}_{2.5}$ concentration of the study period at 09:00 are shown in Figure 2. The values at 11:00 am found to be quite high and the $\text{PM}_{2.5}$ value was found to be 2900 $\mu\text{g}/\text{m}^3$. Here, the particle pollution formed at point B started from the north-eastern part of Gökkuşuğu Shopping Center and spread towards the center. $\text{PM}_{2.5}$ concentration was found to be at least 1300 $\mu\text{g}/\text{m}^3$ at points J and K where cooking restaurants are located. Cooking activities have been ranked 2nd by EPA as the indoor $\text{PM}_{2.5}$ formation source (Lai & Ho, 2008).

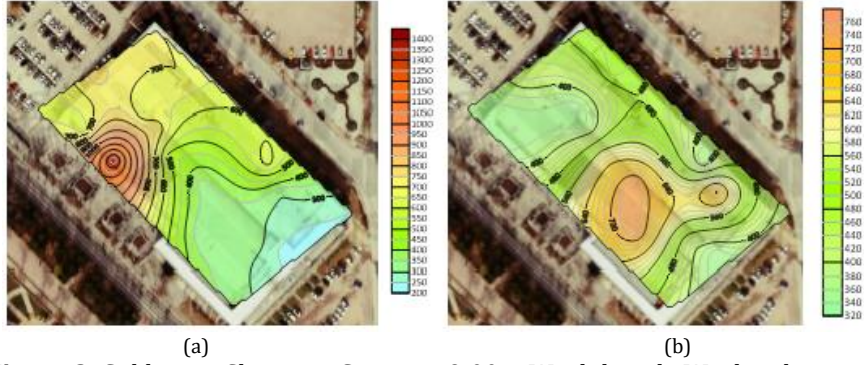


Figure 2. Gokkusagi Shopping Center at 9:00 a. Weekdays, b. Weekend average

Conclusions

In this study, indoor $\text{PM}_{2.5}$ air quality, a breathable air pollutant, which is an important environmental problem in Turkey as in the world, has been examined. Although air pollution is a major problem in Konya, one of the most important industrial cities of Turkey, this study for indoor environment is based on shopping malls, the particulate matter $\text{PM}_{2.5}$, which carries serious risk factors on human health and is ranked second among air pollutants by the World Health Organization. measurements and modeling were done. In order to make the measurements, it was preferred to make the measurements at the Gökkuşuğu Shopping Center located on the Selçuk University Alâeddin Keykubat campus. The sampling period for the measurements was carried out between 24.09.2018 and 07.10.2018. Sampling hours at Gökkuşuğu Shopping Center were held between 09:00 and 19:00. How particulate matter $\text{PM}_{2.5}$ affects indoor air quality throughout the period and what causes it are examined. The results were mapped and modeled using the Surfer 16 program. While modeling, the results were interpreted as weekday and weekend averages. As a result, measurement $\text{PM}_{2.5}$ values in Gökkuşuğu Shopping Center did not exceed WHO's standards.

Acknowledgement: This paper has been prepared a part of Mina Naseer Qasim MSc.Thesis.

Funding: This research has been funded by Selcuk University, Scientific Research Found, Project no:18201117.

Author contributions: **Sukru Dursun:** Conceptualization, Methodology, -Reviewing and Editing; **Mina Naseer Qasim:** Investigation, Data curation, Writing-Original draft preparation, Modelling.

Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Quackenboss, J.J., Lebowitz, M.D., Crutchfield, C.D., (1989). Indoor-outdoor relationships for particulate matter: exposure classifications and health effects. *Environment International*, 15, 353–360.
- [2] Moriske, H.-J., Drews, M., Ebert, G., Menk, G., Scheller, C., Schondube, M., Konieczny, L., (1996). Indoor air pollution by different heating systems: coal burning, open fire place and central heating. *Toxicology Letters*, 88, 349–354.
- [3] URL-2 https://www.pce-instruments.com/english/measuring-instruments/test-meters/particle-counter-pce-instruments-particle-counter-pce-pco-1-det_516316.htm [Retrieved December, 2021]
- [4] Polat, O., (2002), Golden software surfer v.8 kullanim ile ilgili notlar p, <https://docplayer.biz.tr> [04.04.2019].
- [5] URL-3 <https://www.goldensoftware.com/> [Retrieved December, 2021]
- [6] Challoner, A., Gill, L., (2014), Indoor/outdoor air pollution relationships in ten commercial buildings: $\text{PM}_{2.5}$ and NO_2 , *Building and Environment*, 80, 159-173.
- [7] URL-4, Golden software products, <https://www.goldensoftware.com/products>: [Retrieved December, 2021].



Determination of water quality in Hadim district of Konya (Turkey) and the investigation of disinfection efficiency

Sukru Dursun ^{*1}, Abdurrahman Sarcan ²

¹Konya Technical University, Environmental Engineering Department, Konya, Turkey, sdursun@ktun.edu.tr; asarcan_31@hotmail.com

Cite this study: Dursun, S., & Sarcan, A. (2021). Determination of water quality in Hadim district of Konya (Turkey) and the investigation of disinfection efficiency, 75-77

Keywords

Hadim
Konya
Drinking Water
Bacteria
Disinfection
Chlorination
Water quality

ABSTRACT

Drinking and usage water of Hadim Town (Konya, Turkey) has been provided from underground water. For this reason, there is no any treatment method but only disinfection with chlorine is applied. In the scope of this study, it is intended to determine the characteristic of the water quality via some analyzing method of the drinking and usage water and to explore the effectiveness of the existing disinfection method which is applied at present. Water has been analyzed collected 200 water samples from 5 points selected in the central district of Hadim water mains system. Subsequently, analyses, which are intended for characterizing the drinking and usage water of Hadim district, have been conducted both in the territory and in the public health laboratories of Konya province. Furthermore, analyses have been conducted in order to determine to what extent and at what point is effective the selected disinfection method (chlorination). Consequently, it has been determined that, on account of its chemical specialties, drinking water of the Hadim district is suitable for the standards stipulated for our country. Nevertheless, bacteriologically, it has been determined that the quality of the water is low owing to coinciding with coliform type bacteria from time to time.

Introduction

Only less than 1% of the total amount of water on earth can be used as drinking water. Existing drinking water resources, increasing population, rapidly developing industry and disappearing natural environment limit underground and surface drinking water resources. While groundwater is generally directly drinkable, surface waters, streams, streams, lakes and dams are generally not of directly potable quality. Their chemical structures mostly depend on the lands they pass through and on which they are located, on the nearby factories and settlements. Especially those close to large settlements are significantly polluted [1]. All water sources can be used both as drinking water and for industrial purposes. The natural water resources that are widely used in the industry by applying the appropriate treatment process are surface and underground waters. Despite this, it is expected that the ground waters that filter through a thick soil layer are cleaner than the surface waters, but the dissolved salt content is higher [2]. The best waters are spring waters, which are not sufficient in terms of quantity. Well water is also generally of good quality. However, these are not enough to meet the water needs of big cities. Therefore, river, stream and lake waters are used to meet the water needs. Such waters are sufficient in terms of quantity but not sufficient in terms of quality [3].

This study is to determine the conformity of drinking and utility water quality to standards by examining some properties of drinking and utility water in the center of Hadim district of Konya, which has a population of approximately 4000 people, in terms of chemical and bacteriological aspects. In addition, it is to investigate the effectiveness of the disinfection method used by the district municipality and used in the warehouses and distribution network and the disinfectant substance used in disinfection.

Material and Method

Hadim district center covers the drinking water network. On-site measurement and sampling points were selected according to the distribution of the areas covering the study area. At selected points, the physical, chemical and bacteriological parameters of the drinking water of Hadim district center were measured both in the field and in the laboratory. Since Hadim district center is small and accordingly the distribution network is short, it was deemed appropriate to choose 5 stations. For this reason, a total of 10 samples were taken, once a month for chemical analysis, and a total of 50 samples were taken from 5 points, once a month for bacteriological analyses, in order to monitor the quality changes in drinking water. In addition, in order to determine the residual chlorine ratio, a total of 200 samples were taken from 5 points, 4 times a month, once a week.

Study area

In this study, which was started on the basis of shopping centers located in Selçuklu district of Konya province, Hadim is one of the districts of Konya, located in the Central Anatolian region of our country, and is at the intersection of 37 degrees north parallel and 33 degrees east meridian in the northern hemisphere. Eunuch; It was established in a valley in the center of the Central Taurus Mountains of Konya province, and its distance from Konya is 128 km. is At the same time, it falls within the borders of the Mediterranean region. Eunuch; It is in the south of Konya. There is Karaman province in the east, Taşkent district in the south, Bozkır in the west and Alanya lands in the south-west of the district. The altitude of the district from sea level is 1500-1700 m. is

Coliform and E. Coli Determination

Results and Discussion

Some physical-chemical and bacteriological properties of drinking and utility water of Hadim district (district center) were examined and sampling and analyzes were carried out in a 10-month period in order to determine its quality. The results of the analysis of the samples taken from 5 sampling points determined in the study area were arranged separately for each month. Among the chemical analyzes, pH, conductivity, total hardness, chloride and organic matter parameters were evaluated separately and their graphs were drawn. Bacteriological analyzes were also evaluated separately. The residual chlorine parameter, which is used to control the disinfection, was evaluated alone. Organic Matter analysis results between June-2007 and March-2008 were evaluated. In the drinking water network of Hadim district center, the results of the organic matter analysis made in the 10-month period were found even at low values in certain periods. While organic matter was not found in July, November, December and February, it was found at low rates in other months. However, since these values are below the normal values; The drinking water of Hadim District center is at the desired drinking water quality level in terms of organic matter.

Bacteriological Analysis Results of Hadim Drinking Water Network Regarding Monthly E. Coli

The numbers of E. coli in 100 ml determined as a result of the bacteriological examination of the monthly water samples taken from 5 points are given in Table 1.

Table1. E. coli results per 100 ml counted at points from June 2007 to March 2008.

Sampling period	Sampling point-1	Sampling point-2	Sampling point-3	Sampling point-4	A Sampling point-5
	Prefecture	Central Pri.Sch.	Municipality Hotel	Hospital	A. Hadim Mosq
June	240 +*	240 +	240 +	240 +	240 +
July	240 -**	-	-	23	-
August	-	-	-	23 -	-
September	-	-	-	-	-
October	-	-	-	-	-
November	240 +	240 -	240 -	240 -	240 -
December	-	-	-	-	-
January	-	-	-	-	-
February	-	-	23 -	-	23 +
March	240 -	240	23+	23 +	240

* + sign indicates that reproduction continues.

** - sign indicates uremia has stopped.

No bacteriological findings were found in the analyzes performed in September, October, December and January. In June and March, E. coli was found at all sampling points in the drinking water network. In the remaining months, while E. coli was detected at some points, it was not detected at some points. This suggests that the

drinking water network was subsequently contaminated at some points. While the hospital point is the most polluted point bacteriologically, since five of the 10 measurements made, there is a pollution indicator, while the Central İÖO. point was determined as the cleanest point with 3 pollution indicators.

As a result of the analyzes made, in the 3rd week of June, 1st and 2nd week of July, 3rd and 4th week of August, 4th week of September, 1st, 2nd and 3rd week of November, December, No chlorine was found in the mains water in January, February and March. In the 1st week of September, it was found only in the 1st spot, but not in the others. In the 2nd week of September, it was absent in the 1st point, while it was found in the others. In the 3rd week of September, it was found in the 5th position, but could not be found in other points. It was found in the first 4 spots in the 1st and 2nd week of October, but it could not be found in the 5th spot. The amount of chlorine required in the samples taken at all other points was determined. According to the results and as a result of the researches, the disinfection method in the mains water of Hadim district is carried out randomly and far from scientific techniques.

Conclusions and Recommendations

The absence of disinfection in warehouses and networks in December, January, February and March carries a great risk for the public. The presence of chlorine in the samples taken from the points in some weeks indicates that the disinfection was carried out irregularly and uncontrolled during the months. According to the results, it is understood that the current disinfection system used is insufficient and ineffective in terms of protecting the health of the public. We can list the reasons why many water samples taken from the mains could not meet the drinking water standards in terms of bacteriology as follows:

Water resources are dirty or polluted in the area where they originate. Disinfection (Chlorination) is not done in accordance with scientific techniques. Since the network is very old and not constructed properly, there is leakage into the drinking water pipes either from the sewerage or wastewater puddles.

Suggestions

Persons responsible for disinfection application must be qualified and at least trained. Permanent staff should be assigned. Chemical, physical and bacteriological analyzes should be done continuously and precautions to be taken for changes should be planned in advance. Urgent solutions should be sought for chlorination, which is not done in the face of freezing and excess water in winter. Necessary thermal insulation must be provided for the chlorinator. In addition, chlorination techniques should be investigated and a more effective technique and device suitable for the warehouse and network should be used. Extra new tanks should be made in order to remove chlorination and turbidity.

Acknowledgement

This paper has been prepared a part of Absdurrahman Sarcan MSc.Thesis.

Funding:

There is no Research Found for this work.

Author contributions:

Sukru Dursun: Conceptualization, Methodology, -Reviewing and Editing; **Abdurrahman Sarcan:** Investigation, Experimental work, Writing-Original draft preparation, Conclusion.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Gündüz T., 1994, Çevre sorunları, Ankara Üniversitesi, Fen Fakültesi, Ankara.
- [2] Yalçın H., Gürü M., 2002 Su Teknolojisi, Palme Yayıncılık, Ankara.
- [3] Uslu O., Türkman A., 1987, Su kirliliği ve Kontrolü, T.C Başbakanlık Çevre Genel Müdürlüğü Yayınları , Eğitim Dizisi 1, pp.: 360, Ankara.



Konya Aslim Wild Storage Field Rehabilitation and gains

Lütfü Şen ¹, Sukru Dursun*²

¹ Konya Metropolitan Municipality, Zero Waste Department, Konya, Turkey, lutfi.sen@konya.bel.tr

² Konya Technical University, Environmental engineering Department, Konya, Turkey, sdursun@ktun.edu.tr

Cite this study: Dursun, S., & Sen, L. (2021). Konya Aslim wild storage field rehabilitation and gains. 1st Advanced Engineering Days, 78-80

Keywords

Konya
Solid waste
Rehabilitation
Zero waste
Gain
Aslim

ABSTRACT

Domestic solid waste is one of the main problems of cities. Until recently, people have disposed of these wastes with the wild storage method. It still continues in undeveloped or financially limited regions. Developing technology and emerging consumption habits have diversified the character of domestic waste over the years. Along with the diversified waste character, the dangerousness of these wastes has also advanced. From the beginning of the 1970s until 1999, wild storage was carried out on the Aslim locality in Konya. After this date, the rehabilitation and landfill works planned and the first stage rehabilitation have been completed. The work planned in 1999 started in 2000 and was completed in 2004. Within the scope of this work, an area of approximately 7 m height and an area of 35 hectares was rehabilitated, minimizing the negative effects on the environment and public health in the solid waste storage area, surrounded by wire fences and afforestation, creating a green belt around the site. The gas collection systems, leachate collection line and pool, intermediate cover and final cover sections on the site, which were used from 2004 to 2017, were completed and closed for waste acceptance.

Introduction

It was not possible to talk about landfill activities in Turkey until the 1990s. Wild storage continued until recently in many provinces except Burda-Demirtaş, Ankara-Beltaş and Istanbul-Istaç, which are the first examples, and still continues in low-population settlements [1-2]. Environmental disasters in this area have repeatedly shown the importance of the issue. The most well-known Ümraniye landfill explosion, which resulted in the death of 39 people, is a clear example of how the event could result if it was done haphazardly. The increasing population also increases the amount of consumption, which directly affects the amount of waste generated after consumption. For these and similar reasons, waste management of cities is gaining importance day by day. Many directives have been created within the framework of the 2016-2023 national waste management action plan and EU harmonization laws [3]. Aslim wild landfill rehabilitation and Konya Integrated Regular Solid Waste Landfill Project were also continued with EU support in this context [4]. Today, due to the developing financial instruments and economic opportunities, landfills are started in many provinces and districts or access to the landfill is provided (transfer station). According to the report prepared within the framework of the 2016-2023 National Waste Management Action Plan, the irregular casting which was 54% in 2008 decreased to 30% in 2014 [5-6]. Domestic solid wastes pose many environmental risks if they are operated in wild landfills. Considering the aboveground and underground pollution potential, wild storage is a method that should not be applied. Many damages such as pollution of groundwater, transport of garbage by wind, disease-causing factors, damage caused by human and animal contact are only the most well-known ones [7].

Konya Aslım Rehabilitations Field

Due to the environmental problems caused by the irregular landfill, which was used from 1970s to 2000, it was decided to rehabilitate it and a rehabilitation project was prepared in 1999. Solid waste landfill rehabilitation started in February 2000 and continued in parts and was completed in March 2004 [8]. After the first stage work, which was completed in this state, the garbage continued to be stored semi-regularly and this area was used until 2017. With the operation of Kaşınhanı integrated solid waste storage area, this area was closed in 2017 and gas extraction and electricity generation activities continue. Within the scope of the first stage, an area of approximately 7 m height and 35 hectares was rehabilitated, minimizing the negative effects on the environment and public health in the solid waste storage area, surrounded by wire fences and afforestation, creating a green belt around the site. Although the work done here seems insufficient when considering today's conditions, it is a self-sacrificing practice made with environmental sensitivity in terms of the financial conditions of the period. Observations Regarding the Pre-Reclamation Site: The pre-reclamation site was generally scattered and contaminated with the environment. There was no gas and leachate collection system at the site. Aslım landfill is clayey as a ground and is at a suitable level according to the results of the sieve analysis. There were stray animals, unconscious livestock raising people and foragers in the field all the time. Small-scale fires were observed in areas with increased methane concentration from place to place.

Material and Method

Within the scope of this rehabilitation; Approximately 3 million m³ of dispersed garbage was transported to the main garbage mass and arrangement works were carried out on the body of the site. 32 gas discharge chimneys have been created in the field [8]. The entrance-exit road to the field was maintained, the materials causing visual and environmental pollution around the field were collected by the Municipal Environmental Cleaning Teams, and the field was visually reshaped. The project characteristics and rehabilitation outlines used for the rehabilitation project planned in 1999, which is mentioned based on the general condition of the site, are given below. For the rehabilitation project, 3 million m³ of garbage in the main body has been created. The damage to the environment has been minimized in the work carried out on an area of approximately 35 Ha. The unsuitable slope situation in the garbage body was completed by filling in places and arranged in the desired 1/3 ratio. The leachate discharge line and gas drains were placed as planned and made ready for the electricity generation facility infrastructure. Within the scope of rehabilitation, respectively; 1-Natural Clay Floor. The site was closed by applying 2-Gas Drainage Line, 3-Household Solid Waste, 4-Equalization Soil, 5-Geosynthetic Clay Cover, 6-Synthetic Drainage Mat, 7-Vegetable Covering Soil.

The field was closed by applying the Cover Soil: Slope Arrangement: As a result of the slope arrangement made in the field, a more stable structure was revealed. After the collection of scattered garbage piles, the desired slope was obtained as a result of the filling and excavations made on the main body. 490,000 m³ of cover soil was used to cover the main body and slopes. With the slope arrangement, a concrete trapezoidal channel was built at 0 elevation of the field, and a trapezoidal channel was opened on the fill for each upper layer. Wall Formation: It has been designed in a way to completely surround the primary garbage mass in the rehabilitation carried out. The embankment has been projected at an average of 1D:3Y inclination, at a height of 7m, both inside and outside. A surface water drainage channel, which will provide surface water drainage of the waste mass and also the entire site, has been constructed on the outside of the embankment. The upper part of the field, which was partially rehabilitated between 2004-2017, was narrowed and 2 more layers were formed and finally closed in 2017. In these areas, the slope slopes are designed at the same rate (1/3).

Leachate Drainage: 20-30% of the precipitation falling on the wild waste landfills turns into leachate. Here, the geosynthetic membrane layer applied before the top cover was made to prevent leakage. Except for partial leaks, there is no garbage leachate caused by precipitation in the area, only the water contained in the garbage is taken to the collection pools with ø400 main collection pipes and from there with the help of vacuum trucks. Since the field ground is close to the clay soil standard used in impermeable ground applications, the collection of leachates is healthier. Surface Water Drainage: After the final closure of the Aslım rehabilitation area, after the geotextile layer and top cover soil application on the site, a trapezoidal concrete rainwater collection channel was built at the 0 elevation of the site and discharged to Keçili Stream. This channel surrounds the entire site and collects all the water from the rain flow. As of the geological situation of Konya, there is no danger of flooding or raids from the outside, but these trapezoidal channels will be able to function in order to eliminate a similar risk that may occur.

Drainage: With the 1st stage project of the rehabilitation area, gas drainage pipes were placed and 32 gas chimneys were put into operation. For 35 Ha, 200 mm diameter 25400 meters perforated gas drainage pipe was used. Gas taken from the field with a 400 mm main collection line was brought to the combustion plant. As of 2021, it continues to operate with a production capacity of approximately 1 MW. It is envisaged that the facility will be operated until the end of 2022, with a production capacity of 0.6 MW in this period. Final Cover Formation: As a result of the rehabilitation work carried out, gas production continues actively in the field. After the activities in

the field are completely finished, it is planned to plant vegetation in standards that will not damage the top cover. The rehabilitation area is shown in Figure 1.



Figure 1. Rehabilitation area.

Results and Discussion

The risks have been minimized by rehabilitating the field. Leakage water, harmful gas emissions, interaction with the environment and disease-causing factors that can be carried to the city on a macro scale have been eliminated. Leakage waters are monitored with observation wells, and electrical energy production continues with the gas collection and burning system, which is still active. In the literature studies on this subject, it is predicted that there may be methane gas output in the landfills for up to 15 years. Currently, the gas output that can sustain the electricity production in the rehabilitation area and the following landfill continues. As a result of the interview with the operator, it has been seen that the gas output that can perform efficient combustion will continue until the end of 2022 and this gas meets the standards in terms of electricity generation.

Acknowledgement

We would like to thank Konya Metropolitan Municipality, Zero Waste Department for information.

Funding: There is no Research Found for this work.

Author contributions:

Sukru Dursun: Conceptualization, Methodology, -Reviewing and Editing; **Lütfü Şen:** Investigation, Experimental work, Writing-Original draft preparation, Conclusion.

Conflicts of interest: The authors declare no conflicts of interest.

REFERENCES

- [1] Bursa Belediyesi (2014) https://www.bursa.bel.tr/dosyalar/yayinlar/faaliyet_2014.pdf
- [2] İstaç (2018) İstaç 2018 Faaliyet Raporu https://istac.istanbul/contents/68/faaliyet-raporlari_132001335066784043.pdf
- [3] Bek N, Bek A, (2021) Sağlık Çalışanları Örneğinde Atık Bilinci Üzerine Bir Durum Çalışması, Troyacademy 6 (2), 395-410, DOI: <https://doi.org/10.31454/troyacademy.930759>
- [4] KÇŞİM (2019) Konya ili 2018 yılı çevre durum raporu, Konya https://webdosya.csb.gov.tr/db/ced/icerikler/konya_-cdr_2018_rev-ze-20190808113124.pdf
- [5] ÇŞB (2016) Çevre Şehircilik ve İklim Değişikliği Bakanlığı “2016-2023 Ulusal Atık Yönetim Eylem Planı”, Ankara,2016
- [6] Korucu MK, (2019) Ulusal Atık Yönetimi Eylem Planlarında Kullanılan Belediye Atığı Yönetimi İçin Yöntem Seçimi Yaklaşımının Bir Eleştirisi. Ulusal Çevre Bilimleri Araştırma Dergisi, Sayı 2(4): 169-176. <https://dergipark.org.tr/tr/download/article-file/1107475>
- [7] ÇOB (2011) Türkiye 2011 Çevre Durum Raporu. Altan Matbaacılık ÇED İzin Denetim Genel Müdürlüğü Çevre Envanteri ve Bilgi Yönetimi Dairesi Başkanlığı. https://webdosya.csb.gov.tr/db/ced/icerikler/tcdr_2011-20180308151518.pdf
- [8] KBŞBKDB (2021) Konya Büyükşehir Belediyesi Çevre Koruma Kontrol Dai.Bşk.2017-2021 faaliyet raporları. Konya 2021. <https://www.konya.bel.tr/dosyalar/2020FaaliyetRaporu.pdf>



Changes in land use between 1990 and 2018 on the basis of the corine system in Adana Province

Elif Saydan*¹, Şenay Güngör ², Efdal Kaya ³

¹Nevşehir Hacı Bektaş Veli University, Faculty of Arts and Sciences, Department of Geography, Nevşehir, Turkey, saydan.derman@gmail.com,

²Nevşehir Hacı Bektaş Veli University, Faculty of Arts and Sciences, Department of Geography, Nevşehir, Turkey, senaygungor.edu.tr

³İskenderun Technical University, Iskenderun Vocational School, Department of Architecture and Urban Planning, Hatay Turkey, efdal.kaya@iste.edu.tr

Cite this study: Saydan, E., Güngör, Ş., &Kaya, E. (2021). Changes in land use between 1990 and 2018 on the basis of the corine system in Adana Province.1st Advanced Engineering Days, 81-83

Keywords

Land Use Change
Green Area
Corine System
Adana

ABSTRACT

In addition to protecting the ecosystem and environmental health, green areas fulfill more than one function in terms of living requirements and comfort in cities, contributing to the creation of recreation areas, adding aesthetic value to the city and at the same time providing the physical balance of urban areas. With the rapidly increasing urbanization process, environmental changes and population increases in urban areas have brought about changes in land use. Corine System is used in order to monitor the changes on the land in a regular and planned urbanization process, to protect green areas and to carry out planning studies in this direction. With the analyzes made, an accurate and applicable design can be made for the urban area. In this study, the urban growth of Adana province in 1990, 2000, 2018 and the changes that occurred on the land were determined. The causes and consequences of the changes in the observed years were evaluated by means of Geographic Information Systems. According to the results obtained, it is seen that the green areas do not decrease, applicable plans and studies should be made to create more sustainable urban areas.

Introduction

The phenomenon of urbanization, which accelerated with industrialization, caused the density of buildings for the increasing amount of population, while on the other hand, it caused balance disruptions on the natural environments where people meet their basic needs. People are constantly changing the scenery and causing the changing scenery with their daily activities [1]. With the industrial revolution, we are exposed to such human effects, are under more and more pressure every day and encounter obstacles in providing a healthy and sustainable environment. Natural changes occur in land cover between certain periods. People, who have been interacting with nature from past to present, have caused deterioration in the natural cycle and the formation of environmental problems with the anthropogenic effects they have created on the environment with the development of technology and the increase of globalization [2]. Overpopulation caused by migration to urban areas and unplanned urbanization has occurred due to the inability to use the lands appropriately. Land use changes should be put forward in order to prevent unplanned urbanization and improper land use and to ensure that existing resources are sustainable for future generations. CORINE data is used extensively in the international literature in land use change studies [3].

With the studies carried out, it has been observed that Adana Province has experienced significant changes in terms of land use with the increasing industrialization. The spatial changes experienced by the development of the industrial sector, have been examined by land use classification with the CORINE System.

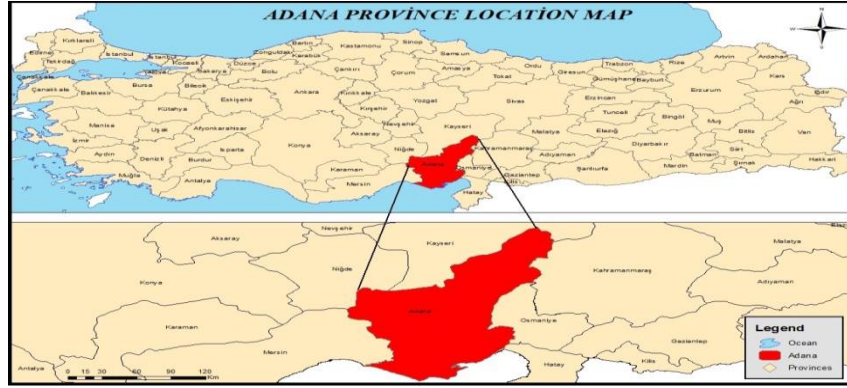


Figure 1. Location map

Material and Method

In this study, CORINE land use data was used. It is a program, established in 1985, aimed at collecting information for the European Union on priority environmental issues such as soil, water, air, coastal erosion and land cover. The European Environment Agency, the CORINE program into its structure since 1994. Land cover use maps with location-based land information are created together with Geographic Information Systems and Satellite images with the CORINE system. In order to correctly interpret the temporal changes of Adana Province on the land between 1990 and 2018, the amount of spatial change has been revealed and the changes that have occurred in the processes discussed have been examined by comparison.

Results and discussion

The changes and differences in the land cover in the province of Adana in 1990, 2000 and 2018 are explained by comparing the data obtained. The number of spatial changes experienced during the process has been revealed and future estimations have been made considering the results obtained. Considering the land use situation in 1990, it is seen that most of the area is divided into forest areas and irrigated fields. Residential areas, transportation areas, industrial and commercial areas, lower rates compared to agricultural areas.

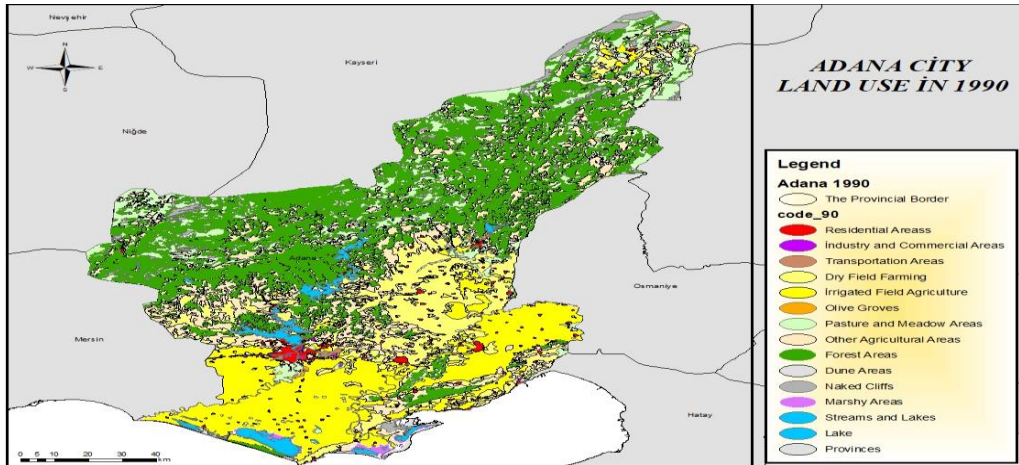


Figure 2. Adana City Land Use in 1990

Considering the land use in 2000, it was seen that although there was a slight decrease in forest, it was still in the first place. Irrigated agricultural areas have also been one of the areas that cover the most land after forest areas. Settlement areas, transportation areas, industrial areas, swamp areas and orchard areas are increasing, while dry agricultural areas, dunes, pasture and meadow areas due to land use rates decreases are observed in these areas.

Considering the land use status of Adana in 2018, it is observed that the forest areas continued to increase in 2018, while at the same time, swampy areas, industrial areas and especially fruit orchards, land use shows that there have been noticeable increases in these areas. The use of dry agricultural areas, vineyards, pasture and meadow areas, bare rocks and sand dunes indicate that the decreases continue in these areas.

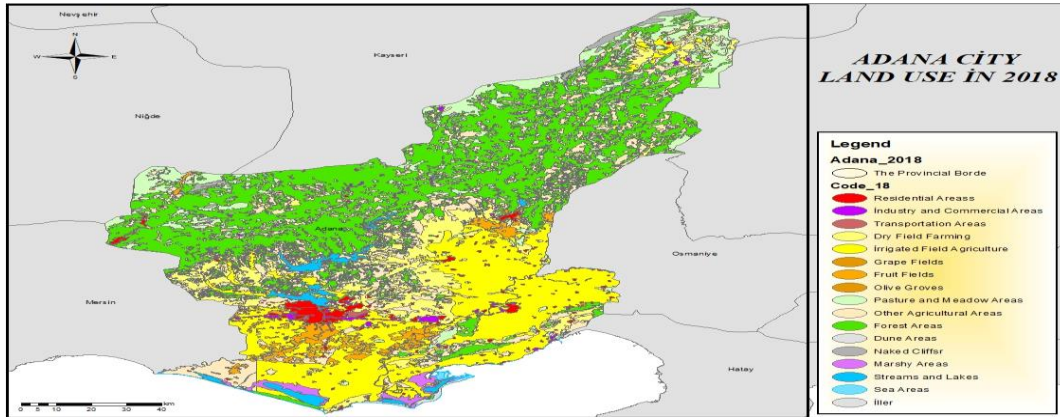


Figure 3. Adana City Land Use In 2018

Conclusion and suggestion

Land use areas in Adana Province, which is the study area, were handled in 15 different categories with the Corine system. While increases were observed in residential and transportation areas, industrial areas, orchards and marshes in Adana province between 1990 and 2018, decreases were observed in pasture and meadow areas, vineyards, dunes and bare rocky areas. Likewise, the increase in population and economic developments, the increase in transportation networks, the increase in highways, the increase in new industrial facility areas and especially the developments in the Organized Industrial Zone have led to the rapid growth of transportation and industrial areas. Due to the newly constructed dams and ponds, there is an increase in the areas of rivers and lakes, as well as sudden increases in orchards. It should be adopted by the society where a healthy and modern life, which is far from environmental problems, is compatible with nature, is important and indispensable for our future. However, as long as necessary precautions are taken, we can leave a sustainable environment that we can pass on to future generations.

References

- [1] Kara, F., &Kartepe, A. (2012). Beykoz District (1986-2011) Land Use Change Analysis with Remote Sensing Technologies.Marmara Journal of Geography, (25), 378-389.
- [2] Özşahin, E., Pekteznel, H., & Eroğlu, İ. (2016). Temporal and Spatial Change of Land Use in Tekirdağ City and Its Surroundings.ZfWT Magazine (8), 307-326.
- [3] Güre, M., Özel, M. E., & Özcan, H. (2009). Çanakkale Province According to Corine Land Use Classification System.Journal of Harran University Faculty ofAgriculture, 37 – 48.



Determining the effect of urbanization on green spaces by NDVI analysis: Bilecik City example

Hüseyin Taş^{*1}, Fatih Adıgüzel², Müjdet Güngör³

¹Nevşehir Hacibektaş Veli University, Faculty of Science and Literature, Geography, Nevşehir, Turkey
huseyinntas0001@gmail.com

²Nevşehir Hacibektaş Veli University, Faculty of Science and Literature, Geography, Nevşehir, Turkey
fadiguzel007@gmail.com

³Nevşehir Hacibektaş Veli University, Gülşehir Vocational School, Nevşehir, Turkey
mujdetgungor@nevsehir.edu.tr

Cite this study: Taş, H., Adıgüzel, F., & Güngör, M. (2021). Determining the effect of urbanization on green spaces by NDVI analysis: Bilecik City example. 1st Advanced Engineering Days, 84-86

Keywords

Geographic Information Systems
Landsat
NDVI Analysis
Bilecik

ABSTRACT

The acceleration of human activities on earth has caused positive or negative effects on the physical environment. These effects have become visible with the advancement of science and technology. Satellite images of Bilecik province used in this study, belonging to three different years, were obtained from Landsat 4-5 TM, Landsat 7 ETM and Landsat 8 OLI satellites. These satellite images were transferred to GIS software and NDVI vegetation analysis was performed. As a result of these analyzes, the parts with intense green color indicate that the vegetation is high, while the parts with the intense red color indicate that the vegetation is low and the settlement is high. The yellow color highlights the transition zone between these two parts. As a result of this analysis, the effect of urbanization on green areas was clearly observed.

Introduction

It is an indisputable fact that humans have a direct or indirect effect on the physical environment. This has sometimes manifested itself as a positive and sometimes a negative effect. It has been observed that natural areas have changed rapidly for human and economic activities with the changing world order. These environmental changes have caused very serious pressures on green areas. Industrialization and the speed of urbanization that occurred in parallel with it have caused significant changes on the natural environment [1]. Today, in parallel with the development of science and technology, changes in the physical environment are revealed more clearly. In this context, it is possible to perform many analyzes with Remote Sensing and GIS techniques. When we look at the studies in the literature, it is seen that NDVI Analysis is generally preferred in vegetation, green areas, temperature and climate research [2]. NDVI Analysis, which means “Normalized Plant Index”, is the easiest and healthiest method in understanding and evaluating the impact of natural and human activities on the earth [3]. Because plants absorb rays 400-700 μm in length and recorded kind of change [4]. In this study, the situation of the central district of Bilecik province was evaluated (Figure 1). Satellite images of Bilecik province of 1990, 2011 and 2021 were processed in ArcGIS, a GIS software, and current analyzes were carried out and its relationship with urbanization was evaluated.

Material and Method

For NDVI Analysis, satellite images of Bilecik province for the years 1900, 2011 and 2021 were obtained from Landsat 4-5 TM, Landsat 7 ETM and Landsat 8 OLI satellites Later, these satellite images obtained were integrated into ArcGIS software and the following formula was added to the raster calculator section of the software, and current analyzes were made [5].



Figure 1. Location map of study area

Results and discussion

As can be seen in Figure 2, red and yellow tones are less and green tones are more in 1990. The main reason for this is the low urbanization and industrial activities.

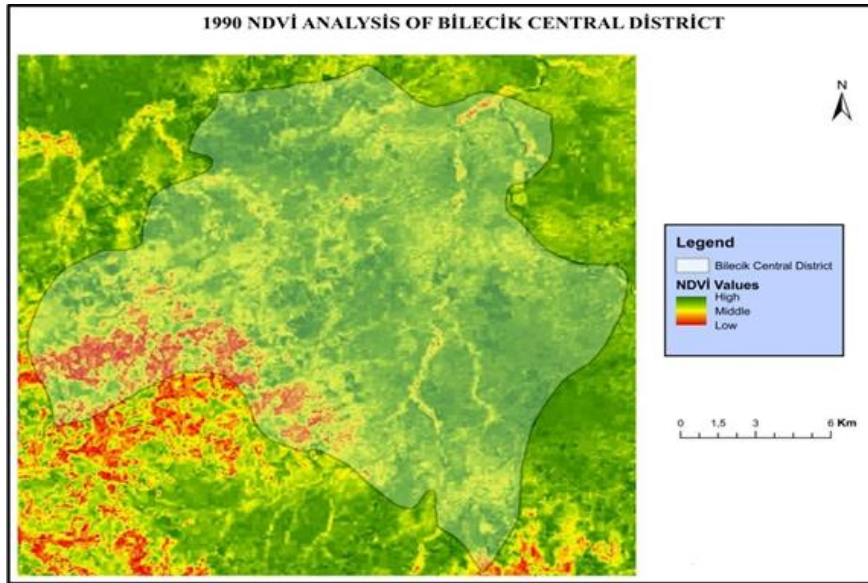


Figure 2. Bilecik Province NDVI Analysis Map dated 26.9.1990.

When it comes to 2011, it is seen that green tones have decreased and yellow and red tones have increased. The main reasons for this situation can be evaluated as the increase in agriculture, industry and tourism activities and the effect of Şeyh Edebalı University, which was established in 2007. The establishment of the university led to an increase in education, accommodation and social areas, and thus, the green areas were opened for development.

When 2021 is examined, there has been an increase in red and yellow tones compared to 2011, while a decrease in green areas has occurred.

Conclusion and suggestion

In our world, where the natural environment and its sustainability are gaining importance day by day. It is important and necessary to know the benefits of green areas and to protect the areas where green is intense. One of the measures to be taken against the global warming problem caused by the increasing temperature levels with the urbanization phenomenon is to protect the existing green areas and make them more sustainable. In

order to increase the quality of life in urban areas and to create healthier cities, the value of green areas is being understood more and more every day. Today, various studies are carried out with different analysis methods in order to reveal the changes in plant densities, to monitor them and to take necessary precautions for their protection. In this study, the density, distribution and change over time of green areas in the Merkez district of Bilecik province were tried to be explained. According to the 1990 NDVI analysis of Bilecik city, it is seen that the green color tone is dominant. When the NDVI analyzes of 2011 and 2021 were examined, it was observed that yellow and red tones became more dominant. Although Bilecik is a small city, it is developing day by day and experiencing an increase in population. In addition to the intensification of industry, trade and tourism activities, Sheikh Edebali University, which was established in 2007, is seen as an important factor in population growth. Considering the development, spread rate and population growth of cities, green areas come to the fore even more. In this context, misuse of green areas should be prevented and long-term and sustainable studies on city plans should accelerate.

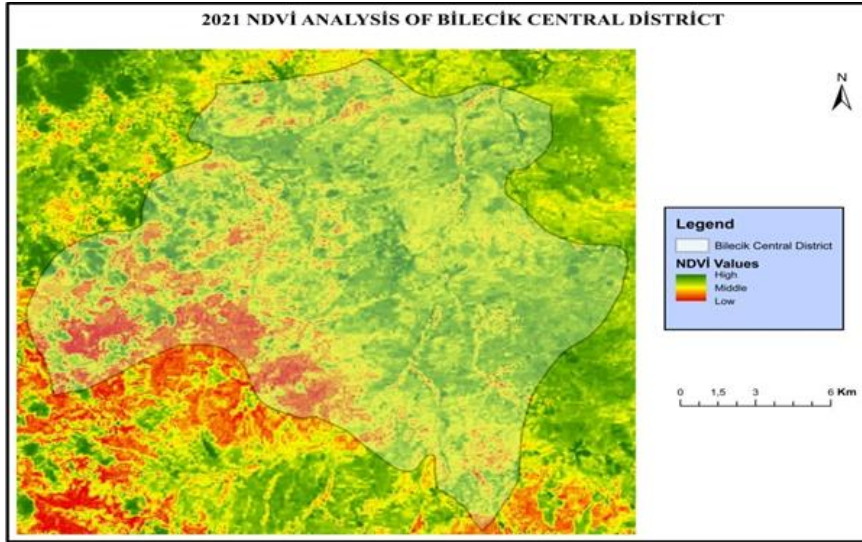


Figure 3. Bilecik Province NDVI Analysis Map dated 14.8.2021

References

- [1] Algancı, U. (2018). Multi-Time Landsat 8 Satellite of Land Cover Changes Identification with Images: The Example of Istanbul. *Map Journal* (160), 24- 33.
- [2] Bozkurt, N., Zontul, M., & Aslan, Z. (2018). To Satellite Data Based on Vegetation Analysis. *Aurum Engineering Systems and Architecture Journal*, 2(1): 75-82.
- [3] Doğan, H. M., Kılıç, O. M., & Yılmaz, D. S. (2014). Tokat Province Plant Density Classes with LANDSAT-7 ETM+ Satellite Images and Geographic Information Systems Researching. *Journal of Gaziosmanpaşa University Faculty of Agriculture*, 31 (1): 47-53.
- [4] Karadas, S.& İmamoğlu, A. (2019). From the Distance of the Süvari Stream Basin Normalized Difference Crop Index Analysis with Detection Techniques (NDVI). *TMMOB 6. Geographic Information Systems Congress*. Ankara.
- [5] Gündoğdu, K. S., & Bantchina, B. (2018). From Landsat Satellite Images Parcel Based Evaluation of NDVI Value Distribution, Uludag University Agriculture Faculty Farm Land Example. *Bursa Uludag University Journal of the Faculty of Agriculture*, 32 (2): 45-53.



Analysis for traffic/road and vehicle/cargo tracking/planning systems (TRVCTPS) in the road transport within the scope of smart cities

Aziz Cumhur Kocalar *¹

¹Niğde Ömer Halisdemir University, Faculty of Architecture, City and Regional Planning Department, Niğde, Turkey, azizcumhurkocalar@gmail.com

Cite this study: Analysis for traffic/road and vehicle/cargo tracking/planning systems (TRVCTPS) in the road transport within the scope of smart cities. 1st Advanced Engineering Days, 87-89

Keywords

Tracking systems
Smart cities
Transportation
Logistics
Disaster logistics
Road transport

ABSTRACT

In the cities, the traffic/road and the vehicle/cargo density constitute a complex problem area. Trip computers, provide information about vehicles and travel. To the extent that this information can be interacted with the traffic and road condition, it will be easier to make an instant travel flow plan and to update the status. However, the depth of interaction is still quite uncertain. Generally, there is a one-way and limited flow of information, and interaction is more focused on obtaining and evaluating information. It is known that vehicles will start to be self-directed (autonomous) in future. It is seen that these expectations force the traffic/road-vehicle situation interaction and management infrastructures to improve through monitoring. The study explores technologies that prioritize traffic/road and vehicle situation interaction within the scope of smart cities. It also evaluates developments in other smart solutions related to the traffic/road and the vehicle/cargo situation tracking/planning (TRVCTPS) from a relational perspective. Especially, the difficulties of disaster and humanitarian aid logistics, can be exceeded, albeit at micro levels, thanks to the development of early warning systems by relevant technologies and institutions, and the implementation of advanced problems and solutions.

Introduction

It is known that hardware and software technologies are developing very fast in recent years and artificial intelligence applications are increasing rapidly in every sector. The network technologies are also developing in the new era after Industry 4.0 and technology are creating a new network society on the way generation after generation. Monitoring systems are also affected by all these developments.

Recent developments in urban informatics from e-government to m-government applications and increasing the dimension of public participation in governance topics were given in a previous study [1]. In those years, this approach was epitomizing new kinds of intelligent approaches.

Smart cities should reflect approaches that always consider interdisciplinary qualities. In a previous study, the focus of the urban space was to begin to examine the problematic systems within this framework. In particular, the transportation sector was chosen as the focus [2]. This paper was published as an ongoing article later and this method will support systematic and sustainable applications in the future [3].

In the cities, to the traffic/road and the vehicle/cargo density constitute a complex problem area in the road transport. The trip computers provide information about the vehicles and travel. To the extent that this information can be interacted with the traffic and road condition, it will be easier to make an instant travel flow plan and to update the status. However, the depth of interaction is still quite uncertain. Generally, there is a one-way and limited flow of information, and the interaction is also focused on obtaining information and evaluating it within the system.

Material and Method

The study explores technologies that prioritize to the traffic/road and the vehicle/cargo situation interaction within the scope of smart cities. It also evaluates developments in other smart solutions related to the traffic/road and the vehicle/cargo situation monitoring from a relational perspective.

The main system is named as Traffic/Road and Vehicle/Cargo Tracking/Planning System (TRVCTPS) in this study.

Research Motivation or Question: Traffic/Road and Vehicle/Cargo Tracking/Planning Systems (TRVCTPS) are developing, how should we evaluate this progress?

The importance of the logistics sector in disaster management is given below and an introduction to the tracking systems has been made.

Logistics in disaster management

Tracking systems are mostly related to the logistics field in connection with freight transportation. Especially, the difficulties of disaster and humanitarian aid logistics, can be exceeded, albeit at micro levels, thanks to the development of early warning systems by relevant technologies and institutions, and the implementation of advanced problems and solutions [4].

Logistics plays a very important role in three phases of disaster management. Cozzolino calls this the "Humanitarian Logistics Stream". Disaster Management Circle: It completes its cycle with Preparedness, Reaction, Reconstruction phases and with the measures phase. [5]. While 7 correct understanding in logistics in enterprises, the focus in disaster logistics is on 3 main elements: quantity, time, and place.

Traffic/Road and Vehicle Tracking/Planning Systems (TRVTPS)

The Traffic/Road and the Vehicle/Cargo Tracking/Planning Systems (TRVCTPS) are related with the different independent systems below. We can understand the technological developments related to tracking systems by briefly introducing those systems with their sub-systems approaches.

1. TTS-Traffic tracking system

Vehicles are tracked for control to the traffic bottleneck in the flow. Vehicles also decide and join waiting queue according to the traffic bottleneck in the flow.

A system approach had been given a study before especially for the bridge traffic bottleneck [6].

1.1 IS-AI TTS- Intelligent Signaling- Artificial intelligence traffic tracking system (EDS)

EDS decides to intelligent signaling for according to the traffic bottleneck in the flow.

2. VTS-Vehicles Tracking Systems

Vehicles are tracked with a central system for logistic operations.

2.1 AV- Autonomous Vehicles

It is known that vehicles will also start to be self-directed (autonomous) in the future. It is seen that these expectations force the traffic/road and the vehicle/cargo situation interaction and management infrastructures to improve through tracking/planning. Considering that in the future, vehicles may begin to be self-managed (autonomous), these forces road communication and management infrastructures to develop. However, the technologies process of autonomous vehicles and "how they will affect driving activities, their impact on planning decisions such as optimum road distance, parking and public transport supply" are still under discussion. Many carriers and urban planners, researchers, and politicians have become more familiar with the technical nature and utility of vehicle automation. But even so, there does not appear to be any consensus yet on the resulting impact or the actions of those responsible [7]. In the other hand some systems are quite independent. A figure gives relation between the technology and systems below (Figure 1).

2.2 LTS- Lane tracking systems

For example, Lane tracking systems are an accident-preventing approach. Lane assistance is often included as part of the safety package. The price rises as similar solutions are also packaged with other additional options.

3. RDTS-Road damage tracking system (instant tracking of road damage with sensors)

RDTS has not any sub-systems yet. May be created in future. Also new systems are coming continually.

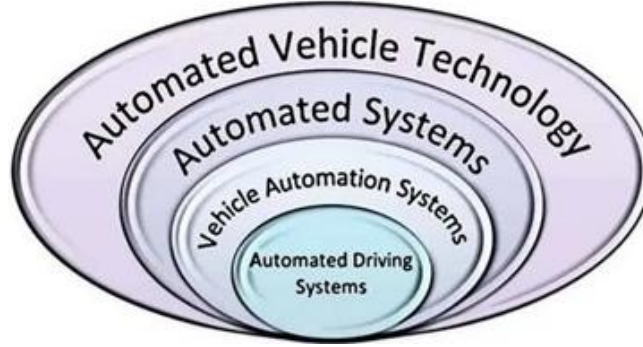


Figure 1. Automated Vehicle Technology and related Systems.

Results

As it is seen, it is clear that we are not ready to prevent the chaos on the roads without planning and management, as we need to think about critical times such as disaster management.

Discussion

Question: Traffic/Road, Vehicle/Cargo, Tracking/Planning Systems (TRVCTPS) are developing, how should we evaluate this progress in case of a narrower perspective within a consolidation approach?

Conclusion

The independent solution steps (LTS, etc.) instead of the sub-systems in a main hierarchical structure works by alone. But society need more integration in the traffic/road, vehicle/cargo, tracking/planning systems in future. Because quantity in vehicles/cargo increasing more and more in over the traffic/road capacity limit.

References

- [1] Kocalar, A. C. (2013b). E-Devletten M-Devlet Uygulamalarına Doğru Kentsel Bilişimdeki Son Gelişmeler ve Halkın Yönetime Katılım Boyutunun Arttırılması, The First International Symposium on Digital Forensics and Security (ISDFS), (Ed. Prof.Dr. Asaf VAROL, Assist.Prof.Dr. Murat Karabatak, vd.), Elazığ, 20-21 May 2013.
- [2] Kocalar, A. C. (2017). Life Cycle Data Analysis for Smart Cities and Support with Geographic Information System (GIS), ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., IV-4/W4, 285–293, <https://doi.org/10.5194/isprs-annals-IV-4-W4-285-2017>, 2017.
- [3] Kocalar, A. C. (2018). Life Cycle Data Analysis for Smart Cities and Support with Geographic Information System (GIS), Volume-V, Issue-I, July 2018. DOI: 10.29032/ijhsss.v5.i1.2018.72-91
- [4] Becerikliler, U. (2017). Maltepe Üniversitesi. Sosyal Bilimler Enstitüsü, Uluslararası Ticaret ve Lojistik Yönetimi Anabilim Dalı, Afet ve İnsani Yardım Lojistiği, Yüksek Lisans Tezi, İstanbul.
- [5] Cozzolino, A. (2012). Cross-Sector Cooperation in Disaster Relief Management, Springer, Heidelberg.
- [6] Kocalar, A. C. (2013a). Karayolunda Motorlu ve Lastik Tekerlekli Özel Amaçlı Araçların Sürüş Güvenliğinde Trafik Kazalarının Önlenmesine Yönelik Bir Karar Destek Sistemi Tasarımı, 4.Karayolu Trafik Sempozyumu, Ankara, 08-09-10.5.2013.
- [7] Tastan, Y. & Kaymaz, H. (2021). Otonom Araçların Önündeki Zorluklar. International Journal of Advances in Engineering and Pure Sciences, 33 (2), 195-209. DOI: 10.7240/jeps.741594.



Monitoring the effects of vegetation cover change on land surface temperature in Nimbia Forest Reserve, Nigeria

Bello Abubakar Abubakar*¹, Sani Abubakar Abubakar²

¹ Nigerian Defence Academy, Faculty of Arts and Social Sciences, Department of Geography, Kaduna, Nigeria, abubakarbello1064@gmail.com

² Kaduna Polytechnic, School of Geodesy and Land Administration, Department of Photogrammetry and Remote Sensing, Kaduna, Nigeria, abu86sani@gmail.com

Cite this study: Bello, A., & Sani, A. (2021). Monitoring the Effects of Vegetation Cover Change on Land Surface Temperature in Nimbia Forest Reserve, Nigeria. 1st Advanced Engineering Days, 90-92

Keywords

Vegetation
Change
NDVI
Land Surface Temperature
Nimbia Forest Reserve

ABSTRACT

Vegetation cover regulates the surface temperature through shading and evapotranspiration. The loss of vegetation cover is a major factor causing higher Land Surface Temperature (LST). This study analyses the effect of forest cover change on LST in Nimbia forest reserve, Nigeria using Landsat data. Maximum-likelihood algorithm was used to classify the area into vegetation and non-vegetation areas. Single-channel algorithm and Normalised Difference vegetation Index (NDVI) were used to extract LST and vegetation density respectively. The relationship between vegetation cover and LST was quantified by correlation analysis. The results revealed that from 2013 to 2020, the forest area decreased from 11.50km² (81.28%) to 10.14 km² (71.68%). The average NDVI also declined from 0.63 to 0.42 which led to the increase in the mean LST from 30°C to 34.5°C. There is a need for monitoring the forest reserve for proper conservation.

Introduction

Vegetation cover provides a vital role in the mitigation of climate change through the cooling effects of shading, high albedo and evapotranspiration [1]. Decrease in vegetation cover as a result of urban expansion and other anthropogenic activities contribute to an increase in surface temperature [2-4]. Land Surface temperature is the radiative temperature of the surface that is derived from solar radiation [5-6].

Remote sensing is one of the effective tools used for studying LST because of its ability to record emitted energy from the surface [4]. Moreover, vegetation cover can be studied from the remotely sensed data using an index [7]. Nimbia Forest reserve located in Kaduna, Nigeria experiences a decline as a result of anthropogenic activities [8]. The degradation of the forest affects both the surface and air temperature. This study analyses the effect of the forest change on LST.

Materials and Methods

Study area

Nimbia forest reserve located in Jema'a Local Government Area of Kaduna State, Nigeria lies between longitudes 8°30' and 8°35' E and latitudes 9°29' and 9°31' N (Figure 1). It is located in the Guinea Savanna vegetation zone with an approximate area of 2, 282.4 hectares. The natural vegetation was cleared in 1976 and replaced with much teak (*Tectona grandis*) and a few *gmelina arbirea* stands. The minimum temperature ranges between 11°C and 12.9°C, while a maximum temperature of 25°C is recorded in March [8]. July and August are the months with the highest relative humidity because of the high rainfall [8-9].

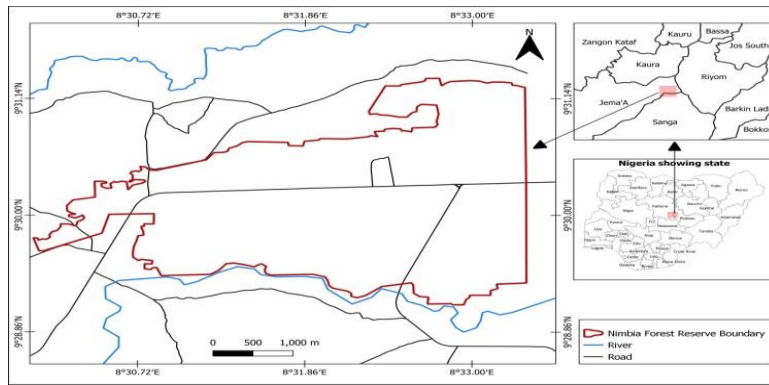


Figure 1. Location of the study area

Data

In this study, satellite data acquired by Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensors (TIRS) were obtained from the United States Geological Survey Earth Explorer data portal. Imageries dated 11 November, 2013 and 30 November, 2020 were used for the extraction of LST and vegetation cover.

Methods

The study area was classified into vegetation and non-vegetation using a maximum likelihood supervised classification. Normalised Difference Vegetation Index (NDVI) was employed to extract the vegetation density, Single channel algorithm was used to retrieve the LST and finally, the relationship between LST and vegetation cover was quantified using correlation analysis. The satellite imageries were processed using Semi-Automatic Classification Plugin (SCP) for QGIS.

Results

The results revealed that in 2013, the area was dominated by vegetation that covered 11.50km² (81.28%), while the non-vegetation area accounted for 2.65km² (18.72%). In 2020, the forest decreased to 10.14 km² (71.68%) as a result of the expansion of the non-vegetation area that increased to 4.01 km² (28.32%). Generally, from 2013 to 2020, the forest reserve decreased by 1.36 km² (13.45%) while the non-forest area expanded by 1.36 km² (33.87%). The density of the vegetation indicated by the NDVI values shows a spatial and temporal variation (Figure 2). In 2013, the lowest value was 0.43, while the highest was 0.83. There was a decline in 2020 with 0.19 and 0.65 as the lowest and highest values respectively.

The spatiotemporal pattern of the LST varied over the forest reserve or the study period (Figure 2). A surface temperature ranges from 26°C to 34°C was recorded in 2013 with an increase in 2020 that range from 29°C to 40°C. There is a negative correlation between vegetation cover and LST with -0.79 and -0.81 for 2013 and 2020 respectively.

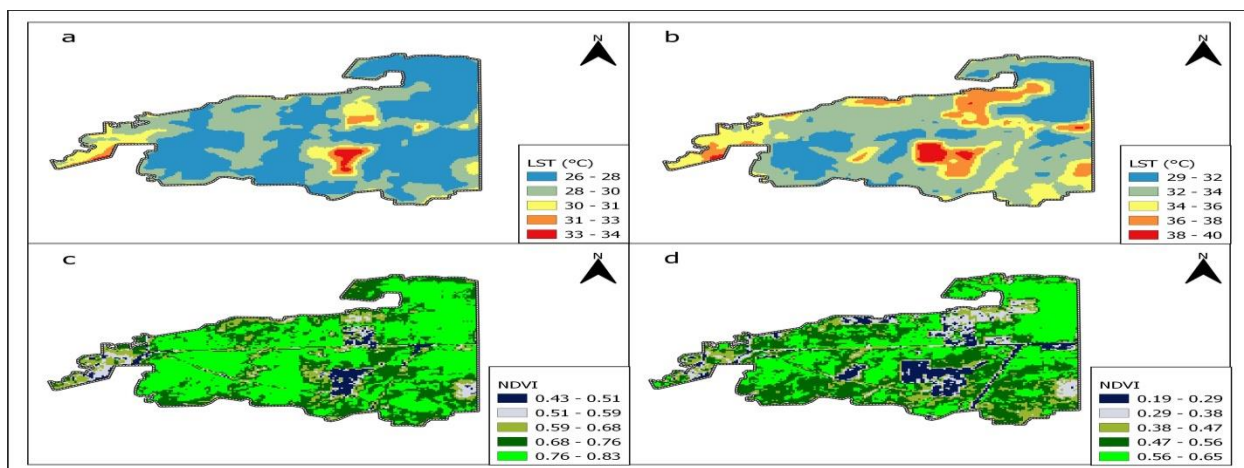


Figure 2. (a) LST map for 2013 (b) LST map for 2020 (c) NDVI map for 2013 (d) NDVI map for 2020

Discussion

The decrease in the forest reserve is a result of anthropogenic activities like clearance for agriculture and collection of wood from the forest. The decrease in the density of the forest indicated by the NDVI values can be attributed to such anthropogenic activities. A previous study by [8] also found a decline in the forest reserve as a result of the anthropogenic activities. An increase in the spatiotemporal pattern of the LST is connected with the decrease in vegetation as a result of decrease in shade, albedo, and evapotranspiration. Moreover, heat emission from the cleared part of the forest contributed to the increase in the surface temperature. The negative correlation between the vegetation cover and LST shows the effect of vegetation in mitigating the LST.

Conclusion

This study examines the effect of vegetation cover change on LST in Nimbia forest reserve, Nigeria. Landsat data were used to extract vegetation and LST single-channel algorithm and NDVI respectively. Maximum likelihood supervised classification was applied to classify the area into vegetation and non-vegetation areas. Correlation analysis was used to quantify the relationship between vegetation and LST. The result revealed a decrease in the area of the forest as a result of anthropogenic activities that led to a decline in its density. There was an increase in the spatiotemporal pattern of the LST caused by the decrease in the vegetation cover. A negative correlation indicated the effect of forest in mitigating LST. Remote sensing is a powerful tool for evaluating the influence of vegetation cover change on LST.

Acknowledgement

We wish to thank the United States Geological Survey (USGS) for the satellite imageries made freely available.

Funding: This research received no external funding.

Author contributions:

Bello Abubakar Abubakar: Conceptualization, Methodology, Writing-Original draft preparation, Writing-Reviewing and Editing. **Sani Abubakar Abubakar:** Data curation, Software, Validation, Visualization, Investigation.

Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Alavipanah, S., Wegmann, M., Qureshi, S., Weng, Q., & Koellner, T. (2015). The Role of Vegetation in Mitigating Urban Land Surface Temperatures: A Case Study of Munich, Germany during the Warm Season. *Sustainability*, 7, 4689-4706.
- [2] Bokaie, M., Zarkesh, M., Arasteh, P. D., & Hosseini, A. (2016). Assessment of urban heat island based on the relationship between land surface temperature and land use/land cover in Tehran. *Sustainable Cities and Society*, 23, 94–104.
- [3] Pal, S., & Ziaul, S. (2017). Detection of land use and land cover change and land surface temperature in English Bazar urban centre. *The Egyptian Journal of Remote Sensing and Space Science*, 20, (1), 125–145.
- [4] Zhi, Y., Shan, L., Ke, L., & Yang, R. (2020). Analysis of Land Surface Temperature Driving Factors and Spatial Heterogeneity Research Based on Geographically Weighted Regression Model. *Hindawi Complexity*, 2862917, 1-9.
- [5] John, J., Bindu, G., Srimuruganandam, B., Wadhwa, A., & Rajan, P. (2020). Land use/land cover and land surface temperature analysis in Wayanad district, India, using satellite imagery. *Ann GIS*.
- [6] Imran, H. M., Hossain, A., Saiful Islam, A. K. M., Rahman, A., Md Abul Ehsan, B., Paul, S., & Alam, A. (2021). Impact of Land Cover Changes on Land Surface Temperature and Human Thermal Comfort in Dhaka City of Bangladesh. *Earth Systems and Environment*, 5, 667-693.
- [7] Alshaikh, A. (2015). Vegetation Cover Density and Land Surface Temperature Interrelationship Using Satellite Data, Case Study of Wadi Bisha, South KSA. *Advances in Remote Sensing*, 4, 248-262.
- [8] Ismaila, M. T., Mohammed, Y. T., Hussaini, Y., Zakari, M. S., Musa, I., & Ezra, V. L. (2014). Analysis of Forest Cover Changes in Nimbia Forest Reserve, Kaduna State, Nigeria Using Geographic Information System and Remote Sensing Techniques. *International Journal of Environmental Monitoring and Analysis*, 2(2), 91-99.
- [9] Ayuba, S. M. (2006). Evaluation of Soil Properties and Development under Teak (*tecton grandis linn F.*). Dissertation, Ahmadu Bello University, Zaria.



Virtual reality supported design and manufacturing suitable for use in hand and wrist function disorders

Pınar Aslan Yıldırım ¹, Adnan Akkurt ¹

¹Gazi University, Graduate School of Natural and Applied Sciences, Industrial Design Engineering, 06500, Ankara, Turkey
pinar.aslanyildirim1@gazi.edu.tr; aakkurt@gazi.edu.tr

Cite this study: Aslan Yildirim, P., & Akkurt, A. (2021). Virtual reality supported design and manufacturing suitable for use in hand. 1st Advanced Engineering Days, 93-95

Keywords

Physical therapy
Unity
Virtual reality
Hand, finger, wrist movements
Fine motor movements

ABSTRACT

Physical therapy and rehabilitation therapies are long-term results that require patience and stability. Therapies; depending on the region and degree of disorders can sometimes be painful and difficult. The design to be proposed with this study; it is designed to help patients who need physical therapy for hand and ankle discomforts more easily and in a fun way, which can be painful and boring. With the designed product, it is aimed to enable the patients to make the necessary movements in their homes. This design is intended to be made of lightweight material that can be worn on the hand and which does not interfere with movement. In addition to that, this design is planned to be used in conjunction with virtual reality environment including fine motor movements such as unlocking, holding small parts, needle threading and limited solutions in the literature and market. Supported by games developed on the base of Unity, physical therapy is expected to motivate patients, and patients are expected to adhere to treatment programs and to achieve more efficient results.

Introduction

While the opportunities and conveniences provided by technology are becoming more and more ingrained in our lives, it also brings some negativities with changing life cultures. Industry 4.0 is based on the fact that people obtain products by managing systems, automations and machines, which are not based on human power. Individuals who have acquired the culture of fulfilling their needs through information systems can unconsciously remove many vital functions that provide a healthy life, such as being active and benefiting from the sun. In addition to this, of course, people can experience physical damage that cannot be easily repaired in births, traffic and unexpected accidents. In patients with reduced mobility for any reason, patients may need to be treated in physical therapy centers to restore the lost movements. Physical therapy and rehabilitation treatments are processes that give long-term results and require patience and stability. Treatments; sometimes it can be painful and difficult, depending on the area and degree of discomfort.

In this study, it is aimed to design a solution that will help patients who need physical therapy for hand and wrist disorders to perform painful and sometimes boring rehabilitation treatments in an easier and more enjoyable way.

Our aim is to make physical therapy movements funny with the game that uses gloves which are worn on the hand, has sensor support and can be followed on a monitor with a wireless connection. With this design, the physical therapy process will be more enjoyable and the patient will be motivated for treatment.

In this design, it is aimed to develop a product for the discomfort, experienced in the hand and wrist regions that includes fine motor movements, which are not found in the examples in the literature and the market. To enable patients to perform fine motor movements; it is planned to present a virtual reality environment that includes movements such as unlocking with a key, holding small parts, threading a needle. With the help of this design, patients will be able to perform the necessary movements at home if they wish. It is aimed that the product planned to be developed will be suitable for both adults and pediatric patients.

It is aimed to offer a local product alternative to centers and patients with virtual reality-based treatment methods, instead of products which are imported with high budgets.

Material and Method

Proper use of hand and wrist disorders virtual reality aided physical therapy device

It is a priority to gain the qualifications that are not found in the literature and the market in the ailments experienced in the hand and wrist regions. It is aimed to produce a local product and offer a local alternative to the domestic market for the centers and patients that offer virtual reality-based treatment methods imported with high budgets.

The method to be followed in the development of the system can be explained as follows;

- The product to be developed should be aimed at both adult and pediatric patients,
- A product that covers fine motor movements should be developed,
- For patients to make fine motor movements; it is necessary to present a virtual reality environment that covers unlocking with a key, holding small parts, threading the needle,
- Must be cost effective,
- The material to be used should be durable, suitable for use in the clinical environment, cleanable, flexible enough to not prevent movement, it is considered to use an elastomer material that can meet all these features in production.

The working principles of the system can be explained as follows;

1. Sensor infrastructure to be used in the product;

- It should be in a structure that will not prevent flexion, extension, radial-ulnar deviation, pronation-supination movements and should also allow fine motor hand movements,
- At the joint points of DIP, PIP, MCP in four fingers; in the thumb, it should be at the IP, MCP, CMC joint points,
- It should be of the bending or flex sensors type and should allow transferring the joint angles to the computer.

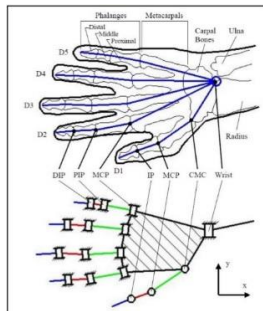


Figure 3. Display of joints where sensors should be placed

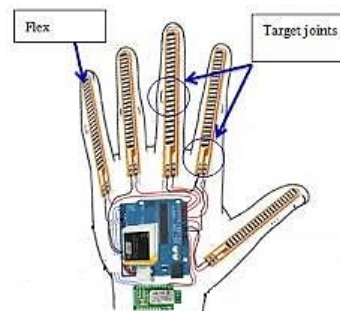


Figure 4. Placement of sensors.

2.The virtual reality infrastructure to be used in this design;

- Ability to process and interpret motion angles received from sensors,
- Having game options that will enable patients to perform fine motor movements in addition to the basic motor movements of the hand and wrist,
- Determining the number of sets required for each movement with the calibration process to be performed for the first use, specific to the patient,
- Comparing the movement angles of the patient with the movement angles of the healthy person currently kept in the database,
- It should include motivating elements such as taking the patients who perform the movements correctly and precisely to the next level.

3.In the reporting processes of the design;

- Graphical display of movement-based proficiency levels and completion times of the exercises performed,
- When the patient is online, it will be possible to send the daily status reports to the doctor by e-mail and to keep the patient under remote control.

Discussion

In this study, first of all, market research was conducted and the devices preferred in physical therapy and rehabilitation processes were examined. Then, a literature review was made and academic studies on the subject were examined. Findings are summarized as follows:

The working principles of “Rapael Smart Glove” can be explained as follows;

- Features a wearable technology on the hand,
- Bending Sensor infrastructure is available,
- The sensor is a 9-axis motion and position sensor consisting of 3 acceleration channels, 3 angular velocity channels, and 3 magnetic field channels that measure wrist movements,
- It has a wireless connection,
- It is made of elastomer material,
- Supports forearm supination/pronation, wrist flexion, extension, radial-ulnar deviation, finger flexion and extension movements, (Rapael Smart Glove Brochure, 2016)

The working principles of “Armeo@Spring” can be explained as follows;

- It can be applied in patients with stroke, multiple sclerosis (MS), spinal cord injury, cerebral palsy, subsequent brain damage, burning cases, recovery from humerus fracture,
- Can make an objective assessment,
- Increased performance feedback,
- Includes hand functions exercise,
- Has arm support,
- It has mechanical support.

The working principles of “Armeo@Senso” can be explained as follows;

- In addition to the features of the Armeo@Spring product, it is suitable for use at home with remote control after the first training given by a therapist. (Hocoma Armeo Brochure, 2018),
- There is a tool for the hand,
- There are 3 motion sensors on the wrist, elbow and chest.

In the literature review, it is noticed that;

- Different materials,
- Different sensor infrastructures are preferred,
- There are studies on the ailments experienced in different limbs,
- It has been observed that different physical therapy movements can be supported.

Conclusion

We aim to provide an enjoyable treatment opportunity for patients with neurological and orthopedic disorders in the hand and wrist region.

In addition, we want to diminish the amount of money used to import products by producing these innovative products domestically.

References

- [1] Rapael Smart Glove Brochure, (2017, February), URL: https://content.neofect.com/en/wp-content/uploads/2016/03/RAPAEEL-GLOVE-Brochure_Eng.pdf
- [2] Hocoma Armeo Brochure, (2019, February), URL: https://knowledge.hocoma.com/wp-content/uploads/2018/12/bro_ArmeoTC_ResearchBrochure_20190218_WEB-1.pdf
- [3] Hocoma Armeo Spring, URL: <https://www.hocoma.com/solutions/armeo-spring/>



Figure 5. Neofect Rapael Smart Glove [1]



Figure 6. Hocoma\Armeo@Spring [2]



Figure 7. Hocoma/Armeo@Senso [3]



Advanced Engineering Days

aed.mersin.edu.tr



A concept study of the recycling of end-of-life tires for use in the construction of buildings

Çağrı Çağan ^{*1}, İskender Özkul ²,

¹Mersin University, Institute of Science, Mersin, Turkey

²Mersin University, Faculty of Engineering, Department of Mechanical Engineering, Mersin, Turkey

Cite this study: Çağan, Ç., & Özkul, İ. (2021). A concept study of the recycling of end-of-life tires for use in the construction of buildings. 1st Advanced Engineering Days, 96-99

Keywords

Rubber
Car Tire
Recycling
Sustainability
Composite brick

ABSTRACT

In this study, it has been tried to dispose of rubber-based tires that have completed their useful life in terms of environment and economy and to bring them back to the economy. Tires, which contain synthetic, natural rubber, carbon black, steel, textile and many binding chemicals, come to the fore as a threat to environmental pollution day by day due to the increase in the number of vehicles. Tire dumps have already formed in most countries around the world and their numbers continue to increase. At the point of disposal and recycling of tires to the environment, it is considered to add a mixture of grinded and processed granular rubber and steel to the bricks used in the construction of residential walls. It is thought that examining this solution in terms of economy, human health and applicability in the long term will contribute positively to sustainable environment and climate change.

Introduction

According to the report published by GoldStein [1], 1.6 billion new tires are produced globally every year. Apart from the tires produced, nearly 1 billion tires are released into the environment as waste every year. Only 100 million of these tires are recycled. Many countries, especially Arabic countries and the Middle East, have problems in the disposal of these tires. In deserts and cities, tire dumps reach gigantic proportions.

Complex processes applied to increase the durability and service life of tires make it very difficult to recycle them in nature. In a research conducted by [2], when a tire content of P205/55/R16 size (width/profile/diameter) is examined in the light of the information given by the manufacturer; precipitated silica (9.65), carbon black (19%), coated steel wires (11.4%), oil (6.12%), textiles (4.7%), sulfur (1.28%), stearic acid (0.96%), recycled rubber (0.5) % and synthetic (24.17%) and natural (18.21%) rubber [3]. The vulcanization process (reinforcement of carbon bonds with sulfur), especially for natural rubber to be more elastic and to increase its service life, serves the purpose of use of tires, but makes recycling difficult.

The images of the tire dump above were obtained from Kuwait [4]. One of the largest tire dumps in the world is located in Kuwait, and tire fires occur in certain regions at certain times of the year. The table below shows how much other substances are used quantitatively in the production of 1 vehicle tire.



Figure 1. Used tire storage area in Kuwait [4]

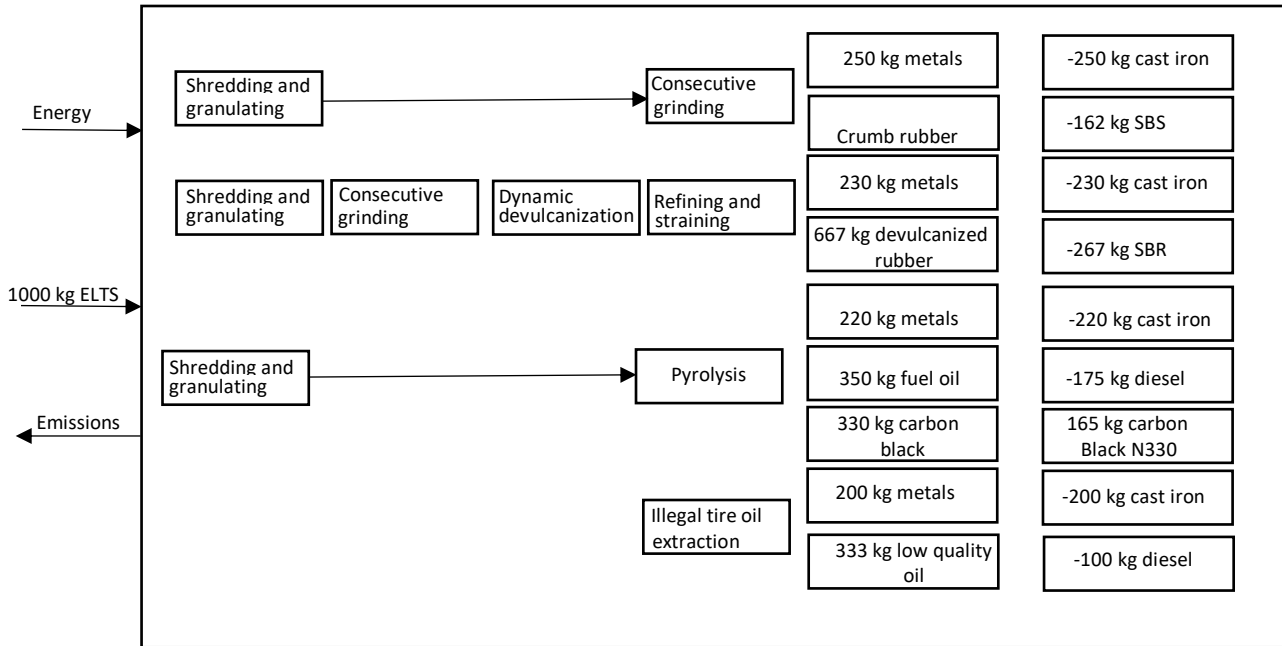
Table 1. Total consumption per one tire manufactured [2]

Total Consumption per one Tire Manufactured	
Input	Quantity
Production Stage	
Synthetic rubber (kg)	1.928
Natural rubber (kg)	1.456
Carbon black (kg)	1.496
Precipitated silica(kg)	0.768
Sulfur compounds (kg)	0.096
Zinc oxide (kg)	0.128
Mineral and plant oils (kg)	0.472
Stearic acid (kg)	0.08
Rubber from recycling (kg)	0.04
Steel wires (kg)	0.888
Textiles (kg)	0.368
Polymer substances-polyuretanec (kg)	0.192
Ethyl acetate (kg)	0.024
Substance facilitating rubber gluing butadiene adhesives (kg)	0.024
Remanining solvents (kg)	0.016
Water (L)	36.112
Electricity (MJ)	828.896
Others (kg)	0.096
Use Stage	
Furnace oil for power generation(L)	5.12
High-speed diesel for power consumption(L)	0.2716
Recycling Stage	
Used tire (kg)	40
Water (L)	36.112
Electricity (MJ)	828.896
Mineral and plant oils (kg)	0.472

Material and Method

According to a study conducted in China by [5], tires are recycled in 4 stages. These stages are detailed in the table below. When the cost benefit calculation is made according to this table, it is seen that the most effective way to dispose of tires is pyrolysis. However, considering that there is a constant demand for rubber in the industry, devulcanization is an important application method for the disposal of tires.

Table 2. Recycling methods of waste tires [5]



Crumb Rubber, tire derived fuel (TDF), rubberized asphalt, stall mats (Pet and Horse), playground material, automotive parts bonded rubber/molded products, upholstery products are currently obtained in the disposal of end-of-life tires. There is still a great contribution to be made to the added value by recycling these tires. With the study we will do, it is planned to add granular waste rubber pieces (3%-7%) to the iso bricks that will be used as insulation and wall material. In this way, insulation will be provided with the rubber material contained in the tire. With the steel wires in the tire content, the strength of the brick mortar will be increased.

The solution we have proposed is a method that we think will cause the least harm to nature in order to ensure the disposal of tires in a controlled manner. In this method, the used tire, which has been made into particles or fibers, will be stacked in the building material in a controlled manner. While the fibrous structures increase the strength value of the material, the granular structures will create pores in the building element. Although the porous rubber particles (~0.13 W/mK) are less efficient than the heat transmission coefficient of the air (~0.026 W/mK), it has a positive effect on the event heat transmission since it is lower than the heat transmission coefficient of the brick (~0.33 W/mK). In addition, considering that both sides of the plaster brick will be covered, it is ensured that the interface of the brick is closed to interaction.

References

[1] Goldstein. (2021). Retrieved from <https://www.goldsteinresearch.com/report/global-tire-recycling-industry-market-trends-analysis>

[2] Piotrowska, K., Kruszelnicka, W., Bałdowska-Witos, P., Kasner, R., Rudnicki, J., Tomporowski, A., ... Opielak, M. (2019). Assessment of the environmental impact of a car tire throughout its lifecycle using the lca method. *Materials*, 12(24), 4177.

[3] Giroto, M. (2021). Retrieved from <https://www.youtube.com/watch?v=IBFdSLGnrB0>

[4] Agency, A. (2021). Retrieved from <https://www.aa.com.tr/tr/dunya/kuevyt-dunyanin-en-buyuk-lastik-mezarligindan-kurtulmaya-calisiyor/2332656>

[5] Li, X., Xu, H., Gao, Y., & Tao, Y. (2010). Comparison of end-of-life tire treatment technologies: A Chinese case study. *Waste management*, 30(11), 2235-2246.



Soft-story deficiency due to open ground story in properly designed reinforced concrete buildings

Emre Akin *¹ 

¹Mersin University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, eakin@mersin.edu.tr

Cite this study: Akin, A. (2021). Soft-story deficiency due to open ground story in properly designed reinforced concrete buildings. 1st Advanced Engineering Days, 99-101

Keywords

Soft story
Reinforced concrete
Open ground story
Infill wall
Seismic response

ABSTRACT

The possible deficiencies that may be caused by the infill walls have been revealed in the literature. The absence of infill walls at the ground story that is termed as the open ground story has generally been related to a soft story deficiency. However, the scale of an accumulation of seismic demands at the ground story due to the absence of infill walls at that particular level should depend on some other parameters regarding the characteristics of infill wall, structural system and even ground motion. The seismic code-compliant reinforced concrete buildings are considered in this study. The soft-story problem due to the open ground story in these types of buildings was considered with a special emphasis on the varying amounts of shear walls. Five-time history records were selected to be used in nonlinear time history analyses of three different building models. The results show that there may be a risk for the soft story formation even in the case of properly designed buildings which may be eliminated by a certain amount of shear walls.

Introduction

The effects of infill walls on the lateral response of reinforced concrete (RC) frame buildings in various stages of the seismic response are known to a certain level thanks to the former studies in this field [1-2]. These studies have concluded that non-uniform allocation of strength and stiffness may take place due to the irregular distribution of infills along the height or on the plan of the building. The open ground story (OGS), where there no infill walls to be able to be used for parking facility or commercial purposes, is generally related to a soft story deficiency. The soft story is defined considering the relative inter-story drift ratios (IDR) of the adjacent stories in Turkish seismic code [3]. However, the IDR values are estimated using lateral drifts that are obtained from linear static analysis according to the code.

The current study focuses on the severity of the soft story irregularity that may be induced by OGS in properly designed RC buildings with none or varying amounts of shear walls. The accumulation of inelastic seismic demands at the ground story as a result of time history analyses will be investigated for this purpose.

Material and Method

SeismoStruct software was used for the nonlinear modeling and dynamic time-history analyses. The models used in the analyses represent 4-story residential RC buildings which have three spans along both orthogonal axes. The RC buildings were designed in three groups to have no shear walls (NSW), two shear walls (SW-2) and four shear walls (SW-4) along the x-axis. The relative cross-sectional areas of shear walls with respect to the floor area are 0.36% and 0.72% for groups SW-2 and SW-4, respectively. The corresponding cross-sectional dimensions of one shear wall was selected as 250×1750 mm². All three buildings were designed according to the previous seismic code of Turkey by considering capacity design principles and with a selection of high-ductility level. The slabs and beams were assumed to behave as a rigid diaphragm in the lateral direction. The dead and live loads of slabs were 4.38 and 2.0 kN/m², respectively. The unit weights of the concrete and infill walls were assumed as 24 and 8 kN/m³, respectively. Only the weights of the infill walls were considered (i.e., as non-structural members)

in the design of structural systems. The characteristic compressive strength and modulus of elasticity of concrete were chosen as 25 and 30000 MPa, respectively. The typical S420 steel with a characteristic yield strength of 420 MPa was assumed for the transverse and longitudinal reinforcements. The reinforcement details of the columns, all of which have identical cross-sectional dimensions of 250×600 mm², are shown in Table 1. All shear walls are reinforced by 10φ14 longitudinal bars at the end columns and 18φ14 longitudinal bars at the main body. φ10 bars were used by a spacing of 160 mm. as the lateral reinforcements at the main body of shear walls. The cross-sectional dimensions of all beams were 250×500 mm². The longitudinal reinforcements of beams which vary depending on the location and supporting members were chosen such that capacity design principles are ensured. The transverse reinforcement of all beams is φ8/140 mm. The layout plan for the structural system of the NSW model is shown in Fig. 1. The shear walls were replaced by the columns C02 and C14 in group SW-2 and columns C01, C04, C13 and C16 in group SW-4.

Table 1. Longitudinal reinforcements of columns

Group	Columns	Longitudinal Reinf.	Lateral Reinf.
NSW	C05, C08, C09, C12	14φ20	φ8/100 mm
	C01, C04, C13, C16	10φ20	
	All other columns	8φ20	
SW-2	C05, C08, C09, C12	12φ20	
	All other columns	8φ20	
SW-4	C05, C08, C09, C12	10φ20	
	All other columns	8φ20	

Three infill wall patterns that are bare frame (BF) without infills, fully infilled (FI) and open ground story (OGS) were considered in the study. Four interior spans (B1-B2, B3-B4, C1-C2 and C3-C4) and two exterior spans (A2-A3 and D2-D3) which are along the x-axis were assumed to be infilled where required. The thicknesses of interior and exterior infills are taken to be 100 and 200 mm, respectively. The details of the modeling were explained by Akin (2019). A nonlinear time history analyses of the models were employed by using five ground motion records: “Dinar-Turkey”, “Düzce-Turkey”, “Imperial Valley-California-06”, “Kobe-Japan” and “Managua-Nicaragua-01”.

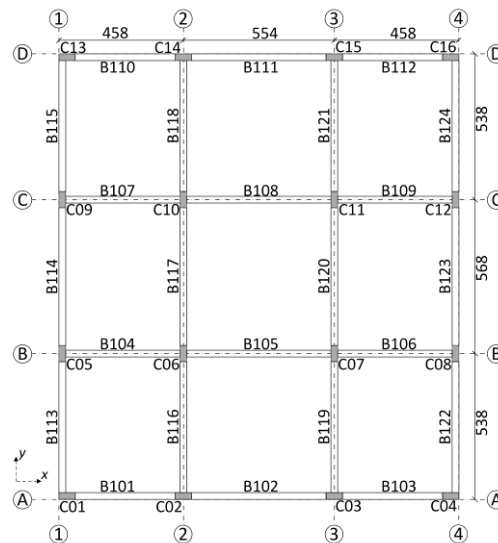


Figure 1. Plan view of the model in group NSW (dimensions in cm.)

Discussion of Results

The moment-rotation hysteretic curves of the frame members at the integration sections were checked to determine the progress of the sectional inelastic response and plastic hinge formation. In the discussions, the models are entitled to represent the presence and amount of shear walls (i.e. NSW, SW-2 and SW-4), infill wall pattern (i.e. BF, FI and OGS) and ground motion record (i.e. Dinar, Düzce, ImpVall, Kobe and Managua) in the given order. The story at the entrance level was named as “ground story” and the upper three stories are “first”, “second” and “third” from the bottom to the top.

The consequent distribution of plastic hinges on the frames along A-A and B-B axes for the BF and OGS models which were subjected to Düzce record is illustrated in Fig. 2. It is apparent that there was a significant accumulation of inelastic seismic demands at the ground story of NSW models due to the infill wall pattern of OGS in comparison to BF. In group SW-2, there was also an increase in the inelastic demands at the ground story of the OGS model compared to BF. However, this was not as serious as it was in group NSW. On the contrary, the

distribution of plastic hinges remained almost identical in case of OGS when compared with BF model in group SW-4.

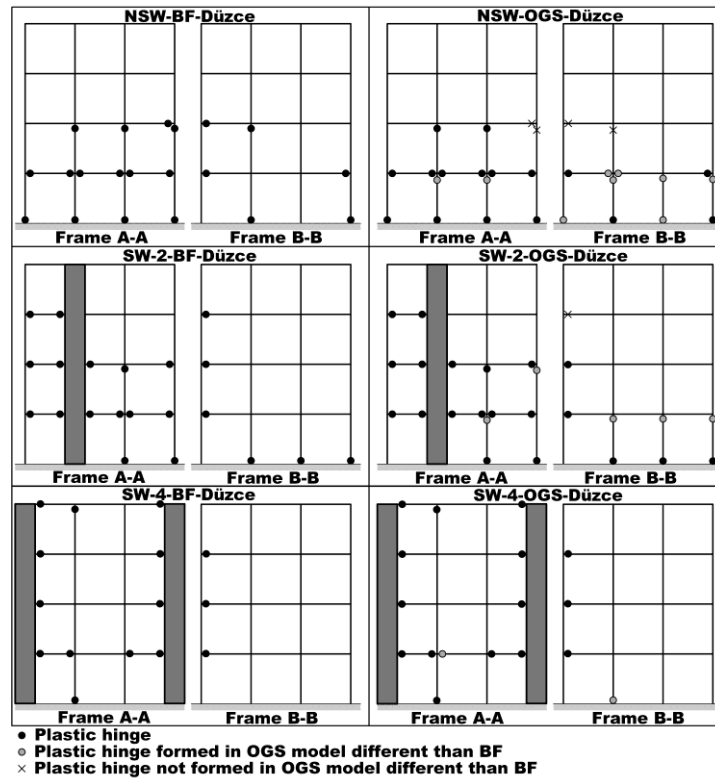


Figure 2. Lateral drift ratio profiles of the models

Conclusion

The results of this study have pointed out a considerable accumulation of inelastic seismic demands at the ground story of seismic code-compliant frame type (i.e., NSW) RC buildings due to OGS. The plastic hinge formations which were observed at both ends of the majority of ground story columns under all considered ground motion records show that a column sidesway mechanism may easily be produced for these types of buildings with OGS. Such an accumulation of seismic demands at the ground story was also the case for SW-2 models with a lower intensity. It may be stated that the risk for a possible sidesway mechanism stands also for the SW-2 models with OGS by observing the number and distribution of plastic hinges although this was reduced thanks to the shear walls with a ratio (i.e., shear wall area/floor area) of 0.36%. The results of SW-4 models have indicated that the effect of infill walls on the lateral response of the structure and consequently the risk for a soft-story deficiency due to OGS could be reduced significantly by the participation of shear walls with a ratio of 0.72%. These results further designate that a threshold value may exist for the amount of shear walls to eliminate the risk for a soft-story deficiency in new constructions, if an infill wall pattern with OGS is required in these buildings.

Funding:

This research received no external funding.

Conflicts of interest:

The authors declare no conflicts of interest.

References

- [1] Negro, P. & Colombo, A. (1997). Irregularities induced by nonstructural masonry panels in framed buildings. *Engineering Structures*, 19, 576-585.
- [2] Akin, E. (2019). Open ground story in properly designed reinforced concrete frame buildings with shear walls. *Structures*, 20, 822-831.
- [3] AFAD (2018). Turkish Earthquake Code for Buildings. The Disaster and Emergency Management Authority of Turkey, Ankara, Turkey.



Evaluation of the soil conditions in Alikahya Region (İzmit)

Talas Fikret Kurnaz *¹

¹Mersin University, Vocational Sch. of Technical Sci., Dep. of Transportation Services, Mersin, Turkey, fkurnaz@mersin.edu.tr

Cite this study: Kurnaz, T. F. (2021). Evaluation of the soil conditions in Alikahya Region (İzmit). 1st Advanced Engineering Days, 102-104

Keywords

Soil investigation
Geotechnic
Geophisic
Liquefaction
Alikahya

ABSTRACT

In this study, the soil conditions of Alikahya region (İzmit) were investigated by the results of geological, geophysical and geotechnical survey results. Alikahya region is almost entirely located on sub-mid-upper Eocene aged rocks and Quaternary aged sediments. The alluvium thickness is nearly 300 m. According to seismic studies, P-wave velocities are between 277-2562 m / sec, and S-wave velocities are between 110-1427 m / sec in the study area. The local soil classes were found Z-3 on the clay stones and Z-4 on the Quaternary aged alluvium, respectively. The ground water level varies between 1-2 m depths in the alluvium. Alikahya region located on first degree earthquake risk zone. Liquefaction analysis results indicated that the region has liquefaction potential.

Introduction

Since our country is located on an active tectonic belt, it has a suitable topography for natural disasters such as earthquakes and landslides. This reveals the necessity of determining safe and risky areas in terms of soil properties in the planning of residential areas. Especially the losses and damages experienced in the İzmit and Düzce earthquakes in 1999 have contributed to the development of earthquake awareness and sensitivity about the precautions to be taken against possible earthquakes in our country.

Local ground conditions also play an important role in the assessment of earthquake risk for residential areas, as well as features such as the probability of an earthquake, its magnitude and distance from the study area. While seismic waves pass through the soil layers, their properties can change according to the local soil conditions and can decrease or increase the earthquake forces acting on the structures located on the ground surface [1]. Likewise, during the propagation of earthquake waves, the properties of the soil layers can also change. For this reason, detailed investigation of local soil conditions in areas with high earthquake risk is of great importance in terms of developing earthquake resistant structure design and minimizing the damages that may occur.

In this study, the soil properties of the Alikahya region of İzmit province were examined with the research results of geological, geophysical and geotechnical methods and the suitability of the region for settlement was investigated. In this direction, field studies such as drilling, seismic refraction, and laboratory results on soil samples were examined in detail. Considering the earthquake hazard of the region, the liquefaction risk of the soils was also investigated.

Geology and Tectonics

Alikahya Region is located in the eastern part of İzmit province. According to the geological data, the İzmit Basin extending from İzmit Bay to Sapanca consists of Quaternary and Pliocene aged sediments, and a transition towards older and solid soils is observed towards the north and south of the İzmit Basin. In the parts close to İzmit Bay, transitions to Lower-Middle Eocene aged sandstone, conglomerate, shale and mudstone are observed. In the Alikahya Region, Quaternary aged alluvium is generally formed by consecutive clay-sand-silt. The unit observed in the northern parts of the study area has a medium-hard rock quality in terms of engineering. The unit is may

described as cracked and fractured. The waters seeping into these cracks and fractures decomposed the rock. Alteration is observed in the surface sections of the unit where it comes into contact with water.

The study area is located on the North Anatolian Fault (NAF). The North Anatolian Fault (NAF) is approximately 1500 km long and is one of the most active faults in Turkey and the world. The NAF splits into two branches from the Mudurnu Stream valley in the west of Izmit Bay. The northern branch forms the Izmit-Sapanca segment, and the southern branch forms the Geyve-Iznik branch. Different structural models have been proposed for this branch of the NAF. The first of these is the right-sided strike-slip system model with a vertical slip component of the NAF in the Gulf of Izmit and the Sea of Marmara [2]. In another model, in which seismological data are also used, it is suggested that the trough areas in the Gulf of Izmit and the Sea of Marmara are grabens developed due to gravitational forces [3]. In the third model, it is assumed that the northern branch of the NAF zone is represented by many fault segments and that there are pull-apart basin structures between these stepped segments [4-5].

Geophysical Research

Field study results of 18 seismic refraction measurements were used to determine the geophysical properties of the soils in the study area. Based on these measurements, layer thicknesses, underground velocity structure, dynamic-elastic engineering parameters of the soils were determined. Table 1 contains the information about the seismic refraction measurement results taken in the first 4 profiles. In the seismic refraction measurements performed along 18 profiles, the longitudinal wave velocities of the soils V_p were measured between 277 – 2562 m/sec and shear wave velocities V_s between 110 – 1427 m/sec.

Table 1. Dynamic parameters

Profile No	V_p	V_s	Pre. period	Thickness	Bulk M.	Density	ElasticityM.	Poisson Rate	Shear M.
Layer No	m/sn	m/s	sn	m	kg/cm ²	gr/cm ³	kg/cm ²		kg/cm ²
P-1/L1	384	129	0.70	2.09	1719	1.37	656	0.43	228
P-1/L2	963	401	"	7.79	12312	1.73	7748	0.73	2776
P-1/L3	1593	782	"		33730	1.96	32127	1.96	11976
P-2/L1	376	150	0.48	2.12	1520	1.37	863	0.40	307
P-2/L2	1323	627	"	9.10	22924	1.87	19920	0.35	7349
P-2/L3	1894	961	"		48179	2.05	50111	0.32	18886
P-3/L1	351	130	0.68	1.92	1350	1.34	644	0.42	226
P-3/L2	873	410	"	8.71	9065	1.69	7696	0.35	2832
P-3/L3	1688	910	"		34677	1.99	42622	0.29	16454
P-4/L1	339	120	0.66	1.81	1273	1.33	547	0.42	191
P-4/L2	956	452	"	7.10	11058	1.72	9551	0.35	3521
P-4/L3	1859	977	"		44439	2.04	50875	0.30	19429

Geotechnical Research

14 drilling studies and laboratory test results of the samples obtained from the drillings were used in determining the geotechnical properties of the soils in the study area. According to the drilling data, the groundwater level in the study area varies between 1 and 3 m. The average of the number of SPT blows determined during drilling is 16 for the study area. According to the unified soil classification (USCS), there are predominantly ML and CH group soils in the region. Average cohesion values (c) vary between 0.22 – 0.56 kg/cm², and internal friction angle (ϕ) vary between 5.20° and 33.4°, according to the results of the triaxial pressure test performed especially for loose soil zones in the study area. The soils in the study area were also classified according to the Regulation on the Structures to be Built in Disaster Areas, which was issued by [6]. According to this; In the sections with rock units, the soil class is Z-3 soil group B, and in the alluvial region with low slope, the soil class Z-4 soil group is D.

Liquefaction Risk

The liquefaction susceptibility of soils is evaluated by the calculated liquefaction safety number using simplified procedures. In this approach, the cyclic shear stresses caused by the earthquake and the cyclic resistance of the soil to liquefaction are compared. The most common field test used to evaluate the resistance of soils to liquefaction is the standard penetration test (SPT). SPT, which is a dynamic penetration test, is one of the most frequently used tests in soil investigations in our country. SPT results are used in liquefaction analysis as well as successfully predicting the firmness and shear resistance properties of especially granular soils. SPT-based liquefaction analysis was first proposed by [7] and has been improved over time. Today, especially with the

procedure proposed by [8], it has become a widely used method to determine the liquefaction sensitivity of sands in Turkey as well as in many countries of the world.

In determining the liquefaction potential of the soils in the study area, liquefaction analyzes based on SPT results were carried out in accordance with the purpose of the study with the obtained drilling information. In this context, using the simplified procedure proposed by [7], the safety coefficients (FS) were calculated for all sandy levels. Considering the earthquake hazard of the region and previous studies, the maximum horizontal ground acceleration was evaluated as $a_{max} = 0.40g$ and the earthquake magnitude as $M_w = 7.5$, in the study. The safety coefficients obtained as a result of the calculations were used to determine the levels with and without liquefaction potential. Levels with a factor of safety less than 1 are considered liquefiable, while levels greater than 1 are considered non-liquefiable. Some liquefaction analysis results of the soils in the study area are given in Table 2.

Table 2. Some liquefaction analysis results in the study area

SK No	Z (m)	Water Level (m)	FC (%)	Unit Weight kN/m^3	N ₁₆₀	CSR	CRR	FS
SK1	3,00	2,44	45,08	19,57	16,50	0,281	0,176	0,63
SK3	3,00	1,9	35,18	19,75	36,00	0,311	0,374	1,20
SK3	4,50	1,9	24,15	19,99	19,50	0,353	0,209	0,59
SK4	3,00	2,2	46,36	19,56	18,50	0,294	0,197	0,67
SK8	3,00	2,8	45	20,10	32,20	0,265	0,318	1,20

Conclusion

In this study, geological, geophysical and geotechnical data were used together to determine the soil properties and liquefaction potential of Izmit province Alikahya region. While there are sandstone, conglomerate, shale and mudstone units in the north of the study area, the remaining areas are represented by Quaternary aged alluvium. Seismic velocities and SPT impact numbers were found to be low, especially at near-surface depths throughout the study area. According to the liquefaction analyzes made considering the earthquake hazard and loose soil structure of the region, it has been determined that some local areas in the study area are at risk of liquefaction (Table 2). It will be beneficial to use the necessary soil improvement methods for new constructions to be made in areas with liquefaction risk in the region.

Funding:

This research received no external funding.

References

- [1] Safak, E. (2001). Local site effects and dynamic soil behavior. *Soil Dynamics and Earthquake Engineering*, 21 (5), 453-458.
- [2] Saroğlu, F., Emre, Ö., Boray, A. (1987). Active faults and seismicity of Turkey. MTA, Report No: 8174
- [3] Crampin, S., & Evans, R. (1986). Neotectonic of the Marmara Sea region in Turkey. *J. Geol. Soc.*, 143, 343 – 348.
- [4] Barka, A., & Kandinsky-Cade, K. (1988). Strike-slip fault geometry in Turkey and its influence on earthquake activity. *Tectonics*, 7, 663-684.
- [5] Barka, A., & Gülen, L. (1988). New constraints on age and total offset of the North Anatolian fault zone; Implications for tectonics of the Eastern Mediterranean region: In “1987 Melih Tokay Symp., Spec. Publ. METU. Ankara, Turkey, 39-65.
- [6] General Directorate of Disaster Affairs (1998). Regulation on Structures to be Constructed in Disaster Areas. Official Gazette dated September 2, 1997 and numbered 23098
- [7] Seed H.B., Idriss I.M. (1971). Simplified procedure for evaluating soil liquefaction potential. *Journal of Soil Mech. Foundation Div., ASCE*, 97 (9), 1249–73.
- [8] Youd T.L., Idriss I.M., Andrus R.D., Arango I., Castro G., Christian J.T., Dobry R., Liam Finn W.D., Harder L.F.Jr., Hynes M.E., Ishihara K., Koester J.P., Laio S.S.C., Marcuson WF III, Martin G.R., Mitchell J.K., Moriwaki Y., Power M.S.,



Physical properties of cement mortars containing steel fiber

Cahit Bilim^{*1}, İlker Fatih Kara², İsmet Vapur³

¹Mersin University, Engineering Faculty, Department of Civil Engineering, Mersin, Turkey
cbilim@mersin.edu.tr; ifkara@mersin.edu.tr; ismetvapur@mersin.edu.tr

Cite this study: Bilim, C., Kara, İ. F., & Vapur, İ. (2021). Physical properties of cement mortars containing steel fiber. 1st Advanced Engineering Days, 105-107

Keywords

Cement
Mortar
Steel fiber
Porosity

ABSTRACT

In this paper, some physical properties such as dry unit weight, porosity, water absorption and capillarity were investigated for cement mortars containing steel fibers. Steel fibers were used at 0% (control), 0.5%, 1.0% and 1.5% by volume. While sand/binder ratio was 3.0, water/cement ratio was 0.50 in the mixtures. After the production of mortar specimens with size of 40 x 40 x 160 mm, dry unit weight, porosity, water absorption and capillarity values were determined at 7, 14 and 28 days. The results obtained from the tests showed that steel fiber produced a decrease in porosity, water absorption and capillarity values of cement mortars.

Introduction

Concrete is a poor material in terms of fatigue strength, wear resistance, tensile strength, load bearing strength after cracking and energy absorption capacity. Various studies are carried out to improve these properties of concrete. One of these researches is steel fibers of different sizes added to concrete mixtures. Steel fiber is a material that changes the structure of concrete and gives it the ability to plastically deformation and absorption of energy [1].

Due to the fact that the steel fibers, which are included in the mixture as glued bundles, do not separate into grains during the mixing, the voids form in the concrete and this leads to the increasing of porosity in steel fiber concretes, which negatively affects the permeability. The increase in permeability may cause corrosion of the steel fiber or increase the deterioration of the concrete as a result of chemical reactions. This durability problem in steel fiber concrete can be avoided by a good mixture, good placement, good compaction and good maintenance in fiber concretes. For instance, Yıldırım [2] reported that the weight of steel fiber concretes increased with an increase in the fiber content and the water absorption rate decreased with the increasing steel content. In this study, the effect of steel fiber addition on the physical properties of cement mortars was investigated.

Material and Method

In the mortars, CEM I 42.5 R ordinary Portland cement (OPC) according to TS EN 197-1 [3] was used. Chemical and physical properties of OPC are given in Table 1. Water / binder ratio was 0.50 and sand / binder ratio was 3.0 in the mortar mixtures where standard sand was used as fine aggregate in compliance with TS EN 196-1 [4]. Mixture preparation was conducted according to the TS EN 196-1 [4] procedure. In the production of the mortars, RC 65/60 BN type, which has a length of 60 mm, a diameter of 0.90 mm and a fineness (length / diameter) of 65, was used with two ends of hooks, uncoated and low carbon steel fiber. The steel fibers were used in the mixtures at a rate of 0% (control), 0.5%, 1.0% and 1.5% by volume. The notations of the mixtures used in the study are shown in Table 2.

Table 1. Chemical and physical properties of OPC

Composition (%)	OPC
SiO ₂	14.3
Al ₂ O ₃	3.33
Fe ₂ O ₃	2.85
CaO	67.3
MgO	1.60
Na ₂ O	0.41
K ₂ O	1.09
SO ₃	4.51
Cl ⁻	0.35
Blaine value (cm ² /g)	3250
Specific gravity	3.15

Table 2. Mixture notations

Mixture	OPC	Steel Fiber
0 SF (Reference)	100%	0%
0.5 SF	100%	0.5%
1.0 SF	100%	1.0%
1.5 SF	100%	1.5%

In order to determine the physical properties of the mortars, 40 x 40 x 160 mm prism samples were produced from each mixture. The prism samples taken out of their molds after 24h were cured for 7, 14 and 28 days in water with a temperature of 21 ± 1 °C. Then, these specimens were subjected to dry unit weight, capillarity, water absorption and porosity tests. TS 4045 [5] standard was used in capillarity tests while TS 3624 [6] standard was used in the determination of water absorption and porosity.

Results and discussion

The dry unit weights of the mortar samples measured in time are shown in Table 3.

Table 3. Dry unit weights (kg/m³)

	7	14	28
0 SF	2090	2070	2050
0.5 SF	1960	2090	2090
1.0 SF	2160	2120	2110
1.5 SF	2190	2170	2120

As seen in Table 3, dry unit weight values of reference mortar were 2090 kg/m³, 2070 kg/m³ and 2050 kg/m³ at 7, 14 and 28 days, respectively. For mortars with steel fiber, dry unit weight values changed between 1960 kg/m³ and 2190 kg/m³ at 7 days. These values were between 2090 kg/m³ and 2170 kg/m³ at 14 days and 2090 kg/m³ and 2120 kg/m³ at 28 days. The dry unit weight values of all steel fiber mortars were higher than reference mortar for all curing ages. The increase in steel fiber dosage increased the dry unit weights of the mortars due to its high specific gravity value.

The porosity values of the mortar samples measured in time are shown in Table 4.

Table 4. Porosity (%)

	7	14	28
0 SF	17.41	16.74	15.36
0.5 SF	15.82	15.87	15.22
1.0 SF	15.70	15.63	15.19
1.5 SF	15.17	15.14	15.11

As shown in Table 4, porosity of reference mortar was determined as 17.41%, 16.74% and 15.36% for 7, 14 and 28 days, respectively. For mortars with steel fiber, porosity values ranged from 15.17% to 15.82% at 7 days. These porosity values were between 15.14% and 15.87% at 14 days and 15.11% and 15.22% at 28 days. The

porosity values of all steel fiber mortars were lower than reference mortar for all curing ages. Additionally, an increase in curing time decreased porosity for all mortars depending on C-S-H gel formation in the structure.

The water absorption values of the mortar samples measured in time are shown in Table 5.

Table 5. Water absorption (%)

	7	14	28
0 SF	8.93	8.31	7.26
0.5 SF	7.79	7.72	7.34
1.0 SF	7.35	7.26	7.16
1.5 SF	7.03	7.16	7.05

As observed in Table 5, water absorption rates of reference mortar were measured as 8.93%, 8.31% and 7.26% for 7, 14 and 28 days, respectively. For mortars with steel fiber, water absorption rates changed between 7.03% and 7.79% at 7 days. These values were between 7.16% and 7.72% at 14 days and 7.05% and 7.34% at 28 days. The water absorption values of reference mortar were higher than those of all steel fiber mortars for all curing ages. The amount of water absorbed decreased with an increase in curing time as a result of C-S-H gel formation in cement matrix for all mortars, similarly to porosity findings.

The capillarity coefficients determined at 7, 14 and 28 days for the mortar samples are given in Table 6.

Table 6. Capillarity (cm/sn^{1/2})

	7	14	28
0 SF	0.0039	0.0031	0.0022
0.5 SF	0.0037	0.0020	0.0013
1.0 SF	0.0032	0.0012	0.0011
1.5 SF	0.0037	0.0030	0.0021

As seen in Table 6, capillarity coefficients of OPC mortar were 39.10^{-4} cm/sn^{1/2}, 31.10^{-4} cm/sn^{1/2} and 22.10^{-4} cm/sn^{1/2} at 7, 14 and 28 days, respectively. For mortars containing steel fiber, capillarity coefficients ranged from 32.10^{-4} cm/sn^{1/2} to 37.10^{-4} cm/sn^{1/2} at 7 days. These values were between 12.10^{-4} cm/sn^{1/2} and 30.10^{-4} cm/sn^{1/2} at 14 days and 11.10^{-4} cm/sn^{1/2} and 21.10^{-4} cm/sn^{1/2} at 28 days. Capillarity coefficients of all steel fiber mortars were lower than those of reference mortar for all curing ages.

Conclusion

The findings obtained from the tests of mortar samples at 7, 14 and 28 days showed that the dry unit weight values of all steel fiber mortars were higher than reference mortar for all curing ages. Also, the incorporation of steel fiber into the mix produced a decrease in porosity, water absorption and capillarity values of cement mortars compared to reference mortar without steel fiber.

Funding: This research received no external funding.

Author contributions:

Cahit Bilim: Writing-Original draft preparation, Methodology. **İlker Fatih Kara:** Investigation. **İsmet Vapur:** Investigation, Presentation.

Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Şimşek, O. (2004). Concrete and Concrete Technology. Seçkin Yayıncılık, Ankara, 247p.
- [2] Yıldırım, S. T. (2002). "The investigation of performance characteristics of fiber reinforced concretes". Firat University Graduate School of Natural and Applied Sciences, Doctorate Thesis, Elazığ, 193p.
- [3] TS EN 197-1. (2012). "Cement- Part 1: Compositions and conformity criteria for common cements", Turkish Standards Institution, Ankara, Turkey.
- [4] TS EN 196-1. (2009). "Methods of testing cement - Part 1: Determination of strength", Turkish Standards Institution, Ankara, Turkey.
- [5] TS 4045. (1984). "Determination of the capillary water absorption of building materials". Turkish Standards Institution, Ankara, Turkey.
- [6] TS 3624. (1981). "Test method for determination the specific gravity the absorption water and the void ratio in hardened concrete", Turkish Standards Institution, Ankara, Turkey.



Effect of fiber content on the liquefaction potential of improved soils

Özgür Lütfi Ertuğrul¹, Fatma Dülger Canoğulları²

¹ Mersin University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, ertugrul@mersin.edu.tr

² Toros University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, fatma.dulger@toros.edu.tr

Cite this study: Ertugrul, O. & Canogullari, D.F., (2021). Effect of fiber content on the liquefaction potential of improved soils. 1st Advanced Engineering Days, 108-110

Keywords

Fibers
CSR
Reinforced soil
liquefaction

ABSTRACT

The use of randomly distributed fibers as soil reinforcement has recently become more popular due to a more satisfactory performance compared with conventional reinforcements. Most previous investigations have focused on the strength and deformation characteristics of fiber-reinforced soil. The liquefaction behavior of fiber reinforced soils has recently received interest since fiber addition is currently considered as a new way of soil improvement to prevent soil liquefaction. Studies indicate that when soils are reinforced with synthetic or natural fibers, a reduction is observed in the number of cycles required to initiate liquefaction under undrained loading conditions. In this study, a regression analysis was performed in the current study by using the results of the previous studies. The obtained formula is able to capture the effect of fiber percentage and relative density of the cohesionless soil on the cyclic stress ratio values with a good agreement.

Introduction

The liquefaction of saturated loose sands is defined as the loss of soil strength due to excessive pore pressures under seismic waves. During earthquakes, liquefaction causes reductions in the bearing capacity of soils and causes excessive settlements [1].

The occurrence of liquefaction has encouraged the interest of many investigators and remarkable work has been carried out to evaluate liquefaction susceptibility. Properties of soil could be improved by using reinforcement materials to eliminate the liquefaction hazard [2].

Soil reinforcement with randomly distributed fibers was investigated by researchers in last few years and results showed that mixing fibers with granular soils improved liquefaction resistance and shear modulus of the soils.

Material and Method

Soil reinforcement with fibers has some advantages compared to traditional soil reinforcement techniques. For example; mixing fibers with the soils is relatively easy with current soil mixing techniques and if homogeneous mixing is achieved, the fibers provide isotropic strength gain in the soil [3].

Although there are various investigations about strength and deformation characteristics of fiber-reinforcement soils under static loads, the studies on under cyclic loading are very limited in the literature.

In order to understand the liquefaction behavior of fiber reinforced soil, a series of ring-shear tests and a series of cyclic triaxial tests have been carried out on soil samples with different fiber content and sand density.

Literature Review

Vercueil et al., [4] performed an experimental study (cyclic triaxial tests) of the liquefaction resistance of Hostun sand reinforced with geosynthetics. The results showed that the liquefaction resistance considerably decreases with fiber addition.

Bhandari and Han [5] carried out studies on the behavior of the geotextile and the soil under a cyclic wheel load using discrete element method. They reported that the geotextile has a major effect on the degree of interaction between the geotextile and the soil.

Altun et al. [6] conducted several stress-controlled cyclic torsional shear tests to investigate the effect of geosynthetics in increasing the resistance to liquefaction of Toyoura sand. The results showed that the liquefaction resistance of sand deposits can be remarkably improved by geosynthetic reinforcement.

Maher and Woods [7] studied the dynamic response (i.e., shear modulus and damping) of sand reinforced with randomly distributed fibers using resonant-column and torsional shear tests. They reported that the addition of fibers enhances the dynamic modulus of cohesionless soils.

Ibraim et al. [8] investigated the static liquefaction behavior of fine sand reinforced with discrete crimped polypropylene fibers in both triaxial compression and triaxial extension tests. They found that the presence of fibers diminishes the potential of liquefaction.

Chen and Loehr [9] studied the behavior of fiber reinforced soil in the triaxial experimental setup under with and without drainage. They found that the soil strengths of the fiber-reinforced specimens under drained conditions exceeds the respective values of the same specimens under undrained conditions at low deformation levels.

Results and Discussion

The studies on the behavior of soils reinforced with randomly distributed elements under cyclic loading is very limited in the literature since the studies are about the strength properties of fiber reinforced soils. Investigators noted that that the number of cycles causing liquefaction increased with an increase in fiber ratio and CSR values increased with the increase of fiber length. Since, application of dynamic triaxial and torsional shear tests are significantly difficult, a regression analysis were performed in the current study by using the results of the previous studies. A sample of the used data is depicted in Table 1.

Table 1. A summary of the results derived from previous studies

Fiber Percent (%)	Dr (%)	Fiber Length (mm)	CSR
1	30	6	0.336
0.5	30	6	0.288
0.25	30	6	0.244
0	30	6	0.221
1	30	12	0.351
0.5	30	12	0.296
0.25	30	12	0.266
0	30	12	0.221
1	50	6	0.399
0.5	50	6	0.323
0.25	50	6	0.264
0	50	6	0.316
1	50	12	0.409
0.5	50	12	0.344
0.25	50	12	0.335
0	50	12	0.316

Based on the multiple variate regression analyses, the following equation was obtained.

$$CSR = a + bF_p + cD_r + d\left(\frac{F_p}{D_r}\right) + e(\exp(F_p^3 D_r^3)) \quad (1)$$

In this equation, CSR represents the Cyclic Stress Ratio whereas F_p , and D_r denotes fiber percent and soil relative density, respectively. The constant parameters of a , b , c , d and e will be taken as: 0.5481, 0.2832, 0.2328, -0.04756, -0.4001, respectively. The graphical representation of the multivariate regression analysis was shown in Fig.1. The coefficient of determination is found as 0.90 for the suggested formula.

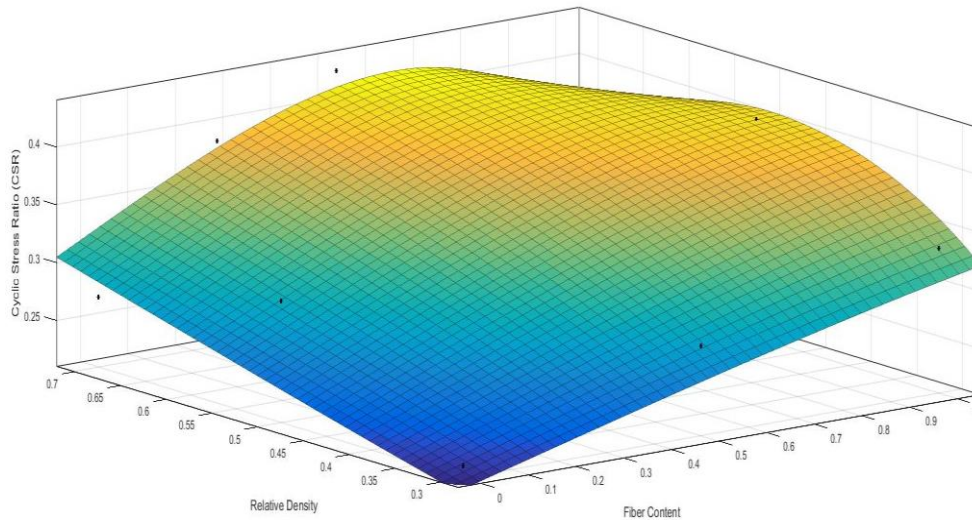


Figure 1. Graphical depiction of the multivariate nonlinear regression modeling results

Conclusion

Fiber reinforcement is an efficient method in limiting or even preventing the occurrence of the lateral movement of the sandy soils due to liquefaction. The presence of fibers affects the behavior of sand in cyclic compression by increasing the cyclic strength therefore liquefaction hazards or deformations appear to diminish. The cyclic test results showed that the addition of randomly distributed polypropylene fibers increases significantly the liquefaction resistance of sands at low relative densities. Since, application of dynamic triaxial and torsional shear tests are significantly difficult, a regression analysis were performed in the current study by using the results of the previous studies. The obtained formula is able to capture the effect of fiber percentage and relative density of the cohesionless soil on the cyclic stress ratio values with a good agreement ($R^2=0,90$).

Funding: This research received no external funding.

Author contributions:

Özgür Lütfi Ertuğrul: Data curation, Validation, Writing-Reviewing and Editing. **Fatma Dülger Canoğullari:** Investigation, Writing- draft preparation.

Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Towhata, I. (2008). Geotechnical earthquake engineering. Berlin Heidelberg: Springer-Verlag; (698 pp.).
- [2] Maher, M. H. Gray, & D. H. (1990). Static response of sand reinforced with randomly distributed fibers. *Journal of Geotechnical Engineering* 116 (11), 1661–1677.
- [3] Darvishi, A. (2014). Behavior of Fiber Reinforced Sand Under Static Load., MSc Thesis, İstanbul Technical University, İstanbul, Turkey.
- [4] Vercueil, D., Billet, P., & Cordary, D. (1997). Study of the liquefaction resistance of a saturated sand reinforced with geosynthetics. *Soil Dyn Earthq Eng* 16 (7–8), 417–25.
- [5] Bhandari, A., & Han, J. (2010). Investigation of geotextile-soil interaction under a cyclic vertical load using the discrete element method. *Geotextiles and Geomembranes* 28 (1) 33–43.
- [6] Altun, S., Göktepe, A.B., & Lav, M.A. (2008). Liquefaction resistance of sand reinforced with geosynthetics. *Geosynth Int* 15(5), 322–32.
- [7] Maher, M.H., & Woods, R.D. (1990) Dynamic response of sands reinforced with randomly distributed fibers. *Jgeotech Eng ASCE* 116(7), 1116–31.
- [8] Ibraim, E., Diambra, A., MuirWood, D., & Russell, A.R. (2010). Static liquefaction of fibre reinforced sand under monotonic loading. *Geotext Geomembr* 28(4), 374–85.
- [9] Chen, C.W., & Loehr, J.E. (2008). Undrained and drained triaxial tests of fiber-reinforced sand. *Proceedings of the 4th Asian Regional Conference on Geosynthetics*, Shanghai, China.



Investigation of the effect of groundwater flow velocity on energy efficiency in energy pile groups positioned parallel to the groundwater flow direction

Fatma Dülger Canoğulları ^{*1}, Özgür Lütfi Ertuğrul ²

¹ Toros University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, fatma.dulger@toros.edu.tr

² Mersin University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, ertugrul@mersin.edu.tr

Cite this study: Dulger Canogullari, F., & Ertugrul, O. (2021). Investigation of the effect of groundwater flow velocity on energy efficiency in energy pile groups positioned parallel to the groundwater flow direction. 1st Advanced Engineering Days, 111-113

Keywords

Energy piles
Groundwater flow
Finite element method

ABSTRACT

In recent years, many studies have been carried out on energy piles based on the principle of utilizing the heat potential of shallow soils. The thermal energy obtained from energy piles is affected by various factors. One of important factors can be considered as groundwater flow. In this study, the effect of groundwater flow velocity on the thermal energy obtained from energy pile groups positioned parallel to the groundwater flow direction was investigated using GeoStudio TEMP/W and SEEP/W Finite Element Method Software. Analyses results indicate that the energy obtained from the piles may increase with the increase in the groundwater flow velocity.

Introduction

In recent years the geothermal heat potential of the ground has interested by researchers as an important renewable energy source. Since it is not possible to transfer geothermal energy to the ground surface in terms of application and economy, the heat potential of shallow soils is an important alternative that should be evaluated.

The energy pile mechanism is an environmental technology that facilitates the use of renewable energy sources for efficient space heating and cooling. In this system, the piles that are already required for structural support are equipped with geothermal loops for performing heat exchange operations to exploit the near surface geothermal energy [1].

Material and Method

Energy piles are actually traditional deep foundation piles with embedded fluid pipes that work as ground heat exchangers. The basic schema of energy piles foundation seen in Fig. 1.

Heat transfer in energy pile foundations is governed by the dynamics of the thermal requirements of the building, the thermal properties of the soil, concrete and heat carrier fluid, the aspect ratio and spacing between the energy piles, the thermal influence of the ground surface and the presence of groundwater flow.

Soil conditions, soil thermal properties, heat exchanger pipe configurations, foundation geometry and presence of groundwater are the main factors affecting the thermal efficiency of energy piles. The presence and movements of groundwater flow in shallow soil complicate the heat transfer mechanism. Generally, groundwater conditions are advantageous for the thermal performance of energy piles. Model geometry designed in TEMP/W and SEEP/W is shown in Fig. 2, heat transfer model with groundwater flow is shown in Fig. 3.

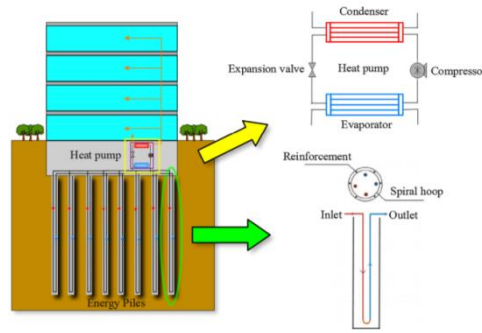


Figure 1. The schematic diagram of Energy Pile foundation [2]

In this study, the effect of the groundwater flow rate in the shallow soil on the efficiency of group energy piles were investigated with numerical analyses. The analyses were performed by TEMP/W and SEEP/W Finite Element Method Software [3-4].

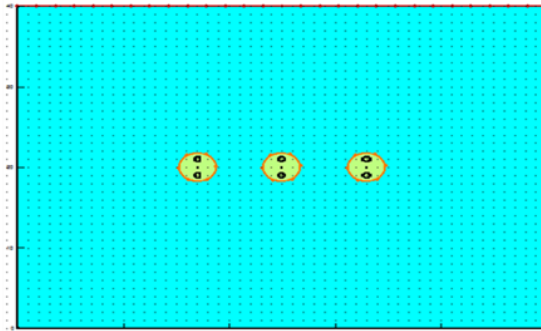


Figure 2. Model geometry (TEMP/W, SEEP/W)

Results and Discussion

In the energy pile groups positioned parallel to the groundwater flow direction in the aquifer, the predicted thermal energy which can be extracted increase as the velocity of the groundwater flow increases. It is seen in Table 1 that the ultimate rate of heat gain is achieved in the first pile in the groundwater flow direction, while the lowest heat gain can be reached in the last pile in the group.

Table 1. Energy values obtained for pile groups positioned parallel to the groundwater flow direction at different groundwater flow rates (plan analysis) [5]

Time	First Pile			Second Pile			Third Pile		
	v= 0,16 m/gün	v= 0,8 m/gün	v= 1,6 m/gün	v= 0,16 m/gün	v= 0,8 m/gün	v= 1,6 m/gün	v= 0,16 m/gün	v= 0,8 m/gün	v= 1,6 m/gün
0	169,39	261,357	346,80	153,63	181,52	211,43	154,29	175,37	197,43
30	107,35	219,121	309,60	75,751	109,87	145,98	75,474	95,059	122,29
60	98,922	215,277	306,01	56,987	100,02	139,28	54,928	81,434	113,31
90	96,931	214,518	305,26	49,472	98,364	138,28	45,378	78,677	111,96
180	96,200	214,314	305,06	44,406	98,036	138,06	36,259	78,052	111,69
360	96,178	214,311	305,06	44,027	98,034	138,05	34,722	78,049	111,69

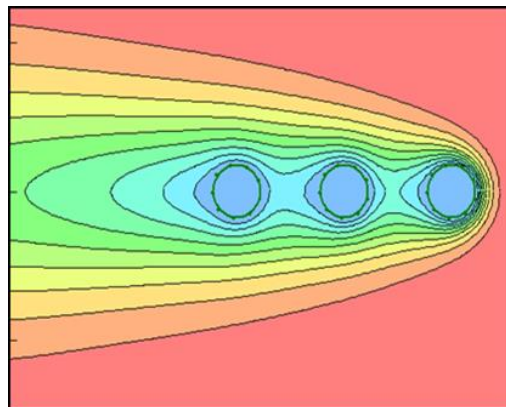


Figure 3. Temperature distributions on the soil at the end of 360 days (groundwater flow available) (TEMP/W, SEEP/W)

In the group formed with three energy piles positioned parallel to the flow direction, the effect of groundwater on the heat energy that can be obtained was formulated using the nonlinear regression technique, taking into account the results of the plan analysis. The quantity of energy (E, Watt) that can be obtained depending on the time (t, day) and the groundwater flow rate in the aquifer (v, m/day) is respectively, starting from the first energy pile in the flow direction:

$$E \text{ (Watt)} = -0,3753\sqrt{t} + 249,4\sqrt{v} \quad R^2 = 0,98 \quad (1)$$

$$E = -31,39 \sqrt[5]{t} + 190 \sqrt[4]{v} \quad R^2 = 0,98 \quad (2)$$

$$E = -39,45 \sqrt[5]{t} + 145,2 \sqrt[4]{v} + 0,07376t + 42,72 \quad R^2 = 0,98 \quad (3)$$

Conclusion

The presence of groundwater flow positively affects thermal energy extraction efficiency in the energy pile groups. In the two-dimensional analyses performed with TEMP/W and SEEP/W it was observed that the maximum energy efficiency in the groups positioned parallel to the groundwater flow direction is in the first pile, while the heat transfer between the pile-ground decreases significantly due to the thermal interaction in the second and third piles, hence it should be considered in the design of energy pile systems.

Additionally, it is understood that the energy obtained from the piles increases significantly with increasing groundwater flow velocity.

Acknowledgement

Acknowledgements of support for the paper are welcome.

Funding:

This research received no external funding.

Author contributions:

Fatma DÜLGER CANOĞULLARI: Investigation, Writing-draft preparation, Software **Özgür Lütfi ERTUĞRUL:** Data curation, Validation, Writing-Reviewing and Editing.

Conflicts of interest:

The authors declare no conflicts of interest.

References

References should be written like this. All of the references should be written in alphabetical order. APA-6 format should be used. Do not put an empty line between references.

- [1] Sutman, M., Speranza, G., Ferrari, A., Lassalle, P. & Laloui, L. (2020). Long-term performance and life cycle assessment of energy piles in three different climatic conditions. *Renewable Energy* 146, 1177-1191.
- [2] Cui, Y., Zhua, J. & Meng, F. (2018). Techno-economic evaluation of multiple energy piles for a ground-coupled heat pump system. *Energy Conversion and Management* 178, 200-216.
- [3] GeoStudio, TEMP/W User Manual (2007). GEO-SLOPE International Ltd.
- [4] GeoStudio, SEEP/W User Manual (2007). GEO-SLOPE International Ltd.
- [5] Canogullari, F.D. (2018). Enerji kazıklarının performans analizi. Master's Thesis, Mersin University.



Assessment of the artificial fiber contribution on the shear strength parameters of soils

Özgür Lütfi Ertuğrul ^{*1}, Furkan İnal ²

¹Mersin University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, ertugrul@mersin.edu.tr

²Mersin University, Engineering Faculty, Civil Engineering Department, Mersin, Turkey, furkaninal@mersin.edu.tr

Cite this study: Ertugrul, O., L., & Inal, F. (2021). Assessment of the artificial fiber contribution on the shear strength parameters of soils. 1st Advanced Engineering Days, 114-117

Keywords

Soil improvement
Soil reinforcement
Fiber
Regression Analysis

ABSTRACT

Soil stabilization is one of the methods of soil improvement that has been used since ancient times in human history. Soil mass reinforced with randomly distributed discrete fibers is one of the techniques for improving the properties of soils. Reinforcing the soil with randomly distributed discrete fibers has attracted the attention of many researchers over the past few decades. For this purpose, many studies have been carried out with fibers obtained from synthetic, natural and waste materials. Studies on soil reinforced with discrete fibers have revealed the effect of fibers are beneficial to strength parameters of soils. In this study multivariate regression analysis were performed by using data from literature to formulate the effect of fibers on the soil. The formulas obtained from multivariate regression analyses are in harmony with the values of unconfined compression and shear strength.

Introduction

As is known, almost all types of structures, from high-rise buildings to the construction of roads, railways, tunnels and viaducts, are built either on the soil or in the soil. In this regard, the structures are in constant interaction with the soil. Unfortunately, the soil that is supposed to carry the constructed structure may not always have sufficient engineering properties. The fact that the soil has insufficient engineering properties may cause the existing soil to be discarded and a new filling to be made or it can bring up the construction of deep foundation. But it may not be possible to implement these solutions for economic reasons. At this point, engineers go to ways to improve the soil on the site.

Soil stabilization is one of the methods of soil improvement that has been used since ancient times in human history. The stabilization of soils has been performed for millennia. For instance, the Mesopotamians and Romans separately discovered that it was possible to improve the ability of pathways to carry traffic by mixing the weak soils with a stabilizing agent like pulverized limestone or calcium [1]. Random distribution of fibers on the ground also improves the strength parameters of the soil by simulating the behavior of plant roots [2]. Also in ancient civilizations, straw was a material used for reinforcing building blocks obtained from slurry [1]. At present, the reinforcing of the soil to improve its properties is attributed to the [3]. One of the methods of reinforcing the soil is use of fiber. Reinforcing the soil with randomly distributed discrete fibers has attracted the attention of many researchers over the past few decades. For this purpose, many studies have been carried out with fibers obtained from synthetic [4-9], natural [10-19] or waste materials [20-25] in order to study the effect of fibers on the engineering properties of the soil.

Literature Review

Uysal [5] carried out a laboratory study by mixing sand samples having different relative density values (20%, 30% and 40%) with kapolymer and virgin homopolymer fibers in ratios of 0.50%, 1.0% and 1.50% of the dry weight of the soil. Shear box tests were conducted in order to observe the effect of relative density and fiber content on the shear strength. It was observed that the samples having a high relative density has a higher shear strength, and the angle of internal friction also increases as the fiber ratio increases.

Wei et al. [12] performed laboratory tests by mixing a silty clay soil with both lime and fibers to investigate the mechanical properties of the soil. Wheat straw, rice straw, hemp and polypropylene fibers were added to the soil-lime mixtures. Unconfined compression and triaxial compression tests were performed on samples in order to examine the shear strength properties. The optimum fiber content was found to be 0.2% or 0.25% and the optimum fiber length was found to be 30%-40% of the sample diameter. Fiber reinforcement has significantly increased cohesion and slightly improved the angle of internal friction. When the performance of fiber varieties in cohesion increases was compared, it was determined that polypropylene, jute, rice straw and wheat straw were from the best to the lowest.

Özdemir [19] investigated the consistency limits, compaction characteristics, unconfined compression and freeze-thaw properties of fiber-clay samples obtained by adding natural (straw, hemp) and synthetic (polyester) fibers to a cohesive soil sample. It was observed that the unconfined compression strength of the samples increased with an increase in the percentage of fiber, and improvements in the unconfined compression strength after freezing and thawing also occurred when compared to natural clay. The samples with hemp additives exhibited superior behavior against freezing and thawing.

Pradhan et al. [26] investigated the effect of polypropylene fiber contribution on the shear strength and unconfined compression strength of cohesive soils. They observed that the addition of fibers increased the peak and residual shear strength as well as unconfined compression strength and CBR values.

Consoli et al. [27] carried out a study to determine the differences in the strength of artificially cemented sandy soil with and without fiber reinforcement. The controlling parameters evaluated were the amount of cement, porosity, moisture content, and voids/cement ratio. A series of unconfined compression tests were performed. Results show that the fiber addition increased the unconfined compression strength of the samples at all cement ratios.

Material and Method

Current state of the art on fiber addition to soils shows that synthetic fiber reinforcement of soils has positive effects on the unconfined compressive strength and shear strength parameters of soils.

In this study, the effects of synthetic fiber addition on the unconfined compression strength, cohesion and internal friction angle of soils were formulated by multivariate regression analysis method. In order to formulate the fiber effects with multivariate regression analysis, the relative density and fiber percent in sandy soils, and the fiber percent and length parameters in cohesive soils were selected from the data in the previous studies and the unconfined compressive strength and shear strength parameters were tried to be determined by regression analysis. The data used in the analyses are given in Table 1.

Table 1. A summary of the data used from literature

Soil type	Dr (%)	FiberPercent (%)	Fiber Length (mm)	Φ (°)	Soil type	FiberPercent (%)	Fiber Length (mm)	q_u (kPa)
SP	20	0	0	28	CL	0	0	157
SP	30	0	0	31	CL	0.5	2	340
SP	40	0	0	33	CL	1	2	380
SP	20	0.5	15	31	CL	1.5	2	397
SP	20	1	15	33	CL	0.5	5	301
SP	20	1.5	15	34	CL	1	5	340
SP	30	0.5	15	33	CL	1.5	5	345
SP	30	1	15	34	Soil type	FiberPercent (%)	Fiber Length (mm)	c (kPa)
SP	30	1.5	15	36	CL	0	0	291
SP	40	0.5	15	36	CL	0.2	12	301
SP	40	1	15	38	CL	0.25	12	331
SP	40	1.5	15	39	CL	0.3	12	307
SP	20	0.5	15	29	CL	0.2	19	326
SP	20	1	15	30	CL	0.25	19	358
SP	20	1.5	15	32	CL	0.3	19	344
SP	30	0.5	15	32	Soil type	FiberPercent (%)	Fiber Length (mm)	Φ (°)
SP	30	1	15	33	CL	0	0	32
SP	30	1.5	15	35	CL	0.2	12	32
SP	40	0.5	15	34	CL	0.25	12	33
SP	40	1	15	35	CL	0.3	12	31
SP	40	1.5	15	37	CL	0.2	19	32
SP	40	0.5	15	36	CL	0.25	19	33
SP	40	1	15	38	CL	0.3	19	33

Results and Discussion

Based on the multiple variate regression analyses, the following equations were obtained for the relationship between fiber percent, fiber length and relative density with the internal angle of friction (Φ , °), cohesion (c , kPa) and undrained compressive strength:

$$q_u = a + bF_p + cF_L + d(F_p^2) + e(F_p \cdot F_L) + f(F_L^2) \quad (1)$$

In this equation, q_u represents undrained compressive strength in kPa whereas F_p , and F_L denotes fiber percent and fiber length. The constant parameters of a , b , c , d , e and f will be taken as 157, 179.7 81.67, -57, -4.333 and -13.13, respectively. For the relationship between fiber percent and relative density with the internal angle of friction (Φ , °) of cohesionless soils:

$$\Phi = g + hF_p + iD_r \quad (2)$$

where F_p , and D_r denotes fiber percent and soil relative density (divided by 100). The constant parameters of g , h , i will be taken as: 22.95, 26.57, and 3.106, respectively. The coefficient of determination is found as 0.90 for the suggested formula. For the relationship between fiber percent and fiber length with the cohesion (c , kPa) of cohesive soils:

$$c = j + kF_p + lF_L + m(F_p^2) + n(F_L^2) \quad (3)$$

The constant parameters of j , k , l , m and n will be taken as: 291, 5120, -86.48, -1e+04, 2.926 respectively. The coefficient of determination is found as 0.99 for the suggested formula.

Conclusion

Researchers conducted laboratory tests in order to investigate the mechanical behavior of fiber reinforced soils. Based on the carried-out tests, it was observed that reinforcing soil with fibers, the peak strength loss is decreased, and thus the behavior of the material changed from brittle to ductile, the swelling pressure and desiccation cracks decreased, in short, the behavior of the soil improved in the desired direction. When compared to classical soil improvement techniques, the main advantage of mixing randomly distributed fibers is the maintenance of strength isotropy and absence of potential failure plane that can develop parallel to the oriented reinforcement [18]. By using the results of the previous laboratory tests reported in the literature, multivariate regression analyses were performed. Formulas were suggested to be used for the practical purposes for the site engineers and designers.

Funding: This research received no external funding.

Author contributions:

Özgür Lütü Ertuğrul: Data curation, Validation, Writing-Reviewing and Editing. **Furkan İnal:** Investigation, draft preparation.

Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Hejazi, S. M., Sheikhzadeh, M., Abtahi, M. S., & Zadhoush, A. (2012). A simple review of soil reinforcement by using natural and synthetic fibers. *Construction and Building Materials*, 100-116.
- [2] Wu, T., McOmber, M., Erb, T., & Beal, E. (1988). Study of soil-root interaction. *J Geotech Eng ASCE*, 1351-75.
- [3] Vidal, H. (1969). *The Principle of Reinforced Earth*. Highway Research Board, Geology and Foundations, 1-16.
- [4] Fındıkçı, B. (2020). Bentonit Kilinin Cam Fiber ile İyileştirilmesi. Kocaeli University, Institute of Science and Technology, Master's Thesis.
- [5] Uysal, N. (2014). Polimer ile Stabilize Edilmiş Kumların Kayma Mukavemetinin Laboratuvar Deneyleri ile Belirlenmesi. İstanbul Teknik University, Institute of Science and Technology, Master's Thesis.
- [6] Ayraçma, B. B. (2015). Sentetik Fiber ve Çimento Katkılı Kumların Mukavemet Özellikleri. İstanbul Teknik University, Institute of Science and Technology, Master's Thesis.
- [7] Sevensan, Ü. (2009). Polipropilen Fiber ve Uçucu Kül Katkılı Ankara Kilinin Geoteknik Özelliklerinin Araştırılması. Kırıkkale University, Institute of Science and Technology, Master's Thesis.

- [8] Çetinkaya, M. (2012). Polipropilen Liflerin Uçucu Kül Zemin Karışımlarında Geoteknik Özelliklere Etkisi. İstanbul Teknik University, Institute of Science and Technology, Master's Thesis.
- [9] Bao, X., Jin, Z., Xiao, X., Tang, W., Cui, H., & Chen, X. (2021). Experimental investigation on mechanical properties of clay soil reinforced with carbon fiber. *Construction and Building Materials*, 1-9.
- [10] Wang, Y. X., Guo, P. P., Ren, W. X., Yuan, B. X., Yuan, H. P., Zhao, Y. L., & Cao, P. (2017). Laboratory Investigation on Strength Characteristics of Expansive Soil Treated with Jute Fiber Reinforcement. *Int. J. Geomech*, 1-12.
- [11] Nezhad, M. G., Tabarsa, A., & Latif, N. (2021). Effect of natural and synthetic fibers reinforcement on California bearing ratio and tensile strength of clay. *Journal of Rock Mechanics and Geotechnical Engineering*, 1-17.
- [12] Wei, L., Chai, S. X., Zhang, H. Y., & Shi, Q. (2018). Mechanical properties of soil reinforced with both lime and four kinds of fiber. *Construction and Building Materials*, 300-308.
- [13] Dang, L. C., Fatahi, B., & Khabbaz, H. (2016). Behaviour of Expansive Soils Stabilized with Hydrated Lime and Bagasse Fibres. *Procedia Engineering*, 658-665.
- [14] Babu, G. S., & Vasudevan, A. K. (2008). Strength and Stiffness Response of Coir Fiber-Reinforced Tropical Soil. *Journal of Materials in Civil Engineering*, 571-577.
- [15] Wu, Y. K., Li, Y. B., & Niu, B. (2014). Investigation of mechanical properties of randomly distributed sisal fibre reinforced soil. *Materials Research Innovations*, 953-959.
- [16] Ahmad, F., Bateni, F., & Azmi, M. (2010). Performance evaluation of silty sand reinforced with fibres . *Geotextiles and Geomembranes*, 93-99.
- [17] Al Adili, A., Azzam, R., & Spagnoli, G. (2012). Strength of soil reinforced with fiber materials (Papyrus) . *Soil Mechanics and Foundation Engineering*, 241-247.
- [18] Prabakar, J., & Sridhar, R. S. (2002). Effect of random inclusion of sisal fibre on strength behaviour of soil . *Construction and Building Materials*, 123-131.
- [19] Özdemir, B. (2019). Doğal/Sentetik Lif ve Uçucu Kül Katkılı Killerin Bazı Geoteknik Özelliklerinin Araştırılması. Atatürk University, Institute of Science and Technology, Master's Thesis.
- [20] Edinçliler, A., & Cagatay, A. (2013). Weak subgrade improvement with rubber fibre inclusions. *Geosynthetics International*, 39-46.
- [21] Kalkan, E. (2013). Preparation of scrap tire rubber fiber–silica fume mixtures for modification of clayey soils. *Applied Clay Science*, 117-125.
- [22] Mirzababaei, M., Miraftab, M., Mohamed, M., & McMahan, P. (2013). Unconfined Compression Strength of Reinforced Clays with Carpet Waste Fibers. *Journal of Geotechnical and Geoenvironmental Engineering*, 483-493.
- [23] Muntohar, A. S., Widiarti, A., Hartono, E., & Diana, W. (2013). Engineering Properties of Silty Soil Stabilized with Lime and Rice Husk Ash and Reinforced with Waste Plastic Fiber. *Journal of Materials in Civil Engineering*, 1260-1270.
- [24] Valipour, M., Shourijeh, P. T., & Mohammadina, A. (2021). Application of recycled tire polymer fibers and glass fibers for clay reinforcement. *Transportation Geotechnics*, 1-14.
- [25] Consoli, N. C., Montardo, J. P., Prietto, P. M., & Pasa, G. S. (2002). Engineering Behavior of a Sand Reinforced with Plastic Waste. *Journal of Geotechnical and Geoenvironmental Engineering*, 462-472.
- [26] Pradhan, P. K., Kar, R. K., & Naik, A. (2012). Effect of Random Inclusion of Polypropylene Fibers on Strength Characteristics of Cohesive Soil. *Geotech Geol Eng*, 15-25.
- [27] Consoli, N. C., Bassani, M. A., & Festugato, L. (2010). Effect of fiber-reinforcement on the strength of cemented soils. *Geotextiles and Geomembranes*, 344-351.

ADVANCED ENGINEERING DAYS

International Engineering Symposium



<http://aed.mersin.edu.tr/>



ISBN: 978-605-73805-0-0